



City of Austin

Invasive Species

Management Plan

Field Resources



Table of Contents

Section 1 Top 24 Invasive Species in Austin.....	4
Section 2 Management Techniques.....	7
Best Management Practices	7
Elements and Tasks of an Invasive Plant Management Program	7
Effective Treatments for Integrated Management of Nonnative Invasive Plants	8
1. Cultural Methods.....	9
2. Manual Methods.....	10
3. Mechanical Methods.....	10
4. Biological Control Methods.....	11
5. Chemical Methods.....	11
6. Strategic Control Method: Combination of Control Methods.....	16
7. Rehabilitation, Restoration, and Reclamation	16
Section 3 Summary of Herbicides	19
Section 4 Species Specific Information for Top 24.....	20
General Control Procedures for Woody Plants	21
<i>Ailanthus altissima</i> (tree of heaven).....	24
<i>Broussonetia papyrifera</i> (paper mulberry)	27
<i>Firmiana simplex</i> (Chinese parasol)	30
<i>Ligustrum spp</i> (privet).....	33
<i>Lonicera japonica</i> (Japanese honeysuckle)	36
<i>Macfadyena unguis- cati</i> (cat claw)	39
<i>Melia azaderach</i> (Chinaberry)	43
<i>Nandina domestica</i> (heavenly bamboo)	46
<i>Pistacia chinensis</i> (Chinese pistache)	49
<i>Pueraria montana var. Lobata</i> (kudzu).....	52

<i>Pyracantha coccinea</i> (scarlet firethorn).....	56
<i>Tamarix spp</i> (tamarisk, salt cedar).....	59
<i>Triadica sebifera</i> (Chinese tallow).....	62
General Control Procedures for Grasses	66
<i>Arundo donax</i> (giant reed)	67
<i>Bothriochloa ischaemum var. songarica</i> (King Ranch bluestem).....	71
<i>Cynodon dactylon</i> (bermudagrass)	75
<i>Phyllostachys aurea</i> (golden bamboo).....	79
<i>Sorghum halepense</i> (johnsongrass)	83
General Control Procedures for Herbaceous Plants	87
<i>Centaurea melitensis</i> (Malta star thistle).....	88
<i>Colocasia esculenta</i> (elephant ear).....	91
<i>Cyrtomium falcatum</i> (hollyfern)	94
<i>Rapistrum rugosum</i> (annual bastard cabbage).....	97
General Control Procedures for Aquatic Plants	100
<i>Eichhornia crassipes</i> (water hyacinth)	101
<i>Hydrilla verticillata</i> (hydrilla).....	104
Section 5 References.....	108

Section 1
Top 24 Invasive Species in Austin

Species	Common Name	Overall Rating	Alert	Impact	Invasiveness	Distribution	Documentation					
							4	3	2	1	0	Overall
<i>Arundo donax</i>	Giant reed	High	No	A	B	A	✓	✓				3.84
<i>Eichornia crassipes</i>	Common water hyacinth	High	No	A	A	A	✓	✓				3.3
<i>Hydrilla verticillata</i>	Hydrilla	High	No	A	A	A	✓	✓	✓			3.38
<i>Ligustrum lucidum</i>	Glossy privet	High	No	A	A	A	✓	✓	✓		✓	3.41
<i>Melia azedarach</i>	Chinaberry tree	High	No	A	B	A		✓	✓		✓	2.69
<i>Phyllostachys aurea</i>	Golden bamboo	High	No	A	B	A	✓	✓	✓	✓		2.61
<i>Pueraria montana var lobata</i>	Kudzu	High	No	A	B	A	✓	✓	✓		✓	2.8
<i>Rapistrum rugosum</i>	Bastard cabbage	High	No	A	B	A	✓	✓			✓	2.92
<i>Sorghum halepense</i>	Johnson grass	High	No	A	A	A	✓	✓	✓			3
<i>Tamarix ramosissima</i>	Salt cedar	High	No	A	B	A	✓	✓	✓			3.15
<i>Alianthus altissima</i>	Tree of heaven	Moderate	No	B	B	A	✓	✓	✓		✓	3.08
<i>Broussonetia papyrifera</i>	Paper mulberry	Moderate	No	B	B	A		✓	✓		✓	2.16
<i>Centaurea melitensis</i>	Malta star-thistle	Moderate	No	B	A	A	✓	✓	✓			3.15
<i>Colocasia esculenta</i>	Elephant ears	Moderate	No	B	A	A		✓	✓			2.15
<i>Cynodon dactylon</i>	Bermudagrass	Moderate	No	B	B	A		✓	✓		✓	2.7
<i>Firmiana simplex</i>	Chinese parasol tree	Moderate	No	B	B	A		✓	✓		✓	2
<i>Lonicera japonica</i>	Japanese honeysuckle	Moderate	No	B	B	A	✓	✓	✓	✓		3
<i>Macdadyena unguis-cati</i>	Catclaw vine	Moderate	No	B	A	A		✓	✓		✓	2.15
<i>Nandina domestica</i>	Sacred bamboo	Moderate	No	C	A	A		✓	✓		✓	2.8
<i>Pistacia chinensis</i>	Chinese pistache	Moderate	No	B	B	A		✓	✓		✓	1.6
<i>Pyracantha coccinea</i>	Scarlet firethorn	Moderate	No	C	B	A		✓	✓		✓	2.15
<i>Triadica sebifera</i>	Chinese tallow	Moderate	No	B	B	A	✓	✓	✓			3.15
<i>Cyrtomium falcatum</i>	Japanese netvein hollyfern	Low	No	B	C	A		✓	✓		✓	1.14
<i>Bothriochloa ischaemum</i>	Bluestem, King Ranch	Unknown	No	B	B	U	✓	✓	✓	✓	✓	2

This table summarizes how each species was scored according to several criteria. The methodology follows the Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands developed by the California Exotic Pest Plant Council, and is used by many states in the country to assess exotic invasive species. Details regarding the scoring methodology can be found at: <http://www.cal-ipc.org/ip/inventory/pdf/Criteria.pdf>. Details regarding each species' score can be found in Appendix G of the City of Austin Invasive Species Management Plan.

Overall Rating

1. High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
2. Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
3. Low – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.
4. Unknown - Evaluated but lack sufficient information to assign a rating or the available information indicates that the species does not have significant impacts at the present time.

Alert

Specific combinations of section scores that indicate significant potential for invading new ecosystems triggers an Alert designation so that land managers may watch for range expansions. Y = Yes, N = No

Impact

The Impact section assesses the cumulative impact (e.g., over a period of several decades) of the species on the wildlands where it typically occurs in Texas or other places with similar environmental conditions. The assessment applies to impacts within the area currently occupied by the species within Texas (to the extent that this area is known). A= Severe, B = Moderate, C = Minor, D = Negligible, U = Unknown.

Invasiveness

The Invasiveness assessment rates a species' potential to establish, spread, and increase in abundance in wildlands. A = High, B = Moderate, C = Low, D = Negligible, U = Unknown

Distribution

This column includes the Ecological Amplitude as well as the distribution of the invasive species. The "ecological amplitude" of the species indicates the diversity of ecological types invaded while the "distribution" addresses the extent of infestation in any given ecological type. This is a percentage of the ecological type's total number of occurrences (frequency) that has been invaded, not as an estimate of the average percent cover occupied by the species within each ecological type. A = Wide, B = Moderate, C = Limited, D = Narrow, U = Unknown

Documentation

This section describes the reliability of documentation for each of the ecological criteria described above. A checkmark in any of the columns 4, 3, 2, or 1, indicates the availability of the following documentation types:

4 = Reviewed scientific publications

3 = Other published material (reports or other non-peer-reviewed documents)

2 = Observational (unpublished information confirmed by a professional in the field)

1 = Anecdotal (unconfirmed information)

0 = No information

The overall column is a weighted average of the documentation found for the species: more weight is assigned to reviewed scientific publications (4), than, for instance, observational documentation (2).

Notes

¹ While bermudagrass has an overall rating of being moderately invasive, it is recognized that bermudagrass is useful in certain applications as a turf grass for ball fields and high traffic areas. It is recommended that improved hybrids of bermudagrass such as Tifgreen, Tifdwarf, Tifway and Santa Ana be used in those applications as these hybrid varieties do not produce seed, whereas common bermudagrass produces seeds that remain viable in soil for at least 2 years.

*See weed risk assessment notes

Source: Warner et al. 2003

Section 2

Management Techniques

Best Management Practices

Best Management Practices for control of problematic vegetation are based on Integrated Pest Management (IPM) principles that will maintain the desired site conditions using a combination of available methods, while minimizing risk to people, property and the environment. This booklet is intended to be supplemental to existing IPM plans. In the absence of a site or departmental IPM plan, the information presented here can be used to guide efforts to control invasive vegetation. Managers use information on pest life cycles and control methods to select the least toxic control method that is effective and economical. IPM plans identify current infestations, set action thresholds for treatment, and prescribe control and prevention methods.

These principles include:

- Maintenance activities using Integrated Pest Management methods that are supported by scientific research as increasing effectiveness and minimizing risk. All departments will combine physical, biological and chemical controls, whenever practical.
- Correctly identifying the plant target pest species and understanding the biology to determine what control practices may be most appropriate.
- Determining the threshold levels at which a pest becomes a problem, a safety hazard or obstacle to determine if and when control is needed and which control method is best suited to the situation.
- Determining the most vulnerable stages of the life cycle of the pest to determine when the target pest is most susceptible to treatment for effective control.
- Using the most effective and economical combination of methods to achieve the desired level of management while minimizing threats to water quality.
- Accomplishing most vegetation management using individual plant treatments, the primary exception to this will be prescribed burning, which may be applied as a long-term, large-scale vegetation management tool, rather than an individual plant treatment.

The determination of a treatment prescription and application method will take into consideration the situation, location and surrounding vegetation. Adjustments will be made, as needed, to accommodate special circumstances related to the facility location and adjacent environmental conditions.

When a Best Management Practices option indicates that pesticide applications are appropriate, control treatments will favor effective low volume applications of the least toxic pesticides that are effective for the job.

Elements and Tasks of an Invasive Plant Management Program

1. Make a plan.

- Base your planned treatments on stated objectives and the best information, then schedule and acquire resources that support your plan.

- Devise both a short- and long-term plan including both specific infestation treatment regimes and ideas for how these fit into a general land management plan.
- Maps of infestation locations and priority ratings of invasive species will assist the planning process.
- An eradication and rehabilitation program for specific invasive plant infestations usually requires several years of treatments and many more years of surveillance.
- Newer infestations and smaller plants require much less time than extensive and dense infestations.

2. *Prevent entry and spread.*

- Educate users of your land about the invasive plants that pose major threats, and how to prevent their entry and spread.
- Establish sanitation procedures to prevent the spread of invasives. Require all individuals to minimize invasive plant spread by following these procedures when working in or near infested lands:
 - o Inspect the site and infestation before operations.
 - o Avoid driving vehicles, mowers, all-terrain vehicles or spray equipment through infestations in seed or fruit.
 - o Brush and wipe all seeds and debris from clothes, boots, socks, and personal protective equipment.
 - o Clean motorized equipment, especially the undercarriage and tire surfaces.
 - o Cover loads or bag cut invasive plants before transport.
- Monitor burn pile areas for new seedlings.
- Be careful not to disturb areas where there is a high probability of invasion.
- Map invasive plant locations and sites at risk, and denote treatments and their desired outcomes. You must positively identify those invasive plants that are present and those poised to enter from adjacent lands, determine their locations and abundance, and record this information.
- Monitor the locations through repeated visits and record progress or the lack of it.
- Employ the search, survey, inventory, monitor and surveillance method.

3. *Eradicate, control or contain, and monitor results.*

- Rehabilitate, restore or reclaim treated lands.
- Establish native or noninvasive plants.
- Promote invasion resistance by encouraging native diversity and ecosystem function.
- Effective treatment schemes for rehabilitation use an integrated approach that combines treatments in an appropriate sequence and at crucial times, allowing native plants to reestablish in the same biological niche as invasives.

Effective Treatments for Integrated Management of Nonnative Invasive Plants

A successful invasive plant management program usually involves a combination of treatment methods based on these and other available tools and resources:

1. Cultural Methods
2. Manual Methods
3. Mechanical Methods
4. Biological Methods
5. Chemical Methods
6. Strategic Control Method: Combination of Control Methods
7. Restoration

Many methods are available to manage invasive plants and rehabilitate sites and more are being developed. A successful plan of attack depends on integrated management that considers all methods relative to the site and its invaders. These methods will be presented in greater detail.

1. Cultural Methods

Proper cultural practices are essential in establishing healthy landscapes and can often help to maintain their resistance to pest problems. Several cultural practices, including prescribed burning and water-level manipulation, can reduce or control invasive plant populations. However, such practices may also have undesirable impacts to soils, animal habitat and native species, so care in planning and enactment must be exercised.

Prescribed Burning

Prescribed Burning is a tool used for many facets of vegetation management. With regards to pest management, it may be used to manage both herbaceous and woody species. It provides the opportunity to accomplish vegetation management over a relatively large area at relatively low cost and target multiple species and individuals with minimal threats to non-target plant and animal species. When applied appropriately, prescribed burning can help significantly improve the effectiveness of other more intensive and costly treatments. Prescribed fire also avoids threats to water quality associated with use of chemical herbicides.

Prescribed burning is generally planned to target species that are susceptible to fire and do not exhibit re-sprouting behavior. Some re-sprouting species can be kept in check by prescribed fire when conducted on a recurring basis. Low intensity burns can be used to treat susceptible young or small-statured woody plants. High intensity burns may also be conducted to increase burn effectiveness on larger woody plants. For most herbaceous species, the timing of application of this practice must coincide with a particular phenological stage of the target species life cycle, for instance when thistle plants are in the rosette stage or before annual species flower and produce seed. Winter or early spring burns are most effective for invasive forb species and King Ranch bluestem is best managed by summer fire.

Water-Level Manipulation

Flooding or drawdowns can reduce invasive plant species in aquatic and wetland habitats but is usually not effective as a stand-alone treatment. This method is species and site specific. For effective outcomes, managers must first understand the biology of both invasive and native plants in the treatment area. Both processes can spread floating seeds of invasives and make habitats more vulnerable to nonnative plant establishment. Lowered water levels in spring and summer can also facilitate herbicide applications in wetlands.

Prescribed Grazing

Prescribed grazing is an approach that relies on cattle, sheep, goats or horses to reduce infestations. Grazing is a potential control treatment when the invasive is palatable and the invasive plant is not poisonous to the animal. Cattle and horses are used for many herbaceous invasive plants, while sheep and goats will feed on invasive woody plants as well. The animal species is important, as is the breed, the best being those breeds that are larger and can handle difficult grazing and browsing conditions. Grazers must be managed so that they do not selectively target palatable native species. Additionally, it is important to note that the animals would be used as a tool for vegetation management. A strict

accounting of animal numbers, incoming and outgoing, must be provided so that animals are not allowed to remain on the property following the completion of work, becoming a management issue themselves.

Mulching

Mulches and other ground coverings are often employed during the installation and restoration of landscapes as well as their ongoing maintenance. They are utilized for a variety of reasons. Mulches suppress weeds, help to retain moisture around plants, reduce possible erosion, and provide visual enhancement. Use of landscape mulches in vegetative buffers should take into account any possible impacts to the buffer as well as nearby waterways. These impacts may include:

- Inadvertent introduction of non-native weeds to the site.
- Leaching of substances such as tannins or nutrients from the mulch into nearby waterways.
- Migration of mulch material into waterways.

Choices of mulches should take these concerns into account. Mulching in areas that are below typical high water lines is discouraged in any vegetative buffers. Seeding of cover crops for erosion control is allowed in buffer zones.

Solarization

Soil solarization uses polyethylene sheeting to cover low growing, cultivated, mowed or chopped invasive infestations and trap solar energy to heat the soil and space under the sheeting to kill and suppress invasive plants. At least 2 years of summer cover are needed to suppress most invasive plants by 90 percent. Other plants and beneficial soil organisms are killed by this method—it is not selective. Black sheeting is more effective than clear sheeting because it blocks needed sunlight, and, at an extra cost, is available with UV blockers to greatly extend the useful life of sheets to more than one growing season. The method is useful as a first treatment for relatively small areas and where herbicides cannot be used. Summer is the most effective season, and use on wet soils increases control. After removal, the bare soil is open for reinvasion and should be quickly re-vegetated or otherwise protected.

2. Manual Methods

Manual methods include hand pulling as well as use of a wide array of tools for cutting, chopping, wrenching and girdling invasive plants. Manual methods are generally used on woody invasive plants when they are small. Eradication is only possible when the root crown or roots that can re-sprout are completely extracted and seedlings are pulled or eliminated following seed germination. Because it is difficult and even impossible to extract all of the shallow roots, stolons, and rhizomes of many mature invasives, re-sprouting will usually occur. When this occurs, chemical treatment is usually required.

3. Mechanical Methods

Mechanical methods usually involve top removal or uprooting of individual plants. This method may be accomplished using hand tools, chain saws or heavy equipment. These methods can complement and



Using a weed wrench

increase the efficiency of herbicide treatments, followed by re-vegetation with desirable plants. Some equipment, with appropriate attachments, can prepare the site for seeding and tree planting. Most important is using the appropriate size equipment to meet job requirements and minimize damage to soils and streams. Timely follow-up with other control methods is essential, because disturbance of the soil creates favorable conditions for regrowth from seeds and root fragments. Mechanical removal with heavy equipment may be appropriate in natural areas. However, care should be taken and the use of heavy equipment should be limited or eliminated, in particularly sensitive areas (e.g. near streams or karst features).

Mechanical treatments will be applied in a manner that minimizes ground disturbance. Methods will be limited to those that allow selection of individual plants. These include use of hand tools, chain saws, and tractor or skid steer mounted devices such as tree shears and others. Less discriminating treatments such as chaining and root plowing will be avoided. Exceptions may be considered on a case-by-case basis.

Skid-Steer Loaders

Tracks attached to the tires of the loader help traction and access to difficult terrain. Skid loaders are easily transported, highly maneuverable, and capable of lift and tilt, which gives this machine, if equipped with appropriate attachments, potential for other invasive plant removal tasks in dense infestations. However, track driven equipment can cause a high level of soil disturbance and should be used with care, and where possible, managers should opt for wheeled equipment.

Mulchers

Mulchers are increasingly preferred for reducing both standing invasive and native woody plants in dense infestations. Mulching machines are best for nonselective situations where the cost of selective control is prohibitive. Mulching machines are land-clearing tools that can cut through dense stands of nonnative plants, reducing them to small pieces of woody debris. After a mulched area has dried and regrowth occurs, herbicides can be more efficiently applied to the re-sprouts.

Bulldozers

Bulldozers (or tracked tractors) are made in a range of sizes and have found use in large-scale invasive plant reclamation projects tackling extensive woody infestation, although smaller tractors and implements are used. The amount of soil disturbance and compaction is considerable with bulldozers, varying by equipment size, soil moisture, number of passes, stand density, and tree/shrub size. The substantial soil damage caused by bulldozers should be an important consideration when weighing the benefits of using such equipment against the drawbacks.

4. Biological Control Methods

Biological control of plants uses living organisms to weaken, kill, or stop seed production of the targeted plant. The most common agents in bio-control programs are insects and pathogens. Uses of nematodes and mites are under study.

5. Chemical Methods

When other techniques are not sufficient, herbicide can offer an alternative. Effective herbicide applications can kill roots without exposing soil, though herbicide toxicity to non-target species and

persistence, activity and mobility in soil or water must be considered. Exposed soil is susceptible to reinvasion and erosion. For successful herbicide treatments:

- Select the least toxic herbicide that is effective for the target species and appropriate for the landscape. Also consider soil mobility, activity in soil and half-life. See White 2007.
- Carefully read the ENTIRE label on the chosen chemical. Look for and adhere to specific instructions regarding use in and near water, land type, specific species, applicator precautions, etc.
- Follow application and mixing requirements prescribed on the label and use the most directed application method that will be effective.
- Choose the optimum time for applications. Factors to consider include the condition and stage of growth of target species, and weather considerations (probability of rain following application, wind speed during application). Many herbicides are effective only when plants are actively growing, so periods of drought, cold or heat may render pesticides ineffective. Uptake of foliar application may be hindered when leaf stomata are closed due to high temperatures.
- Be patient. Allow herbicides to work for several months to a year before resorting to other treatment options or re-treating.

Selecting an Effective Herbicide

Carefully read and study the herbicide label for information on specified areas of use, crops and prohibitions. It is not necessary for the target invasive plant to be listed on the label for permitted use if the label allows use for general weed control

or control of broad categories, such as “annual weeds,” “perennial weeds” or “woody species”. These more general uses are often discussed on the label under the heading of “non-crop areas”, “natural areas”, or “habitat management”. Additional sources of information on both effectiveness and toxicity include Material Safety Data Sheets (MSDS) that can be obtained from manufacturers and herbicide fact sheets. Fact sheets are prepared by third parties and may contain additional information not found on the label or MSDS sheet. Fact sheets, if used, should come from independent (not manufacturer) sources.

Adjuvants and Additives to Herbicide Spray Solutions

Adjuvants are any product added to a spray solution to improve herbicide performance and effectiveness, including delivery, retention on foliage, and foliar or bark penetration. Adjuvants may be included as part of the commercial herbicide product or sold separately as an additive you must mix with the herbicide before application.

Choose an adjuvant, according to label recommendations, that is appropriate for your particular application method and field conditions. Obtaining information about adjuvants and their effects can be difficult. MSDS sheets often the best source of information. Be aware that adjuvants may have more serious or long lasting environmental effects than the active ingredient of the herbicide, especially on aquatic organisms.

Another common additive used by professionals is a marking dye, which makes it easier to determine which areas have been sprayed and which still need treatment. Dyes marketed for this purpose will fade after a period of sunlight exposure.

Water Quality Protection

Water quality is an important environmental issue in relation to pesticide use. The strategies for reducing or preventing water contamination by these products are largely based on common sense.

When applying pesticides, the applicator should read the product labels and use the lowest effective rate listed on the label for any one application. Calibrate equipment to deliver herbicides according to label recommendations and keep records of the amount of product applied. An applicator should NEVER “double the rate for better results” and NEVER deviate from strict label application rates.

*When treating infestations in or **near water bodies** (whether flowing, standing or even temporarily dry) herbicide formulations specific for aquatic applications **MUST BE USED**. An aquatic formulation should be used in any location where there is the possibility of herbicide entering surface water during or even after application, whether carried by wind (drift) by rainfall run off or by soil water movement into shallow aquifers. Weather conditions such as calm winds or clear skies can change quickly in central Texas. If the application is going to occur anywhere that a rapid change in environmental conditions (wind gusts, unexpected rainfall) could carry the chemical into the water, an aquatic formulation should be used. In this case, it is much better to be extremely cautious rather than have an unexpected discharge of the wrong type of chemical entering the water.*

The key to minimizing impact is reducing the levels of possible pollutants that enter the system. Factors determining the potential for ground water and surface water contamination include tendency for the pesticide to attach to soil particles or organic matter, solubility in water, rate of degradation and volatility. Soil characteristics, along with the chemical's inherent mobility, determine the rate at which chemicals move through the soil. Soils with high clay or organic matter content are more likely to bind herbicide molecules, restricting movement of the material while it is decomposed by microorganisms or other degradation processes. To minimize contamination due to runoff, do not apply products within 48 hours of expected heavy rainfall.

Pesticide drift is controlled by spraying only on calm days, using lower pressure, larger droplet size and drift control additives in the spray solution. These precautions should be taken to reduce spray drift on all occasions. More detail on managing spray drift is given in the following section of this plan. The use of broadcast spray methods should be minimized in favor of more directed application methods.

One potential source of water contamination is the disposal of unused herbicide, product containers and rinse water. Prepare only the amount recommended for the area to be treated to prevent having unused herbicide at the end of an application. Rinse all empty containers, regardless of their type, three times before disposal. Do not dispose of container rinse water where it may flow into a waterway. Instead, dispose of rinse water by application on the treated area. Dispose of the product containers according to label directions.

Selective Herbicide Applications

The best approach is usually selective applications to target plants while avoiding or minimizing application to desirable plants. The selective methods described below are directed foliar sprays and wipes, basal sprays and wipes, stem injection, and cut-treat.

Directed Foliar Sprays and Wipes

Directed foliar sprays are herbicide-water-adjuvant solutions aimed at target plant foliage to wet all leaves, applied by either low- or high-volume sprayers. Herbicide



Foliar spray

application by directed foliar spray is one of the most cost-effective methods for treating many types of herbaceous and woody invasive plant species. With this method, herbicide mixtures are applied to the foliage and especially the growing tips of woody plants, or to completely cover all leaves. Foliar sprays can be applied whenever leaves are present but, for woody plant control, are usually most effective from midsummer to late fall.

Winter and spring applications are also effective in controlling some species and are often required to prevent seed formation.

The applicator can direct the spray towards target plants and away from desirable plants for selective treatment. The addition of a spray shield to the end of the wand confines spray to the target. Another safeguard is to only use foliar-active herbicides, because directed sprays of soil-active herbicides can damage or kill surrounding plants when their roots are within the treatment zone. Never use herbicides with soil activity to treat invasive plants under desirable trees or shrubs that are susceptible to the herbicide. If non-target foliage is accidentally sprayed, clip off the foliage to prevent uptake.

Low-volume foliar sprays using spray tips and spraying pressures of 20 to 30 pounds per square inch can ensure effectiveness and limit drift. Wind must be minimal (less than 10 miles per hour) and used by the applicator to facilitate upper crown coverage.



Directed foliar sprays can be applied in volumes greater than 3 gallons using vehicle-mounted spraying systems that have much larger herbicide tank capacities. The high-volume directed

foliar spray is the most efficient approach to large infestations of multiple invasive species where there are few non-target plants.



Handheld weed wicks and rollers apply ultra-low volumes by wiping the herbicide mix onto the target leaf surfaces or bark; the herbicide mixture is contained in the handle. Most wick systems have limited use and durability in forest and field situations, but are useful for application to specific small infestations. Vehicle mounted wipe bars can be used to selectively target large areas of taller target species (e.g.- johnsongrass) with minimal impacts to shorter desirable species.

Basal Sprays and Wipes

Basal sprays are herbicide-oil-penetrant mixtures sprayed on the lower portion of woody stems. The sprays are usually applied with a backpack sprayer or wick applicator. Avoid using basal

applications near water bodies, spray contact with desirable trees or heavy use within their root zone. The herbicide must be an oil-soluble formulation and mixed with a special basal oil product, penetrating oil, diesel fuel, fuel oil, mineral oil, vegetable oil with a penetrant, or blends of these ingredients.

The most effective time period in most of the South for a basal spray and streamline is June through September. After treating with a basal spray, wait at least 2 years before disturbing aboveground plant material, because herbicide activity within plant roots can continue for an extended period.

Stem Injection

Stem injection (including hack-and-squirt) involves the use of mechanical herbicide injectors or the application of herbicide concentrate or herbicide-water mixtures into downward incision cuts spaced around woody stems and often made by a hatchet or machete. Tree injection is a selective method of controlling larger trees, shrubs and vines with minimum damage to surrounding plants. Injection treatments are sometimes not as effective in controlling multiple-stemmed species compared to the faster basal bark treatments, but may be easier in remote or rough terrain where a backpack sprayer is impractical. Incisions should be spaced around the stem, deep enough to penetrate the bark and inner cambium, slightly into the wood. Do not make multiple cuts directly above or below each other because this will inhibit movement of the herbicide within the stem. A complete girdle or frill of the stem is not needed.



Mechanical herbicide injector

Cut-Treat or Cut-Stump

Cut-treat involves applying herbicide concentrates, herbicide-water or herbicide-penetrant mixtures to the outer circumference of freshly cut stumps or the entire top surface of cut stems. Applications are made with a spray bottle, squeeze bottle, backpack sprayer, wick or paint brush. Freshly cut stems and stumps can be treated with herbicide mixtures to prevent re-sprouting and to kill roots. It is critical that the cut is made as low as possible to the ground, and that the stem is treated immediately after the cut is made. To minimize deactivation of the herbicide in the cut-treat method, remove sawdust from stumps before treatment. For stumps

over 3 inches in diameter, completely wet the outer edge with the herbicide or herbicide mixture. Make certain that the solution thoroughly covers the wood next to the bark of the stump. Completely wet the tops of smaller stumps and all cut stems in a clump. Note that some herbicide labels advise treating the outer portion of the stump down to the ground.



Broadcast Herbicide Applications

Broadcast application of pesticides will be avoided. However, in rare cases in which broadcast application is deemed appropriated, chemicals should be selected that have low-non target toxicity, low potential for movement and a short half-life in the environment.

6. Strategic Control Method: Combination of Control Methods

The most appropriate, effective and safest control of a target pest is a strategic combination of several of the control methods outlined above, integrating herbicides into the available management methods. The combination of various manual, mechanical, and chemical methods is often the Best Management Practice for cost-effective and environmentally safe management. All options involving chemical control methods will be in strict compliance with product label requirements.

The proposed use of chemical controls in the following instances must be reviewed and approved by the City of Austin IPM Coordinator prior to their use:

- The proposed use of pesticides within 50' of surface water resources (Critical Water Quality Zone) e.g. flowing, standing or temporarily dry water bodies
- The proposed use of pesticides within 150' of a cave, sinkhole, and/or other recharge features (Edwards Aquifer recharge zone). When chemicals are to be used in close proximity to caves, within or near sinkholes or waterways the most precise methodologies will be used to minimize any and all overspray or drips (Gleason and Taffinder 2007).

7. Rehabilitation, Restoration, and Reclamation

All invasive species management should happen within the framework of a broader restoration plan or resource management plan. This helps to ensure that the invasive species management actions are consistent with other considerations such as programmatic goals, the site use policy, wildfire mitigation, and sensitive resource values and are coordinated with other management or restoration actions. Thus, active control and removal of invasive species should help further the resource management goals for the site and should necessitate little to no rehabilitation or repair of damage – such as undue erosion or the creation of hazardous fuel loads - caused by the removal actions.

Most natural areas respond positively to the removal of invasive species populations of low to moderate density and require little follow-up action aside from routine monitoring and removal of seedlings or resprouts. However, some active repair may be required after the removal of high-density populations.

Some minor soil disturbance from heavy equipment may provide the opportunity for reseeding, or haul roads or trails created during the removal process may need to be stabilized and/or revegetated. The seed bank and/or vegetative layer may be depauperate, which may indicate the need for reseeding or replanting. Also, the opening of herbaceous or woody canopies, while often necessary as part of natural areas management, can release other invasive species that may need to be managed as well.

Below are simple strategies for addressing common problems that may result from the removal of invasive species.

- Address soil disturbance. Compacted soils may need to be loosened prior to seeding. Bare soils should be seeded or otherwise stabilized as soon as possible after disturbance to prevent erosion and reinvasion. In flat areas with favorable soils, stabilization may simply involve seeding. More active revegetation or soil stabilization techniques such as mulching, erosion blankets, wattles, gabions, erosion fencing, sodding, or planting may be necessary on moderate to steep slopes, on erosive soils, or in areas with frequent vehicle or foot traffic.
- Appropriate native plant material should be added as seed, live plantings, or in combination. USDA Natural Resource Conservation Service technical guides at the statewide level are excellent sources of information for seeding mixtures and planting prescriptions (Hynson et al., 1982). The U.S. Forest Service, state foresters, and Texas A&M Agrilife extension agents can also provide helpful suggestions (Kochenderfer, 1970). Locally, the Grow Green guides provide a useful resource. In addition to selecting a seeding mixture, the seeding rate must be determined so that adequate soil protection can be achieved without excess cost of over-seeding. Berglund (1978) describes how to determine seeding rates in *Seeding to Control Erosion along Forest Roads*.
- In riparian areas, special consideration should be given to species' contributions to bank stability and water quality. Many species found in central and southwest Texas have been given draft stability ratings based on their contribution to bank stability (Nelle 2009), ranging from 1 (bare ground) to 10 (anchored rock). Ideally, riparian areas will be dominated by plants with stability ratings between 6 and 9. Stability ratings of 7 or higher are considered to be optimum for bank stability. However, combinations of species, particularly woody species in association with grasses or sedges, can provide higher stabilities than reflected in individual species ratings (Nelle 2009). In addition to stability ratings, wetland indicator status should be considered. Riparian areas should contain a mix of obligate wetland (always occurs in wet areas), facultative wetland (frequently occur in wet areas) and facultative species (equally likely to occur in wet and non-wet areas), dependent on water availability. Perennial waterways can support a larger complement of obligate and facultative wetland species and intermittent waterways will require a higher proportion of facultative species. Regardless of the mix, it is important that all riparian areas contain some species from the facultative groups to provide stability as water availability fluctuates (S. Nelle pers. comm).
- Seed during optimum periods for establishment, preferably just prior to spring or fall rain seasons (Larse 1971). Most forbs and cool season grasses should be sown in the fall while warm season plants should be sown in either the winter or early spring. Seed mixes containing cool season and warm season species should be sown in the fall or early winter. Supplemental irrigation, if feasible, during the establishment phase will increase germination and survival. During dormant

seasons, apply temporary surface stabilization methods to control surface erosion. Possible methods include mulching (without seeding) and erosion blankets and wattles.

- Mulch as needed to reduce rainfall impact, and conserve soil moisture (Larse 1971).
- Amend soil only as needed and as indicated by soil testing.
- Protect seeded areas from grazing, vehicle traffic, and foot traffic until plants are well-established.
- Inspect all seeded areas for failures, and make necessary adjustments.

Section 3

Summary of Herbicides

Active Ingredient	Trade Name Examples	Ester (E) or Salt (S)	EPA Reg. No.	% Active Ingredient	Ready-to-Use	Carriers	Aquatic Approved	Application					
								Foliar	Basal Bark	Stem Injection	Cut-Stump	Girdle	Hack & Squirt
CLETHODIM	Envoy Plus®	E	59639-132	12.6	N	Water	N	✓					
CLOPYRALID	Reclaim®	E	62719-83	40.9	N	Water	N	✓					
	Transline®	E	62719-259	40.9	N	Water	N	✓	✓	✓	✓	✓	✓
COPPER-ETHANOLAMINE	Cutrine-Plus®	E	8959-10	27.9	N	Water	Y	✓		✓			
FLUAZIFOP	Fusilade II®	E	100-1084	24.5	N	Water	N	✓		✓	✓		✓
FLURIDONE	Sonar AS®	E	67690-4	41.7	N	Water	Y	✓					
GLYPHOSATE	Accord®	E	62719-324	41.5	N	Water	Y	✓					
	Aquamaster®	S	524-343	53.8	N	Water	Y	✓					
	Enforcer Brush Killer®	S	62719-226	20-30	N	Water	N		✓		✓		
	Razor Pro®	S	228-366	41.0	N	Water	N	✓		✓	✓		✓
	Rodeo®	S	62719-324	53.8	N	Water	Y	✓					
	Round-up®	S	524-539	41.0	N	Water	N	✓					
	Round-up Pro®	S	524-475	41.0	N	Water	N	✓		✓	✓		✓
	Round-up Pro Dry®	S	524-505	71.4	N	Water	N	✓		✓	✓		✓
IMAZAMOX	Clearcast®	S	241-437	12.1	N	Water	Y	✓	✓	✓	✓	✓	✓
IMAZAPYR	Aresenal AC®	S	241-299	53.1	N	Water	N	✓		✓	✓	✓	✓
	Arsenal PowerLine®	S	241-431	26.7	N	Water	N	✓		✓	✓	✓	✓
	Habitat®	S	241-426	27.8	N	Water	Y	✓			✓	✓	✓
	Stalker®	S	241-398	27.6	N	Water	N	✓	✓	✓	✓	✓	✓
SETHOXYDIM	Poast®	S	7969-58	18.0	N	Water	N	✓					
	Segment®	S	7969-317	13.0	N	Water	N	✓					
	Vantage®	S	7969-88-82	13.0	N	Water	N	✓					
SULFOSULFURON	Outrider®	E	524-500	75	N	Water	N	✓			✓		
TRICLOPYR	Garlon 3A®	S	62719-37	44.4	N	Water	Y	✓			✓	✓	✓
	Garlon 4®	E	62719-40	61.6	N	Oil	N	✓	✓		✓		
	Green Light - Tough Brush Killer®	S	62719-226	8.8	N	Water	N	✓			✓		
	ORTHO Brush-B-Gon®	S	239-2491	8	N	Water	N	✓	✓		✓		
	Pathfinder II®	E	62719-176	13.6	Y	Oil	N		✓		✓		
	Remedy RTU®	E	62719-176	13.6	Y	Oil	N		✓		✓		
	Renovate® 3	S	62719-37-67690	44.4	N	Water	Y	✓		✓	✓	✓	✓

Section 4
Species Specific Information for Top 24



General Control Procedures for Woody Plants

Chemical

Cut stump treatment

Apply herbicide mix immediately to freshly-cut stumps. Apply with a backpack or knapsack sprayer or hand-held spray bottle using low pressures and a solid cone or flat fan nozzle. Spray the sides of the stump and the outer portion of the cut surface, including the cambium in a manner that thoroughly wets the stem and root collar but not to the point of runoff. Apply at any time, including winter months, except when snow or water prevents spraying to the ground line. If target species is mixed in with desirable woody vegetation, do NOT use imazapyr, as research has shown that it can translocate via roots – defer to another listed course of action.

When near water, use:

- 44% a.i. (active ingredient) of an aquatic formulation of triclopyr salt in water, **or**
- 1.8 to 2.7% a.i. of an aquatic formulation of imazapyr in water, **or**
- 27% to 54% a.i. of an aquatic formulation of glyphosate in water

See pg. 13, Section 2, Management Techniques, # 5 Chemical Methods, Water Quality Protection for more details

When away from water, use:

- Any of the above herbicide mixtures for use near water, **or**
- 13% to 20% a.i. of triclopyr ester in oil, **or**
- 1.8 to 2.7% a.i. of imazapyr in water, **or**
- 20% to 41% a.i. of glyphosate in water

Basal bark treatment

On stems with smooth bark (typically less than 6 inches in diameter), apply herbicide mix to the basal parts of the trunk(s) to a height of 12 to 15 inches from the ground in a manner that thoroughly wets all sides of the lower stem(s), including the root collar area, but not to the point of runoff. Apply herbicide mix with a backpack or knapsack sprayer using low pressure and a solid cone or flat-fan nozzle. Apply at any time, including winter months, except when snow or water prevents spraying to the ground line.

When near water, use:

- This method is not appropriate for use near water.

When away from water, use:

- 13% to 20% a.i. of triclopyr ester in oil

Frill, Hack-and-Squirt, and Injection treatment

Using a hatchet or machete, make cuts around the trunk spaced 1-inch apart. Apply herbicide mix into fresh cuts. For best results, use an injection tool to apply 1 ml of herbicide into each cut spaced 3 inches completely around the trunk.

- When near water (See p.12, Section 2), use:
- 44% a.i. of an aquatic formulation of triclopyr salt in water, **or**
- 2.7% **or** 15% a.i. of an aquatic formulation of imazapyr in water (see herbicide specimen label for use of dilute and concentrated solutions), **or**
- 14% to 54% a.i. of an aquatic formulation of glyphosate in water

When away from water, use:

- Any of the above herbicide mixtures for use near water, **or**
- 28% a.i. of imazapyr in water, **or**
- 41% a.i. of glyphosate in water

Girdle treatment

Using a hatchet, machete, or saw, make cuts through the bark and completely around the tree to expose the cambium and growth rings. The cut should angle downward extending into the cambium. Apply herbicide mix with a backpack or handheld sprayer into each cut until thoroughly wet but not to the point of runoff.

When near water (See p.12, Section 2), use:

- 44% a.i. of an aquatic formulation of triclopyr salt in water, **or**
- 7% to 29% a.i. of an aquatic formulation of imazapyr in water, **or**
- 14% to 54% a.i. of an aquatic formulation of glyphosate in water

When away from water, use:

- Any of the above herbicide mixtures for use near water, **or**
- 7% to 29% a.i. of imazapyr in water, **or**
- 20% to 41% a.i. of glyphosate in water

Foliar treatment

Foliar sprays are recommended where cut-stem applications are not practical, typically on herbaceous species or on woody shrubs and vines that are low-growing (less than 8 feet tall) and bushy with multiple stems.

With foliar treatment, apply herbicide mix during the growth periods for each species as recommended on the specimen label. Use a backpack sprayer or a vehicle-mounted sprayer equipped with a solid cone or flat fan nozzle. Covering and completely wet the blades but not to the point of runoff.

Drift management

Herbicide drift is a particular concern with foliar treatment. To minimize drift:

- Use coarse sprays produced by the lowest spray pressure to achieve uniform coverage.
- Use a drift control agent in the tank mix if this function is not provided by other adjuvants in the herbicide product or tank mix.
- Apply foliar spray only to low-growing vegetation (8 feet tall or less).
- Apply herbicide only when eye-level wind speed is low. However, to minimize applicator exposure to wind-blown herbicide, ensure that the wind direction is stable, which typically occurs with winds over 3 mph. Thus, foliar sprays are most safely applied when eye-level wind speeds are between 3 and 10 mph with stable direction away from sensitive receptors such as private property or public use areas where access is not restricted.

Recommended herbicides

See Management Techniques for each species.



Ailanthus altissima

tree of heaven

Identification

Characteristic Features:

- Grows up to 80 ft or more
- Small yellow-green flowers in spring
- Gray bark
- Large compound leaves
- Leaves up to 4ft long
- Alternate leaflets
- Smooth stems

Other Aliases:

- *Ailanthus glandulosa*
- Chinese sumac
- stinking sumac

Habitat Zones:

- Common in wooded areas, overtakes native growth
- Disturbed areas
- Stream channels

Tree of heaven is a fast-growing, deciduous tree in the mostly tropical quassia family (*Simaroubaceae*). Reaching 80 feet or more in height, *Ailanthus* has pale gray, smooth bark with small bumps on

younger branches. Twigs are light tan-brown. Leaves are large and compound, growing up to 4 feet in length, and are composed of 11-25

alternate smaller leaflets. Each leaflet has one or more glandular teeth under lobes on lower margin. In late spring, clusters of small, yellow-green flowers appear near the tips of branches. Seeds are produced

on female trees in late summer to early fall in pinkish, twisted, papery fruits called samaras, which may remain on the trees through winter months. All parts of the tree emit a strong, nutty odor



when bruised. Correct identification of *ailanthus* is essential. Several native shrubs, like sumacs, and trees, like ash, black walnut and pecan, can be confused with *ailanthus*.

Biology & Spread

Tree of heaven reproduces by seed as well as through vegetative sprouting. The species is dioecious, having male and female flowering on separate trees, with blooms late in spring. Samaras exist in large clusters September through October, and may

persist on the tree through the following winter. An individual tree can produce hundreds of thousands of seeds per year, which are dispersed via wind and water. Established trees produce numerous sprouts from the roots, cut stumps and root fragments.

History:

Tree of heaven was first introduced to America as an ornamental in 1784, and by 1840 was commonly available from nurseries. It has a long cultural history in Asia, and seeds were again introduced by Chinese immigrants in the mid-nineteenth century.



Ecological Threats

Tree of Heaven is a prolific seed producer, and grows rapidly enough to form thick stands that take over native vegetation. Root sprouting makes physical control of adult trees extremely difficult. Root sprouting produces multiple plants in one location, and creates an aggressive root system that can damage sewers and foundations.

While intolerant to shade and flooding, it is drought and pollution tolerant. Ailanthus is allelopathic, meaning it



produces toxins that prevent the establishment of other plant species.

Management Strategies/ Control

This woody species exhibits root sprouting characteristics and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or near water, the preferred treatment is cut stump or frill/girdle application of an aquatic formulated herbicide. Follow-up

treatments may be required to control root sprouts before an effective level of control is reached. On sites which contain extensive stands of mature tree of heaven special considerations for accelerated post treatment soil erosion should be included when planning treatment. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use.

Weed Risk Assessment Summary

Ailanthus altissima

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	3.08

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated,		D=None	1 = Anecdotal
not listed		U=Unknown	0 = No information



Ailanthus altissima Tree of heaven

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or near water, the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application can be done using a directed spray on stumps,

girdling wounds, injection, or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached. On sites which contain extensive stands of mature tree of heaven, special considerations for accelerated post treatment soil erosion should be included when planning treatment. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is

warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature tree of Heaven.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21). Caution is advised with cut surface treatments (cut stump, frill, girdle, and hack-and-squirt applications). Failure with cut surface treatments on tree of heaven can stimulate vigorous root sprouting. Either basal bark treatment or concentrate herbicide solutions with cut surface treatments are recommended. Also with cut surface treatments, take special care

to apply herbicide immediately after cutting to ensure optimal effectiveness.

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Broussonetia papyrifera

paper mulberry

Characteristic Features:

- grows up to 50 feet
- fruit and seeds: July to August
- flowers: April to May
- deciduous large shrub or tree
- leaves: rough and fuzzy, velvety underneath

Other Aliases:

- *Morus papyrifera*
- *Papyrius papyriferus*

Habitat:

- Southern New England south to Florida and west to Texas
- Forests and edges
- Meadows
- Floodplains
- Disturbed areas



Identification

Paper mulberry is a deciduous, leafy tree growing up to 50 ft. in height. Both leaves and twigs are pubescent, while bark is tan and only slightly furrowed. Leaves are alternate or whorled along the stem, and can be lobed or mitten-shaped. The upper leaf surface is rough to the touch, and margins are sharply toothed – more so than the native red mulberry. Milky sap will leak from cut twigs or wood. Paper mulberry is dioecious, with male and female flowers blooming on separate trees in the spring. Male flower clusters appear as 2-3 in. long, dangling yellowish spikes. Female flowers are inch wide, spherical flower clusters that bear round, reddish orange fruits in summer. Paper mulberry may be confused with the exotic white mulberry as well as native trees such as red



mulberry, sassafras, basswood, and white poplar.

Biology & Spread

Paper mulberry spreads both vegetatively through local root

sprouting and through seed via birds and other wildlife vectors.

History:

The tree was introduced in the 1700's from Japan and China and known to Florida as early as 1903 as it was widely planted throughout the Southeast as an ornamental and shade tree around dwellings. The inner bark has been used from ancient times by the Chinese as a source of fibrous paper and Pacific cultures used it to make bark cloth.



M. Sallee

Ecological Threats

Paper mulberry quickly and aggressively invades disturbed lands, forming dense thickets that



B. Sanford

displace native vegetation and block sun from groundcover plants. Its shallow root system

provides poor anchor for the tree during high winds, making it susceptible to being blown over.

Management Strategies/ Control

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods.

Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In or near water, the preferred treatment is cut stump or frill/ girdle application of an

appropriate herbicide. Herbicide application can be done using a directed spray on stumps, girdling wounds or as a basal application.

Follow-up treatments may be required to control root sprouts before an effective level of control is reached. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use.

Weed Risk Assessment Summary

Broussonetia papyrifera

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	2.16

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



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For more information visit:
www.texasinvasives.org

Broussonetia papyrifera paper mulberry

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or near water, the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide.

Herbicide application can be done using a directed spray on stumps, girdling wounds, injection or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies,

ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature paper mulberry.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

ensuring complete removal of the root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Saplings

Physical - Manually pull saplings by hand or with a weed wrench,

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Firmiana simplex

Chinese parasol

Characteristic Features:

- Grows up to 50 feet tall
- Deciduous tree
- Very large leaves, up to 12 in across
- Flowers from May to July
- Fruit from June to April

Other Aliases:

- *Sterculia platanifolia*
- phoenix tree
- varnish tree



Habitat:

- Prefers moist areas
- coastal States
- Northward spread anticipated

Identification

Chinese parasol tree has a very unusual appearance for a deciduous tree, having green stems and bark and extremely large, three to five-lobed bright green leaves. Each leaf is up to 12 inches across and casts deep shade. The leaves are dark green

with light green palmate veins.

Chinese parasol tree has a dense, upright, oval

canopy and reaches 35 to 50 feet in height, spreading 15 to 20 feet. In June or July, 10 to 20-inch-long, upright, loose, terminal panicles of yellow/ green blooms appear



and are followed by the production of pods which split open into four petal-like sections to reveal the small, round seeds. Panicle branches containing fruit drop throughout winter leaving star-shaped woody flower bases at the end of the branches. The

foliage of the Chinese Parasol tree can turn brilliant yellow before dropping in fall to reveal an interesting branching structure of green stems.

Biology & Spread

The Chinese parasol is found as an escape plant and in small groups, more frequently in the coastal states but throughout the region except in KY and north TN,

with northward spread expected. It spreads and forms infestations by wind and water dispersed seeds.

Ecological Threats

History:

Introduced in 1757 from China, and planted now as an ornamental. The wood from the tree can was and is utilized for soundboards on a variety of Chinese instruments.



Occasional ornamental plantings in the southern half of the region are a source of escaped plants in surrounding roadsides, riparian areas, and forest margins. These problem trees are characterized by rapid growth early on. They readily

self-pollinate and produce seed, and thus it is thought that a single, reproductive age tree can produce an entire colony. Nectaries in flowers also suggest pollination via insect vectors. The high fat seed has not been observed as spread by wildlife.



Management Strategies/ Control

This woody species exhibits root sprouting characteristics and are treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may

also be used on trees with smooth bark. In or near water, the preferred treatment is cut stump or frill/girdle application of an aquatic formulation herbicide. Herbicide application can be done using a directed spray on stumps, girdling wounds or as a basal application, if away from water. Follow-up treatments may be required to control root sprouts before an effective level of control is reached.

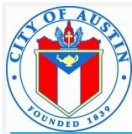
Weed Risk Assessment Summary

Firmiana simplex

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	2.00

Comments: Lack of information. Assessment based on local observations in C. Tx.

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Firmiana simplex Chinese parasol

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on any size tree of this species if away from water. In, or very near, water the preferred treatment is cut stump or frill/girdle application of an appropriate

herbicide. Herbicide application can be done using a directed spray on stumps, girdling wounds injection or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals

formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature Chinese parasol.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the

root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.

*Ligustrum spp.*

privet

Characteristic Features:

- grows up to 15 feet tall
- evergreen shrubs
- opposite, leathery leaves
- tiny white flower plumes
- dark blue-black berries in fall

Other Aliases:

- Japanese privet, wax-leaf privet
- Glossy privet
- European privet
- Chinese privet



G. L. Hinds

Habitat:

- Southeastern US
- woodlands edge
- floodplains, fields, etc. Fact Sheet Series Date of Publication: September 2011

Identification

Ligustrum is a genus of pervasive, long and 2 inches wide, ovate to evergreen shrubs or small trees, elliptic, with a long apex. *L. japonicum* (wax-leaf privet) has growing up to 15 ft tall. An escaped ornamental, it establishes smaller, waxier feeling leaves with in

in fencerows, abandoned pastures, and low woodlands. Twigs are greenish brown to gray, and smooth except for



C-L

raised, corky dots (lenticels). Leaves are dark green, opposite, and petioled with smooth margins. The lower surface is lighter with a prominent yellow main vein. *L. lucidum* (glossy privet) has large, shiny, leaves up to 4 1/2 inches

a shorter apex. Flowers are white and about 1/4 inch wide, occurring in broad, dense clusters up to 8 in. long. Clusters of dark purple, berry-like fruits about 1/4 inch wide persist into winter.

Biology & Spread

Typically occurring in the southeastern US, the Japanese privet grows along woodland edges, in floodplains, old fields, riparian forests, and upland

forests. Colonizes by root sprouts and spread by abundant bird and other animal-dispersed seeds. It is shade tolerant and can withstand some amount of drought.

History:

Originally introduced for gardening purposes, the privet grows easily and can be sculpted into topiaries. They are native to Europe, Asia, and northern Africa.



D. Giardinelli

Ecological Threats

Privet forms dense stands that outcompete native plants for resources. Few insects feed on it because chemicals in the leaves inhibit digestion. Deer, however, will feed on privet. Birds eat the fruits and disperse the seeds to forest gaps and into fields. Other species in

the genus are also problematic. All are evergreen: Chinese privet, wax-leaf ligustrum, glossy privet.



J. Wallace

Management Strategies/ Control

This group of woody species exhibits crown sprouting and is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic,

trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or near water, the preferred treatment is cut stump or frill/ girdle application of an aquatic formulation herbicide.

Weed Risk Assessment Summary*Ligustrum lucidum*

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	A	A	3.41

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Ligustrum spp. privet

Introduction

This group of woody species exhibits root sprouting characteristics and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or very near, water the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application can be done using a directed spray on stumps, girdling wounds, injection or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached. On sites which contain extensive stands of mature ligustrum, special considerations for accelerated post treatment soil erosion should be included when planning treatment.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature Privet.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21). For basal bark treatment, 13% triclopyr has been found to be marginally effective. Thus, 20% triclopyr ester is recommended for this treatment method (M. McCaw pers. comm.).

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance.

Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Lonicera japonica

Japanese honeysuckle

Characteristic Features:

- grows up to 80 feet long
- perennial vine
- sweetly scented flowers; tubular and yellow
- oval, opposite leaves
- small, black fruits

Other Aliases:

- *Lonicera japonica* var. *chinensis*
- *Nintooa japonica*



Habitat:

- roadsides, field edges, floodplains
- woods and forest area
- southern US to New England
- under dense canopies

Identification

As one of the most commonly occurring invasive plants, the Japanese honeysuckle tends to overwhelm and replace native flora in all forest types over a wide range of sites. It is a semi-evergreen to evergreen woody vine characterized by high climbing and trailing up to 80 feet (24 m) long. It branches and often forming arbors in forest canopies and or ground

cover under canopies, and forms long woody rhizomes that sprout frequently. It is mostly commonly identified by the sweetly scented, tubular shaped flowers that fade to yellow. It also grows small black fruits which distinguishes it from the native vining honeysuckles.



Biology & Spread

Growth and spread of Japanese honeysuckle is through vegetative (plant growth) and sexual (seed) means. It produces long vegetative runners that develop roots where stem and leaf junctions (nodes) come in contact with moist soil. Underground

stems (rhizomes) help to establish and spread the plant locally. Long distance dispersal is by birds and other wildlife that readily consume the fruits and defecate the seeds at various distances from the parent plant.

History:

Introduced from Japan in the early 1800s. Traditional ornamental, valued as deer browse, with some value for erosion control. It has spread through the nursery industry, and is still planted in wildlife food plots.



M. Sallee

Ecological Threats

In North America, Japanese honeysuckle spreads widely and out-competes native plant species. Its evergreen to semi-evergreen nature gives it an added advantage over native species in many areas. Shrubs and young trees can be killed by girdling when vines twist tightly around stems and trunks, cutting off the flow of water



M. Sallee

through the plant. Dense growths of honeysuckle covering vegetation can gradually kill plants by blocking sunlight from reaching their leaves. Vigorous root competition also helps Japanese honeysuckle spread and displace neighboring native vegetation.

Management Strategies/ Control

This evergreen woody vine forms arbors in forest canopies and/ or ground cover under canopies. Vines root at nodes when covered by leaves and make control difficult. Persists by large woody rootstocks and spreads mainly by vines rooting at nodes. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. Restoration of soil and

vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

Weed Risk Assessment Summary

Lonicera japonica

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	3

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Lonicera japonica Japanese honeysuckle

Introduction

This evergreen woody vine branches and often forms arbors in forest canopies and/or ground cover under canopies. Vines root at nodes when covered by leaves and make control difficult. Occurs as dense infestations along margins and rights-of-way, as well as under dense canopies. Persists by large woody rootstocks and spreads mainly by vines rooting at nodes.

Herbicide should not be applied when rainfall is expected within 48 hours or

when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for "near water" definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary

following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Mature and sapling vines

Physical – Cut stems near the ground. In a park setting, repeatedly cutting or mowing resprouts may provide eventual control. In natural areas, several follow-up treatments per year may not be feasible. Pulling of mature Japanese honeysuckle typically does not remove enough of the root system to prevent resprouting. Roots may be dug or grubbed out. On a large scale, this will create soil disturbance that may need to be actively remediated.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

For mature vines growing taller than 8 feet, use cut stump or basal bark treatments.

For mature vines that are not taller than 8 feet, especially plants that are bushy or sprawling with many rooted stems, foliar spray may be most practical.

For foliar treatment near water (See p.12, Section 2), use:

- 0.4 to 1% a.i. of an aquatic formulation of glyphosate in water, **or**
- 0.4 to 1.3% a.i. of an aquatic formulation of triclopyr salt in water.

For foliar treatment away from water, use:

- 0.4 to 1% a.i. of glyphosate plus a nonionic surfactant in water, **or**
- 0.3 to 0.6% a.i. of triclopyr ester plus a nonionic surfactant in water

Seedlings

Physical – Pull seedlings, ensuring complete removal of the root. For best results, pull when soil is moist.

Chemical - Chemical treatment is not recommended for seedlings.



Macfadyena unguis- cati

cat claw

Characteristic Features:

- Climbing, woody vine
- Stems to 6 cm in diameter
- Opposite, compound leaves
- Showy, tubular flowers
- Flowers are decorative, yellow and trumpet shaped
- Fruit is linear, flat capsule

Other Aliases:

- yellow trumpet vine



J. Alpaca

Habitat:

- Wooded and riparian areas
- Prefers full sun to partial shade and moist soils
- Naturalized in Texas and cultivated in Alabama and South Carolina
- Occurs ubiquitously through Florida around human habitation, hammocks, and hardwood forest islands

Identification

As a high-climbing woody vine, cat claw stems to 6 cm (2.4 in) in diameter and roots become elongate-tuberous with age. The vine has branches and runners with adventitious aerial roots. The leaves are opposite and twice pinnately compound, with 2 leaflets and a terminal 3- forked tendril; tips of tendril forks are stiffly hooked and claw-like.

Typically leaflets are 3-7 cm (1-3 in) long, and oval to lance shaped, with margins entire. The tubular flowers are showy, trumpet shaped, and up to 7 cm (3

in) long and 10 cm (4 in) across. Their decorative quality makes them attractive for ornamental usage. They are primarily solitary or in few-flowered clusters at leaf axils; petals are joined into yellow floral tubes with orange lines in the throat. Fruit of the plant is a linear, flat capsule, growing up to 50 cm (20 in) long, with oblong, winged seeds.



F. Starr

Biology & Spread

It thrives in full sun or partial shade and in a wide variety of soils. Cat claw remains at seedling stage for some time, while enlarging roots into tuber-like storage organs, then rapidly elongating, forming long runners when no erect substrate is within reach. With adventitious roots and clawed tendrils, it clings tenaciously to any substrate.

Typically the flowers bloom in spring, with high seed production, but may not begin flowering until the vine is well established. Seeds are dispersed by wind.

History:

Introduced for ornamental use in 1947 and noted as grown outdoors in the South. Persistent around former habitations in south Florida. Cultivated in northern Florida and naturalized near human habitations. Native to Central or South America and the West Indies.



Ecological Threats

Cats claw vine is a long lived plant that grows relatively slowly. As the plant matures, typically in its second year, root tubers and stolons form. Tubers and stolons can also form at each node if the vine is creeping along the soil surface. Pursuant to its rooting abilities, a dense mat will cover the forest floor, climb into trees, and smother native vegetation. The weight of the vines

can eventually kill canopy trees. Areas that are susceptible to invasion of cat claw include stream banks and areas near human habitations.



Management Strategies/ Control

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual vines will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. Repeated cutting or mowing will provide eventual control, but it could take years to deplete the reserves of larger plants. In, or near water, the preferred treatment is cut stump or frill girdle application of an appropriate herbicide.

Herbicide application can be done using a directed spray on stumps. Follow-up treatments may be required to control root sprouts before an effective level of control is reached. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation

Weed Risk Assessment Summary

Macfadyena unguis- cati

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	A	A	2.15

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Macfadyena unguis-cati cat claw

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual vines will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. Repeated cutting or mowing will provide eventual control, but it could take years to deplete the reserves of larger plants. In, or very near, water the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application can be done using a directed spray on stumps.

Follow-up treatments may be required to control root sprouts before an effective level of control is reached.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water”

definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Mature and sapling vines

Physical – Cut stems near the ground. In a park setting, repeatedly cutting or mowing resprouts may provide eventual control. In natural areas, several follow-up treatments per year may not be feasible. Pulling of mature Japanese honeysuckle typically does not remove enough of the root system to prevent resprouting. Roots may be dug or grubbed out. On a large scale, this will create soil

disturbance that may need to be actively remediated.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

For mature vines growing taller than 8 feet, use cut stump or basal bark treatments.

For mature vines that are not taller than 8 feet, especially plants that are bushy or sprawling with many rooted

stems, foliar spray may be most practical.

For foliar treatment near water (See p.12, Section 2), use:

- 0.4 to 1% a.i. of an aquatic formulation of glyphosate in water, **or**
- 0.4 to 1.3% a.i. of an aquatic formulation of triclopyr salt in water.

For foliar treatment away from water, use:

- 0.4 to 1% a.i. of glyphosate plus a nonionic surfactant in water, **or**
- 0.3 to 0.6% a.i. of triclopyr ester plus a

nonionic surfactant in water

the root. For best results, pull when soil is moist.

Seedlings

Physical – Pull seedlings, ensuring complete removal of

Chemical - Chemical treatment is not recommended for seedlings.



Melia azedarach

Chinaberry

Characteristic Features:

- Grows up to 50 feet tall
- Up to 2 feet in diameter
- Lacy, dark-green leaves, musky odor
- Lavender flower clusters
- Flowers are fragrant
- Poisonous yellow berries

Other Aliases:

- *Melia azedarach* var. *umbraculifera*
- umbrella tree
- Persian lilac
- bead tree
- Pride-of-India



D. Keith

Habitat

- Roadsides, forests margins, old homesites
- Semi-shade tolerant and high temperatures
- Has formed significant natural stands in riparian areas and higher grasslands in Texas

Identification

Chinaberry is a deciduous tree or bush which grows up to 50 feet (15 m) in height and 2 feet (60 cm) in diameter. It is branched with multiple boles, and lacy dark-green leaves which emit a musky odor. The leaves grow alternately on the branches, and contain many leaflets growing along the main leaf. The main leaf grows to approximately 2 ft. in length, while the leaflets reach about 1-3 inches in length. The flowers of the tree are

clusters of white to lilac colored blooms, yielding in spring. They are particularly fragrant, and average in size about 3/4 in. Round, poisonous yellow berries hang from long stalks and bloom in large clusters during summer time. The berries remain on the tree into the winter season even after the leaves have fallen.



Texasinvasives.org

Biology & Spread

Chinaberry reproduces on-site primarily from root sprouts, and over longer distances via bird-

dispersed seeds. It is reproductively mature when it reaches the size of a shrub.

History:

Introduced in the mid-1800s from Asia as a shade tree and for the colorful flowers and berries it produces. Widely planted as a traditional ornamental around home sites. Extracts potentially useful for natural pesticides.

**Ecological Threats**

The Chinaberry tree forms thickets which reduce diversity. Its leaf litter raises soil pH, thus altering soil conditions for native plants and seed germination.

Chinaberry is fast growing tree and can reach 18 - 24 feet in height in 4 - 5 years,



and may ultimately reach 50 – 60 feet.

Management Strategies/ Control

This woody species is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on

trees with smooth bark. Herbicide application can be done using a directed spray on stumps, girdling wounds or as a basal application. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Weed Risk Assessment Summary

Melia azaderach

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	B	A	2.69

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Melia azedarach Chinaberry

Introduction

This woody species is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For large individuals located in areas with minimal public access, trees can be girdled the exposed cambium will receive herbicide application. Basal applications may also be used on small trees with smooth bark. Herbicide application can be done using a directed spray on stumps, girdling

wounds, injection or as a basal application.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature Chinaberry.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

Saplings

Physical – Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the

root. For best results, pull saplings when soil is moist.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Nandina domestica

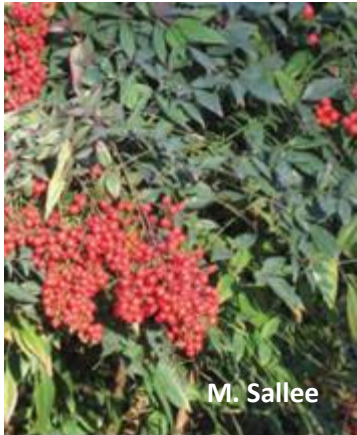
heavenly bamboo

Characteristic Features:

- 8ft tall, evergreen
- bi-pinnately compound leaves
- pink to white or cream flowers, bright red berries
- bright yellow wood
- resembles bamboo

Other Aliases:

- sacred bamboo



M. Sallee

Habitat:

- Forest edges
- Forest under canopy
- Moist areas
- Shade tolerant
- Disturbed/neglected areas

Identification

Showy, erect evergreen shrub growing to a height of 6-10 feet and width of 3- 5 feet (Some cultivars,



M. Sallee

such as dwarf nandina, are shorter). The plant has multiple bushy cane-like stems growing together, resembling bamboo. Leaves are alternate and bi-pinnately compound, with many 1 to 2-inch, pointed leaflets. Foliage can range from pinkish to green

and be tinged with red in the winter months. Flowers are ¼ to ½ inch across, white to pink and bloom in loose, erect, terminal clusters early in summer. Small, bright red berries appear in fall and winter if plants are grouped, as single plants seldom fruit heavily.

Biology & Spread

Nandina will grow in full sun to shade, appearing under forest canopies and near forest edge habitats. It prefers reasonably rich soil but does not thrive in sand. Nandina spreads both vegetatively

through underground root sprouts and by seeds, which are dispersed by birds and small mammals. Nandina has been in cultivation for centuries, and is still widely sold as an ornamental shrub.

History:

Native to eastern Asia, nandina was introduced to North America in the 1800s. It is still widely planted as an ornamental, and spreads from landscaping around old homes.



K. Rawlins

Ecological Threats

Nandina quickly invades habitats by root sprouts and by animal-dispersed seeds. Berries can, however, be toxic to cats and other small mammals. Seedlings persist for several years before maturing. It can displace native understory species



C. Johnson

Management Strategies/ Control

This woody species exhibits root sprouting and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual shrubs will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. Basal applications of herbicide may also be used on shrubs with smooth bark, away from water. Foliar spray can be used on small individuals, but cut stump treatment is preferable.

Herbicide application can be done using a directed spray on stumps, girdling wounds or as a basal application. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Weed Risk Assessment Summary

Nandina domestica

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	C	B	A	2.8

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Nandina domestica heavenly bamboo

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual shrubs will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. Basal applications of herbicide may also be used on shrubs with smooth bark, away from water. Foliar spray can be used on small individuals, but cut stump treatment is preferable. Herbicide application can be done using a directed spray on stumps,

girdling wounds, injections or as a basal application.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Shrub

Physical – There is no effective physical control for mature heavenly bamboo.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

Saplings

Physical – Nandina’s tap root can make hand pulling and weed wrenching difficult and

ineffective. Attempt this control method only when soil is moist. Discontinue pulling or wrenching if complete tap root cannot be fully extracted.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21)

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-

vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Pistacia chinensis

Chinese pistache

Characteristic Features:

- Grows up to 40 feet tall
- Deciduous tree
- Heat and drought tolerant
- Red seed pods attract birds

Other Aliases:

- Chinese pistachio



Identification

A medium-sized landscape tree to 40 feet tall and wide, 12" to 18" in diameter. Branch structure is irregular and it often develops co-dominant leading branches. This deciduous species has glossy green leaves consisting of up to 10 pairs of leaflets that in fall (autumn) turn yellow, orange and scarlet. The inconspicuous flowers, borne in panicles, are followed in summer by small red spherical seed pods that turn blue in fall and attract birds.



Biology & Spread

Pistacia chinensis is a dioecious species. A branched spike of small, greenish flowers appears in spring above foliage. Female trees do not produce large quantities of seeds until established for fifteen or twenty years. Planted as an urban street tree. Also occurs on riversides and cultivated areas.

Habitat:

- Common urban street tree
- Riversides and cultivated areas

History:

Native to China, this species is now commonly available for landscape plantings in Texas. Often used as the root stock for grafting the edible pistachio. Introduced; US Distribution: AL, CA, GA, TX . In 2006, the California Invasive Plant Council (Cal-IPC) evaluated *Pistacia chinensis* but did not list it.

**Ecological Threats**

Handling plant may cause skin irritation or allergic reaction. Occurrence outside of cultivation in Texas reported at least 10 years ago from one or a few populations. Evidence indicates that the species has persisted. Recent escapes raise concerns about this tree replacing native species.

**Management Strategies/ Control**

Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, if away from water. In, or near water, the preferred treatment is cut stump or frill/ girdle application of an appropriate herbicide. Herbicide application can be done using a

directed spray on stumps, girdling wounds or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control reached. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Weed Risk Assessment Summary*Pistacia chinensis*

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	1.6

Comments: Lack of information. Assessment based on local observations in C. Tx.

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Pistacia chinensis

Chinese pistache

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark if away from water. In, or very near, water the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application

can be done using a directed spray on stumps, herbicide injectors, girdling wounds or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See

p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature Chinese pistache.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the

root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Pueraria montana var. Lobata

kudzu

Characteristic Features:

- grows up to 100 feet long
- deciduous twining rope vine
- alternate and compound leaves
- fragrant purple flowers
- grape like fragrance
- leguminous pod fruits in fall

Other Aliases:

- *Glycine javanica*
- *Pueraria lobata*
- *Pueraria thunbergiana*



D.K. Northington

Habitat:

- Well drained areas
- Eroded lands or disturbed regions
- Sandy, deep-loam soils in full sun

Identification

Kudzu is a deciduous mat-forming woody leguminous vine, 35 to 100 feet (10 to 30 m) long with three-leaflet leaves. Roots are large, tuberous and semi-woody, reaching depths of 3 to 16 feet (1 to 5 m). In fall or after first frost, leaves and small vines die and form mats which persist into winter.

Leaves are dark green, alternate and compound, comprised of three oval to chordate leaflets, each three to four inches long. Leaflets may be slightly or entirely lobed with hairy stems. Dense stands of kudzu are found along forests and roadside edges and are characterized by thousands of single-colored plants. Fragrant purple flowers are clustered in axillary racemes up to one foot long. Each floret is pea-like, and may be purple or purplish-red, and

the fragrance is described as grape-like. Flowers are rarely



V. Adams

produced in open patches on flat ground, but do form in mid-summer on draped vines. Bears flattened leguminous pods containing up to ten hard-covered seeds in late fall. The seeds can remain dormant and viable for several years before germinating.

Biology & Spread

Kudzu spreads mainly through vegetative expansion of its runners and rhizomes. Vines can root at the nodes to form new plants. Kudzu also spreads somewhat through the seeds it produces in the fall. However, since only one

or two viable seeds are produced per cluster of pods and these hard-coated seeds may not germinate for several years, seed production is not its most vigorous form of dispersal.

History:

Kudzu was introduced in 1876 in Philadelphia where it was used in a Japanese government display garden. It was then planted widely as an ornamental vine for its abundant vegetation and sweet-smelling flowers and shading. The Soil Conservation Service promoted it as a forage plant and encouraged its use for erosion control. In the 1950's, the U.S. government ceased advocating the use of this plant. In 1970, the USDA declared kudzu a noxious weed and in 1997 kudzu was listed as a noxious weed.



H. Pickle

Ecological Threats

Dense packing of kudzu can result in tens of thousands of plants occupying a single acre of land.

Kudzu kills or degrades other plants by smothering them under a solid blanket of leaves, by girdling woody stems and tree trunks, and by breaking branches or uprooting entire trees and shrubs through the sheer force of its weight. Once established, Kudzu plants grow rapidly, extending

as much as 60 feet per season at a rate of about one foot per day. This vigorous vine may extend 32-100 feet in length, with stems 1-4 inches in diameter. Kudzu roots are fleshy, with massive tap roots 7 inches or more in diameter, 6 feet or more in length, and weighing as much as 400 pounds. As many as thirty vines may grow from a single root crown.

Management Strategies/ Control

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 8 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-

infestation. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is

site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to



M. Murphrey

reduce soil erosion and further invasion.

Weed Risk Assessment Summary

Pueraria Montana Var.Lobata

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	B	A	2.8

Comments: Limited distribution in Austin/ Potential to survive, should probably be an "Alert".

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Pueraria montana kudzu

Introduction

Kudzu is a deciduous, woody, leguminous vine that forms dense colonies along forest and roadside edges. The plant spreads by rooting at nodes and by seed. On mature plants, vines and roots originate from a knot or ball-like root crown on top of the soil surface. A large, semi-woody tuberous root can reach depths of 3 to 16 feet (1 to 5 m). Dense colonies can contain tens of thousands of plants per acre. During peak growing season in early summer, this prolific vine can grow rapidly, up to a foot a day.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Mature and sapling vines

Physical – Physical methods alone are unlikely to control mature kudzu. However, mowing, shredding, or prescribed fire can sever rooted stems, prepare the site for herbicide treatment, and encourage a low, bushy growth form that will be easier to treat with herbicide. Allow vines to resprout to a height of 2 to 3 feet before applying herbicide treatments.

Chemical – The most effective herbicides for kudzu control are picloram away from water and 2, 4-D + dicamba near water. However, these herbicides are not recommended for use on most sites in Travis or Hays counties, especially west of Interstate 35. Each of these herbicides is US EPA Restricted-Use. Dicamba and 2,4-D are also State Limited-Use and State Regulated herbicides. Picloram and dicamba retain soil activity, are highly mobile in soils, and can damage nearby desirable vegetation including large trees.

Picloram is also a demonstrated groundwater contaminant. Thus, the use of these herbicides should be planned and executed with extreme caution and should only occur after other treatment options have failed.

Other herbicides can provide containment of established kudzu stands and eradication with repeated treatment over several years. These are, in decreasing order of effectiveness: clopyralid, triclopyr, and glyphosate. With each of these herbicides use

foliar spray treatments. With backpack or vehicle-mounted sprayers equipped with flat fan nozzles, thoroughly wet all foliage, but not to the point of runoff. Apply herbicide after kudzu has begun to flower, typically in mid-summer.

Foliar die-back can be achieved with each of these herbicides, but regrowth should be expected and two to ten annual

foliar treatments may be required for complete control.

When near water (See p.12, Section 2), use:

- 0.3 to 4% a.i. (active ingredient) of an aquatic formulation of triclopyr salt plus nonionic surfactant in water, **or**
- 0.4 to 1% a.i. of an aquatic formulation of glyphosate in water

When away from water, use:

- Any of the above herbicide mixtures for use near water, **or**
- 0.15% a.i. of clopyralid plus a nonionic surfactant in water, **or**
- 1.4 to 2.8% a.i. of triclopyr ester in water, **or**
- 1% a.i. of glyphosate plus a nonionic surfactant in water



Pyracantha coccinea

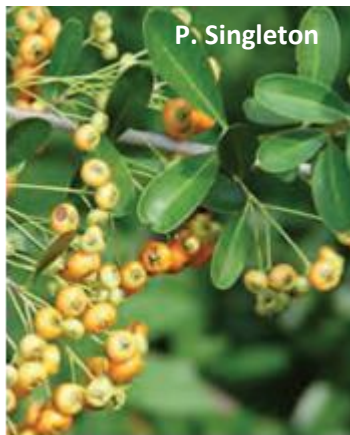
scarlet firethorn

Characteristic Features:

- grows up to 20 feet (6 m) tall
- prefers well-drained soils in full sun
- tolerant of dry, alkaline soils
- bright colored berries in fall
- white spring flower clusters

Other Aliases:

-



Habitat:

- Evergreen sumac
 - USDA Zones 6 to 9 Fact Sheet
- Series Date of Publication:
September 2011

Identification

Firethorn is a shrubby, large, drought-tolerant evergreen that produces large quantities of bright red fruits in fall and winter months. Growing up to 10 ft. high and 12 ft. wide, its branches shoot out in every direction, giving it an unkempt appearance. Branches have inconspicuous, sharp thorns that hide among the dark green, glossy leaves. Blooms occur in the spring, yielding clusters of white, five-petaled flowers.



Biology & Spread

Birds eat the brightly colored fruits in the fall and winter and disperse the seeds.

History:

Native to Southern Europe, to Caucasus Mountains in western Asia. Introduced to US; Distribution is AL, CA, DC, LA, MS, NM, OH, OR, PA, TX , UT.

**Ecological Threats**

Pyracantha is capable of escaping cultivation and forming impenetrable thickets that exclude native species and tend to

dominate understory. Restoration of soil and vegetation and follow-up monitoring, are necessary following



treatment, especially when soil is left bare, to prevent re-infestation.

Management Strategies/ Control

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. Near water, the preferred treatment is cut stump or frill/girdle application. Herbicide application can be done using a directed spray on stumps, girdling wounds or as a basal application. Follow-up treatments

may be required to control root sprouts before an effective level of control is reached. On extensive stands of mature pyracantha, special considerations for accelerated post treatment soil erosion should be included when planning treatment. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use.

Weed Risk Assessment Summary*Pyracantha coccinea*

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	C	B	A	2.15

Comments: Largely no information. Assessment Based on local observations in C. Tx.

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Pyracantha coccinea scarlet firethorn

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of mechanical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or very near, water the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application can be done using a directed spray on stumps,

herbicide injectors, girdling wounds or as a basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached. On sites which contain extensive stands of mature pyracantha, special considerations for accelerated post treatment soil erosion should be included when planning treatment.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies,

ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature scarlet firethorn.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

complete removal of the root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance.



Tamarix spp.

tamarisk, salt cedar

Characteristic Features:

- shrub or small tree
- up to 20 ft tall
- pale pink to white flowers
- small, in spike like raceme
- fruit is a capsule

Other Aliases:

- tamarisk



J. Shouse

Habitat:

- Seasonally saturated soils in arid areas
- Tolerant of a wide variety of environmental conditions
- Saline soils optimal, but salt cedar is adaptable

Identification

Salt cedar is a pervasive shrubby tree species growing up to 20 feet tall, with small, alternate, scale-like leaves on numerous slender branches. Small, pale pink-white flowers appear in spike-like racemes. The flowers are perfect and regular, with distinct petals and sepals occurring in fours or fives. The fruit is a capsule. Eight species of salt cedar have been listed as introduced to North America. These species can be effectively divided into two groups: evergreen *Tamarix aphylla* does not sexually reproduce in this climate, and thus is not a serious concern. Deciduous, shrubby species, including *T. pentandra*, *T. tetranda*, *T. gallica*, *T. chinensis*, *T. ramosissima*, and *T. parvifolia*, as described by various authors, are more invasive. Literature varies as to whether these should be considered different species or a

single hybridizing group. The scientific name *T. pentandra* is used when grouping these species.



Biology & Spread

Salt cedar spreads vegetatively through adventitious roots or re-rooting of broken branches, and sexually. Each flower can produce thousands of tiny (1/25-inch diameter) seeds that are contained in a small capsule

usually adorned with a tuft of hair that aids in wind dispersal. Seeds can also be dispersed by water. Seedlings require extended periods of soil saturation for establishment.

History:

Salt cedar was introduced to North America as a nursery plant on the east coast in the early 1800s. It was planted as an ornamental throughout the US and thus spread to the west coast. By the 1920s it had begun invading the wildlands and watersheds of the southwest and presenting serious control problems.



Environmental Systems

Ecological Threats

Salt cedar is a fire-adapted, aggressive colonizer that outcompetes native riparian vegetation. Dense stands monopolize water sources, lowering the water table and choking stream beds with extensive root systems, increasing both the frequency and intensity of flooding and fires. Although it provides some

shelter, it is not desirable habitat or forage for most native species of birds and mammals. Salt secretions from tamarix inhibit the growth of native species.



D. Slack

Management Strategies/ Control

This species is treated combining cultural, physical and chemical methods. Individual trees will be cut and their stumps will receive herbicide applications within five minutes. Basal applications of herbicide may be used on trees with smooth bark, away from water. Near water, the preferred treatment is cut stump or frill of an appropriate herbicide. Herbicide application can

be done using a directed spray on stumps, girdling wounds or as a basal application. On sites which contain extensive stands of mature tamarisk, special considerations for accelerated post treatment soil erosion should be included when planning treatment. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour.

Weed Risk Assessment Summary

Tamarix ramosissima

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	B	A	3.15

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Tamarix spp. tamarisk, salt cedar

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of physical, cultural and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or very near, water the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide

application can be done using a directed spray on stumps, girdling wounds, injection or as a basal application. On sites which contain extensive stands of mature Tamarisk, special considerations for accelerated post treatment soil erosion should be included when planning treatment.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies,

ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature salt cedar.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21).

Up to 12% a.i. of imazamox in water is also effective on salt cedar as a hack-and-squirt, frill and girdle, or cut stump application. May be used near water. (See p.12, Section 2 for “near water” definitions and water quality information.)

After herbicide treatment, wait at least two years before disturbing treated salt cedar plants. Earlier disturbance can reduce overall effectiveness.

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the root. For best results, pull saplings when soil is moist.

Chemical - See General Chemical Control Procedures for Woody Plants (p.21).

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



Triadica sebifera

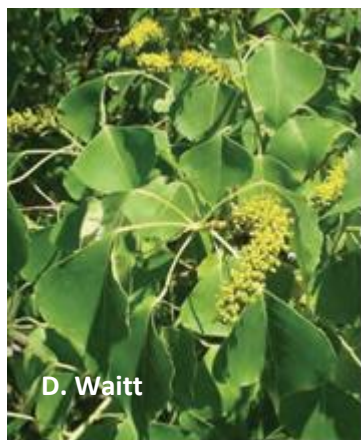
Chinese tallow

Characteristic Features:

- grows up to 60 feet tall
- flowers have yellow green sepals and no petals
- can flower and set fruit in three years
- alternating leaves
- diamond-shaped leaves
- red fall color

Other Aliases:

- *Croton sebiferum*
- *Sapium sebiferum*



D. Waite

Habitat:

- Stream banks, riverbanks, and wet areas like ditches as well as upland sites
- Both freshwater and saline soils
- Shade tolerant, flood tolerant, and allelopathic

Identification

Chinese tallow is a deciduous tree which grows up to 60 feet (18 m) in height and 3 feet (90 cm) in diameter. The tree has distinct



V. Schroller

diamond-shaped (deltoid) leaves which are wide at the base and pointed on the end and can range from 1.5-3.5 in long, 1.5-4 in wide. They can easily be distinguished redbuds which have cleft, heart-shaped leaves. In southern

regions, tallow is planted for its fall color. Blooms in late spring appear as dangling yellowish spikes up to 8 in long. Fruits are small, three-lobed clusters that split to reveal popcorn-like seeds in fall and winter.

Biology & Spread

Chinese tallow is monoecious, with both male and female flowers on the same plant. The dangling spike is made up of staminate (male) flower clusters while the pistillate (female) flowers occur first and mature as three-sepaled green clusters at the base of the spike. Tallow trees can reach reproductive age in as little as three years, and prolifically produce seeds which are readily transported by water and birds. Flowers mature March through May and fruit ripens

August through November. Also propagates via cuttings, stumps, and root sprouts.

History:

Chinese tallow tree is native to China and Japan and has historically been grown for its seed oil. It was introduced into the United States in the 1700's in South Carolina as an ornamental and distributed further in the Gulf Coast in the 1900's as a potential soap industry crop.

**Ecological Threats**

Chinese tallow rapidly transforms native habitats into single-species tallow forests if left unhindered.

Chinese tallow alters light availability for other plant species. Foliage blocks out light for groundcover species and

once dead, accumulates and quickly decays, releasing excess nutrients into the soil.

**Management Strategies/ Control**

This woody species exhibits root sprouting characteristics and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or near water, the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application can be done using a directed spray on stumps, girdling wounds, injection or as a basal application. Follow-

up treatments may be required to control root sprouts before an effective level of control is reached. Seeds are primarily dispersed by birds, animals or water. On sites which contain extensive stands of mature Chinese tallow, special considerations for accelerated post treatment soil erosion should be included when planning treatment.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use.

Weed Risk Assessment Summary*Triadica sebifera*

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	3.15

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated,		D=None	1 = Anecdotal
not listed		U=Unknown	0 = No information



Triadica sebifera Chinese tallow

Introduction

This woody species exhibits root sprouting characteristics and is treated using a combination of cultural, physical and chemical methods. Where feasible, individual trees will be cut and their stumps will receive herbicide applications within five minutes of the initial cut. For larger individuals located in areas with minimal foot-traffic, trees can be girdled and the exposed cambium will receive herbicide application. Basal applications of herbicide may also be used on trees with smooth bark, away from water. In, or near water, the preferred treatment is cut stump or frill/girdle application of an appropriate herbicide. Herbicide application can be done using a directed spray on stumps, girdling wounds, injection or as a

basal application. Follow-up treatments may be required to control root sprouts before an effective level of control is reached. Seeds are primarily dispersed by birds, animals or water. On sites which contain extensive stands of mature Chinese tallow, special considerations for accelerated post treatment soil erosion should be included when planning treatment.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible.

When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Trees

Physical – There is no effective physical control for mature Chinese tallow.

Chemical – See General Chemical Control Procedures for Woody Plants (p.21). Up to 12% a.i. of imazamox in water is also effective on Chinese tallow as a hack-and-squirt, frill and girdle, or cut stump application. May be used

near water. (See p.12, Section 2 for “near water” definitions and water quality information.)

Saplings

Physical - Manually pull saplings by hand or with a weed wrench, ensuring complete removal of the root. For best results, pull saplings when soil is moist.

Chemical - See Generalized Chemical Control Procedures for

Woody Plants (p.21). Up to 12% a.i. of imazamox in water is also effective on Chinese tallow as a hack-and-squirt, frill and girdle, or cut stump application. May be used near water. (See p.12, Section 2 for “near water” definitions and water quality information.)

Sprouts and seedlings

Cultural – Maintain full vegetative cover. Prevent soil disturbance. Mulch and/or re-vegetate bare soils to prevent seed germination.

Physical – Manually pull seedlings by hand, ensuring complete removal of the root. For best results, pull seedlings when soil is moist.

Chemical – Chemical treatment is not recommended for tree seedlings. Most tree seedlings will not advance to the sapling stage.



General Control Procedures for Grasses

Arundo and bamboo, while classified as grasses, develop extensive rhizome systems and do not respond to control efforts like other grasses. Details for their treatment can be found in the Field Resources Manual, Species Specific Fact Sheets and Management Protocols.



Arundo donax

giant reed

Characteristic Features:

- Height: up to 20 feet (6 m)
- Spread: tuberous rhizomes, fibrous roots, viable bud, disturbances
- Bloom: August to September
- Leaves: alternate, hairless, droopy
- Tolerates: high salinity, variable soil types
- Resembles: common reed

Other Aliases:

- *Arundo donax*
- Arundo
- giant reed
- giant cane



J. Johnson

Habitat:

- Moist areas (ditches, swales, streams, riverbanks, well drained soils)
- Disturbance areas (human caused or natural: mowing, flooding, roadsides)

Identification

Giant reed is a tall, perennial grass that grows up to 20 feet (6 m) in height. Its spreading tuberous rhizomes form compact masses from which tough, fibrous roots emerge that penetrate deeply into the soil, forming thickets in distinct clumps. Alternate leaves are elongate, 1-2 inches wide and a foot long, drooping at the ends.

The flowers are borne in 2-foot long, erect, dense, plume-like panicles during August and September, and persist through winter. Seed are not viable. Dried plants remain standing in winter and spring

while low and sheltered plants may remain green. Closely resembles common reed [*Phragmites australis* (Cav.) Trin. ex Steud.], which has similar but looser and more drooping large hairy seed heads, and unlike giant reed, occurs mainly near swamps, marshes, and wet habitats in extensive infestations.



M. Sallee

Biology & Spread

Reproduction is primarily vegetative, through rhizomes which root and sprout readily. Each stem and rhizome section has a viable bud. Plants spread by movement of stem and rhizome parts in soil or by human induced or natural disturbances such as flooding. Little

is known about the importance of sexual reproduction in giant reed, or about its seed viability, dormancy, germination, or seedling establishment, but giant reed does not produce viable seeds in Central Texas.

History:

Introduced to the U.S. from Asia, Africa, and Europe in the early 1800's, through Los Angeles. It has become widely dispersed into subtropical and warm temperate areas of the world, mostly through intentional human introductions. It is widely planted throughout the warmer climates of the United States as an ornamental and for erosion control.



S. Strandtman

Ecological Threats

Giant reed chokes river and stream channels, crowds native plants, interferes with flood control, increases fire potential, and reduces habitat for wildlife. The long, fibrous root mats of giant reed form a framework for debris dams that can build up and damage bridge supports and other structures. Root and stem fragments can float downstream and initiate new

infestations. Rapid growth rate and vegetative reproduction enable it to quickly invade and dominate new areas. Once established, it has the ability to outcompete and completely suppress native vegetation.



L. Uppinghouse

Management Strategies/ Control

Mechanical control such as repeated mowing may be somewhat effective, but may take years to deplete the rhizomes, and plants continue to spread. Large scale removal of rhizomes involves significant soil removal. Very young plants in new infestations can be dug up, but care must be taken to remove all roots and rhizomes- small fragments left in the soil may reestablish. Where feasible, systemic herbicides may be applied to stands of giant reed but only as a foliar spray. Cut stump treatment is not considered effective because not enough chemical reaches the roots. (Crosby, personal communication). Herbicide should not be applied when rainfall is expected within 48 hours or

when winds exceed 10 miles per hour. Always follow the label carefully and avoid impacts to non-target vegetation. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. Post-treatment soil and vegetation restoration may be necessary to prevent re-infestation, especially when soil is left bare. Restoration is site specific, but in general the two basic steps are: addressing any soil damage, and seeding or replanting appropriate native species. If the area cannot be immediately reseeded or replanted, it should be mulched or otherwise protected to reduce soil erosion and further invasion.

Weed Risk Assessment Summary*Arundo donax*

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	B	A	3.84
Comments:					
Rating	Alert	Scores	Documentation		
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications		
2=Moderate	N=No	B=Moderate	3 = Other published material		
3=Limited		C=Limited	2 = Observational		
4=Evaluated, not listed		D=None U=Unknown	1 = Anecdotal		
			0 = No information		



Arundo donax giant reed

Introduction

This grass species is treated using a combination of mechanical and chemical methods. Relying solely on mechanical control means either repeated, frequent mowing to exhaust the rhizome 'bank' or physical removal of roots and rhizomes- something mostly effective with new plants in early stages of colonization. Mowed plants will re-grow quickly, and when removing rhizomes, any small fragments left in the soil may reestablish. Where feasible, systemic herbicides can be effective on giant reed, but plants must be actively growing. Herbicide applications are generally more effective when performed in late summer or fall, when the plants are at full height and once seed heads have formed, as the plant is pulling nutrients into the root system in preparation for winter dormancy. Treatment is NOT effective if application occurs before mid-June or after mid-October, as the plants are either not tall enough to receive sufficient chemical 'dose' or have possibly entered winter dormancy and will not take up the chemical. Giant reed does not typically produce viable seeds in Central Texas, so removal of seed heads

is not useful in limiting spread. Rhizome clumps are the most frequent dispersal vector, but plants can also root from culm, or stem, nodes.

Herbicide should always be applied in a manner to prevent contact with non-target vegetation; when giant reed is growing under canopy or in stands mixed with other hardwoods, careful choice of herbicide is critical. See Table in Section 3 for recommendations. Always follow the label carefully to avoid impacts to non-target vegetation, including aquatic plants. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for "near water" definitions and information on water quality.

A combination of chemical and mechanical treatment may be helpful when infestations occur in areas where herbicide application must be extremely limited (for example, where public access cannot be restricted even for the short period of during application time). Plants can be cut and allowed to re-grow to at least 4 ft

prior to spraying- thus limiting the drift into non-target areas. But these applications can be less effective, and optimal results come from spraying plants at full height. It is NOT effective to apply herbicide to the cut stumps of giant cane, as insufficient herbicide is taken up by the plants.

Giant reed can be difficult to kill and may require multiple years of treatment. Once treated with an herbicide, dead standing plants should be left in place to provide mulch and to limit re-growth. It also is critical to monitor treated areas and re-treat any new colonies. Restoration with native vegetation is also important, because natural re-colonization is limited by the woody surface 'cap' formed by rhizomes of giant reed. The cap does protect the soil from eroding while the treated plant deteriorates.. Inserting seeds or plants into holes poked in the cap (to reach the soil beneath) may prove effective, but this method has not been documented. At a minimum, seeding should be done at the edge of the cap and in any gaps in the woody surface.

General Control Procedures

Physical /Mechanical- Remove prior plantings and control sprouts. Growth from new infestations or young plants can be controlled by pulling up entire plant, including root mass. Frequent repeated cutting to ground may result in control for young infestations but the cutting frequency required to exhaust massive root systems makes this ineffective for older growth. Burning treatments are suspected of having minimal effect due to underground rhizomes.

Disposal - If available, contract with a commercial composting facility (CoA's Hornsby Bend) for disposal. Otherwise, bag and dispose of plants in a dumpster or burn. Cut debris may be piled and left for enhancement of wildlife habitat (i.e., cover for small mammals), but only if all chance of re-sprout or spread is eliminated : Avoid debris contact with moist soil and keep it away from shorelines with the potential for water borne dispersal.

Chemical – Treat plants no earlier than mid-June . For optimum control, wait until after blooms have set (September or October), but before winter dormancy sets in. Treated area should be monitored each year for re-growth and need to re-treat. If patches are near water, ALWAYS USE AQUATIC FORMULATIONS of all herbicides. (See p.12, Section 2 for “near water” definitions and water quality information.) Foliar sprays applied under high pressure are most effective, especially with dense stands. Backpack sprayers can be used on smaller plants and patches.

For patches mixed with trees or nearby woody vegetation, use imazamox at the following rates:

For backpack sprayers, 5% imazamox with 1 % MSO. For high pressure sprayer, 2% imazamox with 1% MSO. For monoculture stands with adjacent vegetation where drift can be avoided, 2% imazamox + 1 % glyphosate+1% MSO is potentially more effective than imazamox alone, although

glyphosate will ‘brown’ any vegetation it contacts, but should not kill trees. Use a 4 % glyphosate + 1 % MSO if glyphosate is used alone. For monoculture patches with no nearby vegetation within two drip lines*, use Imazapyr (Arsenal AC) as a 1-percent solution (4 ounces per 3-gallon mix); or a combination of 0.5 % imazapyr (2 ounces per 3-gallon mix) and a 4 % glyphosate (1 pint per 3-gallon mix). If public access to freshly treated plants is an issue, cutting the Arundo then spraying herbicide on the regrowth is an option, but the plants MUST BE FOUR FEET tall at a minimum or insufficient herbicide will be delivered. Applying herbicide to cut stems is generally ineffective, as it does not deliver enough herbicide to the roots for a good kill.

*Drip line is determined by outer edge of overhanging canopy. If using imazapyr, spray area MUST be at least twice this far from any non-target woody vegetation, as this herbicide can translocate via roots and is lethal to other woody plants.



Bothriochloa ischaemum var. *songarica*

King Ranch bluestem

Characteristic Features:

- 30 - 60 cm tall
- Cespitose grass
- Rounded sheaths and flat blades
- Drought resistant
- No tolerance of flooding

Other Aliases:

- *Andropogon ischaemum*
L. var. songaricus (Rupr. ex Fisch. & C.A. Mey)



B. Kowing

Habitat:

- Disturbed mesic upland soils.
- Prefers fine-textured, calcareous soils

Identification:

King Ranch bluestem is a perennial, with foliage from 30-80 cm and fertile culms up to 1-1.5 m. The plants are usually matted or tufted, occasionally stoloniferous or rhizomatous under close grazing or mowing.

Stems are slender, erect, light green turning yellowish at maturity; nodes are brown-purple, glabrous with short appressed

hair. They are native to Africa, Asia, and Europe, and often the dominant grass, growing in dry

stony places. The plant is adapted to a well-drained sandy soils, loams and clays. It prefers fine-textured, calcareous soils and has some tolerance to low available iron and salt, growing naturally onto



A. Fuller

saline soils. It is drought resistant, but has no tolerance of flooding, and flowers throughout the growing season.

Biology & Spread

This grass was often seeded on degraded rangelands for soil and water conservation, and is now common along roadsides throughout Texas.

History:

Widely planted for grazing and on roadsides.



G. Hinds

Ecological Threats

In open areas, non-native grasses can form large monocultures that hamper and outcompete native plants. King Ranch bluestem poses a very serious ecological threat due to widespread planting by ranchers and highway departments. It is now considered invasive and its presence threatens the abundance and diversity of native species. Land managers and conservationists should

implement control practices that limit the distribution and spread of King Ranch bluestem.



M. Sallee

Management Strategies/ Control

This grass species is treated using a combination of mechanical and chemical methods. Mechanical control (e.g. summer burning) can be somewhat effective. Systemic herbicides may be applied to coincide with different growth stages; affecting translocation of herbicide to dormant buds and likely changing overall efficacy.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use.

Weed Risk Assessment Summary

Bothriochloa ischaemum

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Unknown	No	B	B	U	2.00

Comments: Not calculated. No scoring guidelines when distribution score is 'U'.

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Bothriochloa ischaemum var. *songarica* King Ranch bluestem

Introduction

This grass species is treated using a combination of mechanical and chemical methods. Mechanical control (e.g., repeated mowing and burning) may be somewhat effective. Systemic herbicides may be applied to coincide with different growth stages; affecting translocation of herbicide to dormant buds and likely changing overall efficacy. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed

10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up

monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Cultural

To reduce seed germination and plant establishment:

- Maintain dense and diverse native plant cover;
- Limit mowing
- Oversow with native grasses and forbs;
- Prevent soil disturbance;
- Mulch and/or revegetate disturbed soils;

Physical

- Grub individual plants with hand tools.
- Prescribed fire during the growing season (June to October) can kill King

Ranch bluestem plants and reduce dominance for two or more years. Post-fire recovery will be faster in areas where KR was most dominant pre-fire.

- Growing-season fire may be reapplied as soon as fine fuel loads recover sufficient to achieve desired fire behavior, typically within two to three years.

Paired Treatments

- King Ranch bluestem plants that survive and recover quickly after fire can be easily grubbed or

chemically treated in the relative absence of other desirable herbaceous species. Thus, fire followed by chemical treatment or grubbing will be more effective than single treatments used in isolation.

Chemical

- Close mowing, prescribed fire, or disking may be used to prepare the site for herbicide treatment and improve chemical control.
- Use a foliar herbicide treatment during active growth before the grass

- exceeds the recommended growth stages on herbicide specimen labels.
- In small areas or in large areas where desirable species are dominant use a backpack sprayer or a vehicle-mounted sprayer equipped with a solid cone or flat fan nozzle. Spray down on the plant, covering and completely wetting the blades but not to the point of runoff.
 - In large areas where King Ranch bluestem is dominant, use a vehicle-mounted boom sprayer
- calibrated to deliver low volumes of herbicide mix.
- When near water (See p.13, Section 2), use:
- 0.4 to 1% a.i. of an aquatic formulation of glyphosate plus nonionic surfactant in water.
- When away from water, use:
- The above herbicide mixture for use near water, **or**
 - A grass-specific herbicide such as
 - 0.14% a.i. of fluazifop plus crop oil concentrate or nonionic surfactant in water, **or**
- With vehicle-mounted boom sprayers, use the per-acre application rate recommended on the herbicide specimen label.
- 0.05 to 0.09% a.i. of clethodim (example: 0.44 to 0.85 oz. of Envoy Plus per gallon) plus nonionic surfactant in water, **or**
 - 0.18 to 0.27% a.i. of sethoxydim plus spray adjuvant or crop oil concentrate in water, **or**
 - 0.5 to 2% a.i. of glyphosate in water.



Cynodon dactylon

bermudagrass

Characteristic Features:

- Grows up to 1.5 ft tall
- Perennial grass
- Durable turf material
- Vigorous creeping ability
- Occasional toxicity
- Numerous cultivars

Other Aliases:

- *Capriola dactylon*
- *Panicum dactylon*
- Devil's grass



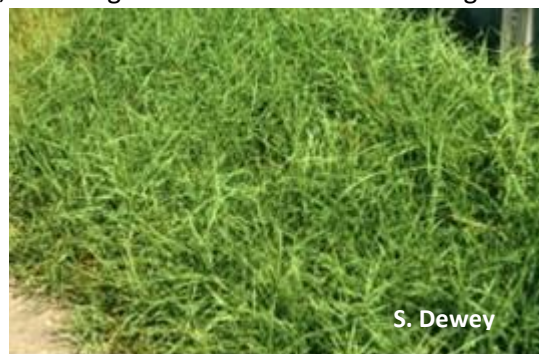
Habitat:

- Disturbed sites, gardens,
- Crops, orchards,
- Turf, landscaped and forestry areas
- Grows in areas that are irrigated or receive some warm season moisture
- Tolerates acidic, alkaline, or saline conditions
- Limited flooding
- Grows poorly in shade

Identification

Bermudagrass is a highly variable sod-forming perennial with extensive creeping rhizomes and stolons, to 1.5 ft tall. Bermudagrass is commonly grown as durable turf or forage in tropical to warm temperate regions nearly worldwide. Numerous hybrids and cultivars have been developed, including some that tolerate cooler conditions. Because of its vigorous creeping habit, controlling bermudagrass is problematic where warm season moisture is ample. Contact with plants can cause dermatitis in sensitive

individuals, and the pollen is a common allergen. Mature bermudagrass pastures have occasionally been implicated in livestock photosensitization or neurological syndromes, especially in late fall or early winter. Toxic symptoms may be due to molds or fungi sometimes associated with bermudagrass.



Biology & Spread

Bermudagrass reproduces vegetatively through the dispersal of rhizome and stolon fragments via landscaping activities and soil movement. Seeds also disperse with water, soil movement, agricultural and landscape machinery, as a commercial seed impurity, in livestock feeds and bedding, and with other human activities. Seeds germinate spring through fall when temperature and

moisture conditions are favorable. Some seeds survive up to 3-4 years under field conditions. Hybrids and other *Cynodon* species seldom produce viable seed. Temperatures below -1 C (30 F) kill aboveground parts. Optimal growth occurs when daytime temperatures are between 35 C and 38 C (95-100 F) Bermudagrass utilizes the C4 photosynthetic pathway.

History:

Introduced in the mid- 1800's as a pasture grass as it is characterized by drought resistance and ability to stay green through the hot summer months. It likely originates from eastern Africa, and is now commonly used as a turf grass in the southern United States.

**Ecological Threats**

In open areas, non-native grasses can form large monocultures that hamper and out-compete native plants. Bermudagrass is widely sold commercially and has the ability to quickly spread from its intended environment as a heavy- use turfgrass. It releases chemicals from both living and dead plants that may inhibit the growth of other plants. Mulch will not suppress the grass, as it is able to grow through heavy, substantial layers.

Management Strategies/ Control

This grass species is treated using a combination of physical, mechanical and chemical methods. Mechanical control (e.g., repeated tilling and disking to expose rhizomes) may be somewhat effective. Shading (as by taller grasses or forbs) will reduce and eventually eliminate the grass. Well-timed follow-up treatments are important for control of bermudagrass.

**Weed Risk Assessment Summary**

Cynodon dactylon

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	B	A	2.7

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Cynodon dactylon bermudagrass

Introduction

This grass species is treated using a combination of physical, mechanical and chemical methods. Mechanical control (e.g., repeated tilling and disking to expose rhizomes) may be somewhat effective. Shading (as by taller grasses or forbs) will reduce the grass. Well-timed follow-up treatments are important for control of bermudagrass.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed

10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary

following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Cultural

To reduce seed germination and plant establishment:

- Maintain dense and diverse native plant cover;
- Limit mowing
- Oversow with native grasses and forbs;
- Prevent soil disturbance;
- Mulch and/or revegetate disturbed soils;

Physical

- In small areas or in large areas where desirable species are dominant,

hand-pull rhizomes and stolons.

- In large areas where bermudagrass is dominant, disk repeatedly several times throughout the growing season to desiccate rhizomes, expunge the seedbank, and control resprouts. Follow-up by replanting diverse native plants at high seeding rates and/or tight plant spacings.

Chemical

- Close mowing, prescribed fire, or disking may be used to prepare the site

for herbicide treatment and improve chemical control.

- Use a foliar herbicide treatment during active growth before the grass exceeds the recommended growth stages on herbicide specimen labels.
- In small areas or in large areas where desirable species are dominant use a backpack sprayer or a vehicle-mounted sprayer equipped with a solid cone or flat fan nozzle. Spray down on the plant,

covering and completely wetting the blades but not to the point of runoff.

- In large areas where bermudagrass is dominant, use a vehicle-mounted boom sprayer calibrated to deliver low volumes of herbicide mix.

When near water (See p.13, Section 2), use:

- 0.4 to 1% a.i. of an aquatic formulation of glyphosate plus nonionic surfactant in water.

When away from water, use:

- The above herbicide mixture for use near water, **or**
- A grass-specific herbicide such as
 - 0.14% a.i. of fluazifop plus crop oil concentrate or nonionic surfactant in water, **or**
 - 0.05 to 0.09% a.i. of clethodim (example: 0.44 to 0.85 oz. of Envoy Plus per gallon) plus nonionic surfactant in water, **or**

- 0.18 to 0.27% a.i. of sethoxydim plus spray adjuvant or crop oil concentrate in water, **or**

- 0.5 to 2% a.i. of glyphosate in water.

With vehicle-mounted boom sprayers, use the per-acre application rate recommended on the herbicide specimen label.

*Phyllostachys aurea*

golden bamboo

Characteristic Features:

- Perennial
- Up to 40 ft. in height
- Named for its yellow green stems
- May flower only once in 7-12 year period
- Fan cluster shaped leaves

Other Aliases:

- Fish pole bamboo

**Identification**

Golden bamboo is a perennial, forming stalks 16 to 40 feet (5 to 12 m) in height. It produces jointed cane stems and bushy tops of lanceolate leaves in alternating, fan-shaped clusters, pointing upward on grass-like stems. It is named for its yellow green color. The aboveground jointed stem is called the culm, and the underground jointed horizontal stem which bears true roots is called the rhizome. Stems are divided into hollow internodes. Budding takes place at the nodes. Spikelets are solitary with 8 to 12 flowers, but are rarely seen. In fact, golden bamboo may only flower once in a 7-12 year period. The southeastern native switchcane (*Arundinaria gigantea*) has one flat side on its stem, distinguishing it

from the fully rounded stems of golden bamboo.

**Biology & Spread**

Golden bamboo reproduces vegetatively via budding of rhizomes. It rarely flowers, and

sometimes signifies the death of the plant. Bamboo, once established, is very aggressive in both its rate of growth as well as the sprouting of

new stems. It rapidly spreads in all directions from its original establishment. It is found throughout the US.

Habitat:

- Full or partial sun
- Moist, deep loamy soils that hold moisture
- Dense thickets along roads, forests, clearings, edges

History:

Native to Asia, it was introduced in 1882 as an ornamental. Still frequently planted as an ornamental and privacy plant.



S. Moore

Ecological Threats

In open areas, golden bamboo spreads very rapidly by rhizomes. Infestations of bamboo displace native vegetation, alter habitat, and upset food chains. Sheaths which remain on the ground retain water, and with shade from the thick stems, they suppress undergrowth from native plants. In streams, bamboo leaf

litter alters aquatic food webs, limiting food sources for litter-feeding stream invertebrates.



M. Murphrey

Management Strategies/ Control

This woody grass species is treated using a combination of mechanical and chemical methods. For very small areas with concern for public access, cut stem treatments may be used but are not recommended, as the best control seen by some experts is 10%. However, if this option is chosen, plants will be cut to the ground in the spring and their stumps will receive herbicide applications within five minutes of the initial cut. In the fall, herbicide should be applied to any regrowth, and repeated as needed. Foliar

chemical treatment can be used for larger infestations. Small infestation can be regularly cut back, however this method alone rarely results in control. A 3 ft. deep root barrier enclosing the plant can prevent spread. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Weed Risk Assessment Summary

Phyllostachys aurea

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	B	A	2.61

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Phyllostachys aurea golden bamboo

Introduction

This woody grass species root sprouts and is treated using a combination of mechanical and chemical methods. In the fall, foliar spray herbicide should be applied to any re-growth and potentially repeated two weeks later. Small infestation can be regularly cut back, however this method alone rarely results in control. A 3 foot deep root barrier enclosing the plant can prevent spread.

Herbicide application can be done as a foliar application, basal application, or in rare cases,

direct application to stumps. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Cultural

To reduce seed germination and plant establishment:

- Maintain dense and diverse native plant cover;
- Prevent soil disturbance;
- Mulch and/or re-vegetate disturbed soils;

Physical

- Hand-pull or grub all roots and rhizomes within small colonies when soil is moist.

- Mowing once a month for multiple years can reduce bamboo dominance and achieve some control.

Chemical

- Cut stalks to the ground and allow to re-sprout to 3 to 4 feet tall before applying herbicide.
- Use a foliar herbicide treatment during active growth.
- Use a backpack sprayer or a vehicle-

mounted sprayer equipped with a flat fan nozzle. Spray down on the plant, covering and completely wetting the blades and stalks but not to the point of runoff.

- Repeat treatments will be needed to achieve complete control.
- DO NOT use imazapyr in areas with adjacent woody vegetation.

When near water (See p.13, Section 2):

- If there is no adjacent woody vegetation, use aquatic formulation of glyphosate 2% + imazapyr 1% + Methylated Seed Oil 1%. Spray the plant to wet.
- If growth is mixed or near woody

vegetation, do NOT use imazapyr. Instead, just glyphosate alone: 5% a.i. glyphosate mix + 17# ammonium sulfate/100 gal water + 0.5% non-ionic surfactant. The MSO/Silicone surfactants work well with either of these

treatments.(J. Crosby, pers comm)

When away from water,

- Either of the above herbicide mixtures for use near water,
or

0.14% a.i. of fluazifop plus crop oil concentrate or nonionic surfactant in water.



Sorghum halepense

johnsongrass

Characteristic Features:

- perennial grass
- up to 2 m tall
- 1 of 10 most noxious weeds
- reddish to purplish-black panicles
- folded leaves at base

Other Aliases:

- *Holcus halepensis*
- *Sorghum miliaceum*
- Guinea grass



Habitat:

- Disturbed sites, roadsides, fields
- Fertile, well drained soils in warm temperatures
- Orchards, vineyards, agricultural fields, old fields, ditch-banks

Identification

A coarse, perennial grass with vigorous rhizomes, johnsongrass can grow up to 8 ft. tall. Its leaf blades are folded at the base, can grow up to 2 ft.



long, and are flat with a white midrib which distinguishes it from eastern gammagrass or switchgrass. The flowers of the grass are open, spreading, red to dark purplish panicles, up to 20 in long, with whorls of fine branches.

Johnsongrass seeds from May to March. These plants can rapidly develop colonies. Johnsongrass is considered a noxious weed in many states, and is especially troublesome in agricultural fields due to its potential toxicity.

Biology & Spread

Johnsongrass persists and colonizes by rhizomes, spreads by seeds, and can produce seeds the first year. Each rhizome segment can sprout. The panicles shed seeds near the parent plant (shatter). Seeds disperse to greater distances with wind, water,

agricultural activities, and animals. Some seeds survive ingestion by birds and mammals. Unlike commercial sorghums, glumes tightly enclose seeds and can protect seeds from decomposition in the soil for several years.

History:

Brought to South Carolina in the early 1800s as a forage crop. Continues to spread by seed dispersal in agricultural machinery. Introduced from the Mediterranean region. Multiple varieties developed that resulted in cold hardiness and a rapid spread northward.



G. Carter

Ecological Threats

Johnsongrass grows rapidly, is highly competitive with crops, and can be difficult to control. It can produce over 80,000 seeds in one season. Infestations in crops can reduce yields significantly. On untended land, it can form pure stands which out-compete native grass, reducing diversity. Plants are highly variable and many regional biotypes exist. Healthy plants can provide good forage for livestock, however, foliage of johnsongrass and other sorghums can produce toxic amounts of hydrocyanic acid when exposed to frost, stressed by drought, or damaged by trampling or herbicides and may be poisonous to livestock in these instances.



L. Fleming

Management Strategies/ Control

Occurs as dense stands and rapidly spreads along roadsides through mowing. Treat when new plants are young to prevent seed formation, pull and excavate all rhizomes before seed are present. Anticipate wider occupation when plants are present before disturbance. Burning treatments have little effect due to persistent rhizomes. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Weed Risk Assessment Summary

Sorghum halepense

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	A	A	3

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Sorghum halepense johnsongrass

Introduction

In open areas, non-native grasses can form large monocultures that hamper and out-compete native plants. Johnsongrass persists and colonizes by rhizomes, spreads by seeds, and can produce seeds the first year. Each rhizome segment can sprout. The plant occurs as dense stands and rapidly spreads along roadsides through mowing. Treat when new plants are young to prevent seed formation, pull and excavate all rhizomes before seed are present. Burning treatments appear to have little effect, due to persistent rhizomes.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Cultural

To reduce seed germination and plant establishment:

- Maintain dense and diverse native plant cover;
- Limit mowing
- Oversow with native grasses and forbs;
- Prevent soil disturbance;
- Mulch and/or revegetate disturbed soils;

Physical

- Hand-pull or grub individual plants when soil is moist or in loose soils, as in gravelly stream channels.

- Close cutting to the soil surface repeatedly throughout the growing season can achieve some control.

Chemical

- Close mowing, prescribed fire, or disking may be used to prepare the site for herbicide treatment and improve chemical control.
- Use a foliar herbicide treatment during active growth before the grass exceeds the recommended

growth stages on herbicide specimen labels.

- Use a backpack sprayer or a vehicle-mounted sprayer equipped with a solid cone or flat fan nozzle. Spray down on the plant, covering and completely wetting the blades but not to the point of runoff.

When near water (See p.13, Section 2), use:

- 0.4 to 1% a.i. of an aquatic formulation of glyphosate plus nonionic surfactant in water.

When away from water,

- Sulfosulfuron is the preferred herbicide for johnsongrass. It selectively kills johnsongrass without significantly damaging native grasses such as big bluestem, little bluestem, bushy bluestem, sideoats gramma, buffalograss, indiagrass, lovegrass, and switchgrass.
 - Use 0.006% a.i. of sulfosulfuron (example: 6 drops of

Outrider per gallon)
plus nonionic
surfactant in water, **or**

- The above herbicide mixture for use near water, **or**
- A grass-specific herbicide such as
 - 0.14% a.i. of fluazifop plus crop oil concentrate or nonionic surfactant in water, **or**
 - 0.05 to 0.09% a.i. of clethodim (example: 0.44 to 0.85 oz. of

Envoy Plus per gallon)
plus nonionic
surfactant in water, **or**

- 0.18 to 0.27% a.i. of sethoxydim plus spray adjuvant or crop oil concentrate in water, **or**
- 0.5 to 2% a.i. of glyphosate in water.



General Control Procedures for Herbaceous Plants



Centaurea melitensis

Malta star thistle

Characteristic Features:

- winter annual
- spiny head
- yellow flowers
- grows up to 1 m tall
- alternate stem leaves
- stems are stiff and openly branched

Other Aliases:

- Tocalote



B. Byerley

Habitat:

- grows mostly in calcareous and disturbed soils
- often found near hay and horses

Identification

Malta star thistle is an erect winter annual with a spiny, yellow-flowered head that typically reaches 1 m tall. It is often confused with yellow star thistle, but does have its differences. Malta star thistle has much smaller and weaker spines around the base of the flower. The stems are stiff and openly branched from near or above the base or sometimes not branched in very small plants. Stem leaves are alternate, and mostly linear or narrowly oblong to oblanceolate. Margins can be smooth, toothed, or wavy, and leaf bases extend down the stems (decurent), giving the stems a winged appearance. Malta star thistle begins in a lobed rosette form but leaves typically are withered by flowering time. The flower of the plant forms at the end of the stem, is yellow, and is about 1/2 to 5/8 in. tall. Usually a flower can be found near the



K. Cook

bottom of the plant at the point of the lowest branch. Malta star thistle provides little to no value for livestock and wildlife, and the spiny flowerhead on Malta star thistle guarantees that recreationists will avoid infested areas.

Biology & Spread

Malta star thistle is insect-pollinated and reproduces by seeds that are spread via mowing. Seed production is highly variable. These plants can produce up to 60 seeds per head and up to 100 heads per individual plant, which are distributed by livestock, people, vehicles, etc. Its root structure is ineffective at protecting soil against erosion.

History:

Introduced during the 1700s from the Mediterranean basin, it is now a pest in most western states. Scattered populations also occur in the Midwest and Eastern United States.

**Ecological Threats**

Malta star thistle rapidly displaces native plant diversity with a pure stand of the weed. Native species can exhibit drought stress when starthistle infestations are extensive, even in years with normal rainfall, due to water competition. This perpetuates the invasion of the weed, and the area of the monoculture. When this occurs, range forage value is lost, as starthistle is low in palatability. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Management Strategies/ Control

A variety of methods ranging from biological, chemical, and mechanical should be used. An integrated weed management plan, including tactics to prevent the spread of star-thistle outside of infested areas, is recommended. For example, clothing, vehicles, mower decks and animals should be inspected and cleaned to remove any seeds before continuing on into un-infested areas. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. Avoid chemical control near water bodies when feasible; when warranted near water bodies, use chemicals formulated for aquatic use. Restoration is site specific. In general, the two basic steps are addressing soil damage and reintroducing appropriate native species. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected.

Weed Risk Assessment Summary

Centaurea melitensis

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	A	A	3.15

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Centaurea melitensis Malta star thistle

Introduction

A variety of methods are available for managing Malta star-thistle, ranging from biological, chemical, and mechanical. For this reason, an integrated weed management plan, including tactics to prevent the spread of yellow star-thistle outside of infested areas, is recommended. For example, when driving, walking, or moving livestock through infested areas, clothing, vehicles, and animals should be inspected and cleaned to remove any of the spiny seed heads before entering un-infested

areas. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Cultural

To reduce seed germination and plant establishment:

- Maintain dense and diverse native plant cover;
- Oversow with native grasses and forbs;
- Prevent soil disturbance;
- Mulch and/or revegetate disturbed soils;
- Clean seed and thatch from mowing equipment before transporting between sites.

Physical

- Mow or cut short with a line trimmer just before or during flowering to

remove the aboveground portions of the plant and to reduce seed set.

Repeat treatments may be needed throughout the growing season.

- Hand pull or grub anytime between the rosette and flowering stages to fully remove the root.

Chemical

Use a foliar herbicide treatment anytime between the rosette and flowering stages. Use a backpack sprayer equipped with a solid cone or flat fan nozzle. Spray down on the crown, covering the crown and

completely wetting the plant but not to the point of runoff.

When near water (See p.13, Section 2), use:

- 0.4 to 1% a.i. (active ingredient) of an aquatic formulation of glyphosate in water, **or**

When away from water, use:

- The above herbicide mixture for use near water, **or**
- 0.5 to 2% a.i. of glyphosate in water, **or**
- 0.08 to 0.16% of clopyralid in water



Colocasia esculenta

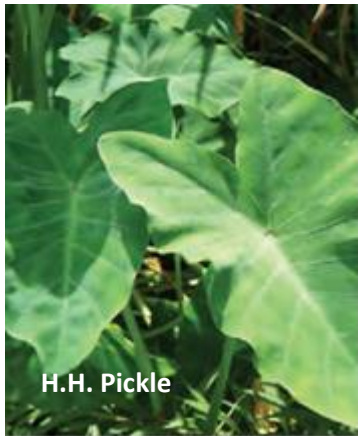
elephant ear

Characteristic Features:

- Perennial 1.5 m (4 ft) tall
- Dark green to purple ornamental leaves
- Leaves shaped like fat arrowhead or elephant's ear
- Tiny flowers on fleshy stalk

Other Aliases:

- *Colocasia antiquorum*
- wild taro
- coco yam
- Dasheen



H.H. Pickle

Habitat:

- North Carolina to Texas
- Rivers, lake shores, ditches, canals
- Needs soil that is moist to wet, mildly acidic, and rich in organic material

Identification

Perennial herb to 1.5m (4 ft) tall, with thick shoots from a large corm; slender stolons also often produced, along with offshoot corms. Leaf blades to 60 cm (24 in) long and 50 cm (20 in) wide, arrowhead shaped, with upper surface

dark green and velvety; leaves peltate (stalked from back of blade); petioles large, succulent, often purplish near top. Inflorescence on a fleshy

stalk shorter than leaf petioles;

part of fleshy stalk enveloped by a long yellow bract (spathe).

Flowers tiny, densely crowded on upper part of fleshy stalk, with female flowers below and male flowers above. Fruit a small berry, in clusters on the fleshy stalk.



C. Bryson

Biology & Spread

Elephant ear reproduces primarily vegetatively, via culm fragmentation and budding at the base of the plant. Rough, swollen underground stems called corms can float through bodies of water

and take root on shore. Outside its native range, elephant ear seldom produces flowers. Disturbance to the plant greatly encourages its spread.

History:

Introduced to the United States in 1910 as a substitute crop for potatoes. Later cultivated as an ornamental. Numerous varieties continue to be sold.



P. Coleman

Ecological Threats

Taro invades wetland areas and colonizes freshwater shorelines, forming dense growth. The huge leaves shade out existing vegetation and it out competes native species, thus altering natural habitat and ecosystem processes and reducing biodiversity. It

will form dense stands along lakes and rivers where it completely eliminates native species..



H. Pickle

Management Strategies/ Control

This aquatic species is treated using a combination of mechanical and chemical methods. When feasible, harvesting is the least toxic control methods. In mechanical removal, all care must be taken to keep the plant intact, as remaining fragments and corms will readily germinate. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, use

chemicals formulated for aquatic use.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

Weed Risk Assessment Summary

Colocasia esculenta

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Moderate	No	B	A	A	2.50

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Colocasia esculenta elephant ear

Introduction

This aquatic species is treated using a combination of mechanical and chemical methods. In mechanical removal, care must be taken to keep the plant intact, as remaining fragments and corms will readily propagate.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental

requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are

necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Physical - Use a shovel or grubbing tool to remove. When removing, care must be taken to keep plant intact and remove all fragments and corms to discourage spread. The site should be regularly visited for follow-up treatment of resprouts. This species produces sap when cut which stain clothing and can cause dermatologic irritation.

Chemical – In Central Texas, this species is typically found at or near the edge of permanent bodies of water, so chemical strategies are limited by general restrictions. 1% solutions of aquatic formulations of 2,4-D, triclopyr or glyphosate have provided effective control within 6 weeks of application. Repeated applications of glyphosate (2% solution) with a surfactant may be

effective, especially if coupled with other management strategies. Dr. Earl Chilton of TPWD reports success controlling *Colocasia* using :
5% imazamox + .25% Inlet (a nonionic surfactant) + .025 % Thoroughbred (nonionic organosilicone surfactant) applied with a handheld pump sprayer.



Cyrtomium falcatum

hollyfern

Characteristic Features:

- Evergreen in frost-free areas
- High heat tolerance
- Low water requirement
- Reproduces by spores

Other Aliases:

- *Polystichum falcatum* (L. f.)
Diels
- Japanese fern
- Taiwan fern



J. Hanz

Habitat:

- Prefers moist but well drained soil
- Does well in partial to full shade

Identification

Japanese hollyfern is an upright fern that forms a rounded mound up to 2 ft. (60 cm) high and 3 ft. (1 m) wide. It sports glossy, very dark green fronds on slender, arching stems. The individual pinnae are leathery, serrated with sharp points, and have a remarkable resemblance to holly leaves - thus the common

name. Spores, light green when young and dark at maturity, adhere to the backs of specialized

fronds. Japanese holly fern is evergreen in frost-free areas, but loses its fronds in colder climates. In the Austin area, it can be found growing on shaded limestone cliffs, rock faces, and openings of karst features, often in areas where chemical treatment is undesirable, and sometimes where physical access is difficult.



T. Pella

Biology & Spread

The source of this infestation is unknown but may be present in gardens in adjacent urban centers. Spores are dispersed by wind, on clothing or footwear.

There is no known length of time that the spores can last. The species appears to prefer damp and shady places, but does also grow in the open.

History:

Sold in the nursery and landscape trade, *Cyrtomium falcatum* is native to east Asia and has widely escaped from cultivation. Introduced to U.S. Found in the states of: AL, CA, CO, FL, GA, HI, LA, MS, NJ, NY, OH, OR, SC, TX , VA.



Ecological Threats

It has naturalized and displaces native plants along riparian areas, crevices, coastal cliffs, stream banks, rocky slopes, and other moist, stable areas.



Management Strategies/ Control

There is little to no information about Holly ferns invasiveness. This overall assessment should actually be rated as an "Unknown". And the City of Austin should monitor this species to better understand its impact. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, use

chemicals formulated for aquatic use. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

Weed Risk Assessment Summary

Cyrtomium falcatum

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
Low	No	B	C	A	1.14

Comments: Lack of information. Assessment based on local observations in C. Tx.

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Cyrtomium falcatum hollyfern

Introduction

There is little to no information about Holly ferns invasiveness. This overall assessment should actually be rated as an "Unknown". The City of Austin should monitor this species to better understand its impact. In the Austin area, it can be found growing on shaded limestone cliffs, rock faces, and openings of karst features, often in areas where chemical treatment is undesirable and sometimes where physical access is difficult.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When chemical control is warranted near water bodies, use chemicals formulated for aquatic use. See p.13, Section 2 for "near water" definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation. Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Physical

Hand-pulling and grubbing with hand tools are the preferred control methods for this species. In moist soils, roots are typically easily removed. Follow-up monitoring is needed to locate and remove new sporlings each growing season.

Chemical

For plants that cannot be physically removed or where hand-

pulling or grubbing has been unsuccessful, use a foliar herbicide treatment anytime during the growing season. Use a backpack sprayer equipped with a flat fan nozzle. Spray down on the crown, covering the crown and completely wetting the plant but not to the point of runoff.

When near water or karst features, use:

- 0.4 to 1% a.i. (active ingredient) of an aquatic formulation of glyphosate in water.
- When away from water, use:
- The above herbicide mixture for use near water, **or**
 - 0.5 to 2% a.i. of glyphosate in water.



Rapistrum rugosum

annual bastard cabbage

Characteristic Features:

- Annual herbaceous plant
- Grows up to 5 ft. in height
- Large taproot
- Small showy yellow flowers
- Unusual fruit, silique
- Two segmented seed capsule

Other Aliases:

- turnip weed
- giant mustard
- mustard weed



R. Thomas

Identification

Annual bastard cabbage is an annual, many-branched, herbaceous plant that grows from 1 to 5 feet in height and has a taproot that can become quite large. Leaves are deep green, lobed and wrinkled, and sometimes have a reddish cast. The terminal lobe is larger than the lateral lobes, especially on the basal leaves. Younger leaves growing higher up on the plant are less lobed and more elongated. Annual bastard cabbage typically flowers from early spring into summer, bearing clusters of small, showy yellow flowers resembling those of broccoli and cabbage at

the tips of its branches.. Annual bastard cabbage can be identified more easily by its unusually shaped fruit, which is a two-segmented seed capsule, called a silique. The seed capsule is stalked, with a long beak at the tip, and contains 1-2 seeds. The seeds are oval-shaped, dark brown, smooth and tiny (about 1/16-inch). Two subspecies of this plant are recognized: *R. rugosum* ssp. *Rugosum* and *R. rugosum* ssp. *orientale*.



L. Laszewski

Biology & Spread

Annual bastard cabbage seeds germinate early in the growing season and quickly cover the ground with a blanket of leafy rosettes (circles of leaves at

ground level). These dense rosettes block sunlight from reaching seeds and seedlings of native plants.

Habitat:

- Open sites
- Disturbed soils

History:

The introduction of annual bastard cabbage into the U.S. is uncertain. It appears to be spreading through contaminated grass seed mixes or mulching materials.



R. Thomas

Ecological Threats

Annual bastard cabbage is an early successional plant that develops a broad, robust mass of basal leaves, which allows it to successfully out-compete native plant species. In some places, it forms a monoculture (a vegetative cover of mostly one species). Annual bastard cabbage has long been established on

agricultural fields, roadsides, and disturbed lands and is becoming invasive in natural areas such as open forests and along streams.



K. McNew

Management Strategies/ Control

Manual removal of the plant and its taproot, and disposal of seeds, is effective, though labor-intensive. Timely mowing regime will help reduce the invasive seed bank. Over-sowing with native grasses and herbaceous groundcovers will help reestablish the competing native seed bank and can be effective in controlling annual bastard cabbage (Simmons, 2005). Due to its ability to attain resistance to several selective herbicides,

control that is exclusively through chemical methods may prove difficult. Research into effective herbicide control is on-going. Herbicide should not be applied when rainfall is expected as open forests and along streams. within 48 hours or when winds exceed 10 miles per hour. Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Weed Risk Assessment Summary

Rapistrum rugosum

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	B	A	2.92

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Rapistrum rugosum annual bastard cabbage

Introduction

This species is controlled using a combination of physical, chemical and mechanical methods.

Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour.

Follow departmental requirements for control near water bodies. In general, avoid chemical control near water bodies when feasible. When

chemical control is warranted near water bodies, ALWAYS use chemicals formulated for aquatic use. See p.13, Section 2 for “near water” definitions and information on water quality.

Restoration of soil and vegetation and follow-up monitoring, are necessary following treatment, especially when soil is left bare, to prevent re-infestation.

Restoration is site specific, but in general the two basic steps are addressing soil damage and reintroducing appropriate native species through seeding or replanting. If the area cannot be immediately reseeded or replanted, it should be mulched, or otherwise protected, to reduce soil erosion and further invasion.

General Control Procedures

Cultural

To reduce seed germination and plant establishment:

- Maintain dense and diverse native plant cover;
- Over-sow with native grasses and forbs;
- Prevent soil disturbance;
- Mulch and/or re-vegetate disturbed soils;
- Clean seed and thatch from mowing equipment before transporting between sites.

Physical

- Mow or cut short with a line trimmer just before or during flowering to

remove the aboveground portions of the plant and to reduce seed set.

Repeat treatments may be needed throughout the growing season.

- Hand pull or grub anytime between the rosette and flowering stages to fully remove the root.

Chemical

Use a foliar herbicide treatment anytime between the rosette and flowering stages. Use a backpack sprayer equipped with a solid cone or flat fan nozzle. Spray down on the crown, covering the crown and completely wetting the plant but not to the point of runoff.

When near water (See p.13, Section 2), use:

- 0.4 to 1% a.i. (active ingredient) of an aquatic formulation of glyphosate in water

When away from water, use:

- The above herbicide mixture for use near water, **or**
- 0.5 to 2% a.i. of glyphosate in water, **or**
- 0.08 to 0.16% of clopyralid in water



General Control Procedures for Aquatic Plants



Eichhornia crassipes

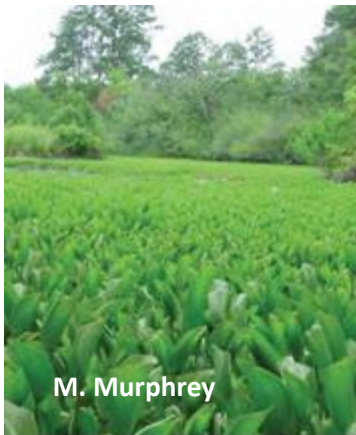
water hyacinth

Characteristic Features:

- large spike of 15-18 lavender flowers, up to 2 in. wide
- bulbous, spongy leafstalk
- thick leaves with dense veins, up to 6 in. wide
- grows up to 3 ft (1 m) high

Other Aliases:

- *Eichhornia speciosa*
- *Piaropus crassipes*



M. Murphrey

Habitat:

- Warm climate plant found across southern US
- Still, shallow waters with high nutrient content
- Grows in a wide variety of aquatic habitats

Identification

Water hyacinth is characterized by conspicuous and lavender, and spikes of lavender to pinkish blue flowers, in aquatic habitats. This floating plant has roots that are dark and feathery, only extending into the soil during flowering. The water hyacinth plant floats on and extends above the water due to enlarged-bulb-like petioles. Leaves of the hyacinth are thick, shiny, bright green, from 1-6 inches in width, contain dense veins, and are kidney-shaped or slightly concave. Flowers are



C. Jones

grow in groups of 8-15 atop a stalk reaching 16 inches. Typically flowers are 6-petaled, with the central lobe having a yellow oval-shaped spot bordered in blue. While rarely observed, fruit is a 3-celled capsule, containing many ribbed seeds, and can be found in a submerged, withered flower. While the water hyacinth can easily be confused with the frog's bit, the inflated, spongy stem

and individual white flowers are distinguishing characteristics that set the two plants apart.

Biology & Spread

Water hyacinth primarily reproduces vegetatively, via fragmentation and offshoots of the branching stems. It is also known to reproduce through seed production in favorable conditions, such as high temperature and high humidity. Peak flowering season occurs in late summer and early fall. Pieces of the plant are transported to

new places by wind, water, and at time accidentally on boats or other equipment.

History:

Water hyacinth is thought to be native to the Amazon River basin of South America. It was introduced to the United States in 1884 at the Cotton States Exposition in New Orleans, Louisiana. It spread across the southeastern U. S. and was identified in Florida in 1895. It was reported to be in California in 1904.



K. Kirkwood

Ecological Threats

Alteration of native vegetation and fish communities by lowering light penetration and dissolved oxygen levels is just one of the threats the water hyacinth imposes on ecosystems. Habitats for fish and other animals are disrupted by the plant, but it can cause an increase in insect population, such as mosquitoes.

It can impede boat traffic on rivers



N. Hirsch

and waterways and clog irrigation canals and intake pumps. The hyacinth grows at a phenomenal rate, known to double in size in less than 2 weeks.

Management Strategies/ Control

This aquatic species can be treated using a combination of mechanical and chemical methods. When feasible, plant harvesting machines/ choppers or complete drainage is necessary for large infestations and are the least toxic control methods. Small populations can be limited by hand pulling and careful raking with a pond rake, but seeds remain viable in the pond substrate, so ongoing

monitoring and control is necessary. For larger populations herbicide control can be effective but in a closed system or small pond can result in a sharp decrease in dissolved oxygen as dead plants sink and decay. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour. ALWAYS use chemicals formulated for aquatic use.

Weed Risk Assessment Summary

Eichhornia crassipes

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	A	A	3.3

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated,		D=None	1 = Anecdotal
not listed		U=Unknown	0 = No information



Eichhornia crassipes water hyacinth

Introduction

This floating aquatic species can be treated using a combination of biological, physical, mechanical and chemical methods. Any method of aquatic plant control in a public water body in Texas requires the submittal of an Aquatic Vegetation Treatment

Proposal to Texas Parks and Wildlife Department no less than 14 days prior to work. This process includes City of Austin review for herbicide proposals within City jurisdiction, and also requires additional notification per TPWD guidelines.

When chemical control is warranted in water bodies, ONLY aquatic formulations of herbicide can be used. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour.

General Control Procedures

Physical – Harvesting may manage small initial populations. Where possible, remove all of the plant parts from the water and dispose of properly. Consistent monitoring for several growing seasons is required to control new or missed plants. When feasible, plant harvesting machines/choppers or complete drainage is necessary for controlling large infestations. Small populations can be limited by hand pulling and careful raking with a pond rake, but seeds in lake substrate may provide years of re-growth

Drawdowns – Complete drainage is necessary for large infestations, but may be needed in smaller ponds, as lowering the water level sometimes only concentrates these floating plants in the remaining open water. Seeds can survive in the pond/lake sediments, providing re-growth for several seasons.

Chemical - For larger infestations, herbicides can be effective, but herbicide control in a closed system or small pond can result in a sharp decrease in dissolved oxygen as dead plants sink and

decay. As with other control methods, seeds survive in the substrate and germinate over time, requiring multiple control efforts for complete eradication.

Biocontrol - *M. scutellaris* is a small plant-hopper native to South America whose nymphs and adults feed on the sap of water hyacinth. Nymphs are active and readily hop, even off the surface of the water. The insect's population increases rapidly, which will enable it to quickly impact the water hyacinth population.



Hydrilla verticillata

hydrilla

Characteristic Features:

- Perennial submersed aquatic plant
- Tiny reddish brown flowers
- Toothed leaf margins and reddish veins
- Stems root as deep as 40 ft.
- Tip resembles bottlebrush

Other Aliases:

- Florida elodea
- water thyme
- Indian star vine



Habitat:

- Rooted on bottom of freshwater sources
- Lakes, rivers, reservoirs, ponds, ditches
- From Connecticut to the Gulf, and to the West Coast

Identification

Hydrilla verticillata is a rooted submersed aquatic plant that can be distinguished from related species *Elodea canadensis* and *Egeria densa* by the small spines along hydrilla's leaf midrib. Each of these species can create dense infestations, but only hydrilla is problematic in central Texas water bodies. Hydrilla typically grows in

depths from 3 m to 15 m depending on water clarity, and tends to form mono-specific stands that can cover hundreds of acres. Small reddish brown male flowers grow on stalks, but female flowers are white and translucent and float on the surface. Wind blows pollen from the male flowers to the female flowers.

Biology & Spread

Hydrilla commonly reproduces from fragmented stems which readily regrow, facilitating its spread between and within reservoirs. . New growth comes from turions (subterranean tubers) formed in leaf axils, which can survive dehydration, freezing and

ingestion/regurgitation by waterfowl. Hydrilla can grow up to 1 inch in a day and stems can reach 30 feet in length. Stems continue to grow after they reach the water surface, filling the entire water column with dense plant material.



History:

Hydrilla was first introduced into North America in the mid to late fifties by the aquarium trade. California officials have also traced Hydrilla infestations to shipments of mail order water lilies. Once introduced and established, hydrilla is easily spread through boating and fishing activities and by waterfowl.



L. Laszewski

Ecological Threats

Dense underwater stands of hydrilla cause wide fluctuations in water temperature, pH and dissolved oxygen. It



J. Ringer

limits the growth of native plants as its dense growth blocks sunlight from undergrowth competitors. Sport-fishing populations can be stunted as thick growth limits predator activity. While the number of fish may increase, large fish become rarer. Surface matting can collect trash and promote mosquito habitat. Dense

growth can limit recreational access, restrict water flow, clog intakes for both drinking water and power generation. Hydrilla causes hundreds of millions of dollars in economic damage nationwide, from both recreation losses and infrastructure maintenance and repair costs.

Management Strategies/ Control

This aquatic species is treated using a combination of mechanical and chemical methods. When feasible, harvesting and herbivorous fish such as sterile grass carp are the least toxic control methods. Follow departmental requirements for

control near water bodies. When chemical control is warranted near water bodies, use chemicals formulated for aquatic use. Herbicide should not be applied when rainfall is expected within 48 hours or when winds exceed 10 miles per hour.

Weed Risk Assessment Summary

Hydrilla verticillata

Rating	Alert	Impact	Invasiveness	Distribution	Doc.
High	No	A	A	A	3.38

Comments:

Rating	Alert	Scores	Documentation
1=High	Y=Yes	A=Severe	4 = Reviewed scientific publications
2=Moderate	N=No	B=Moderate	3 = Other published material
3=Limited		C=Limited	2 = Observational
4=Evaluated, not listed		D=None	1 = Anecdotal
		U=Unknown	0 = No information



Hydrilla verticillata hydrilla

Introduction

This submersed aquatic species can be treated using a combination of biological, mechanical and chemical methods. Any method of aquatic plant control in a public water body in Texas requires the submittal of an Aquatic Vegetation Treatment

Proposal to Texas Parks and Wildlife Department no less than 14 days prior to work. This process includes City of Austin review for herbicide proposals within City jurisdiction, and also requires additional notification per TPWD guidelines.

Harvesting and herbivorous fish such as sterile grass carp are the least toxic control methods. When chemical control is warranted in water bodies, ONLY aquatic formulations of herbicide can be used.

General Control Procedures

Physical – Harvesting by hand or small boat-mounted cutters may be used to manage small infestations. The density of growth typically requires significant labor and time, and complete control is usually not achieved because plants re-grow from the cut stems. Plant fragments as small as one whorl can potentially start a new infestation, so all plant material must be removed from the water and placed well away from the shoreline. Once out of the water, plant material will dehydrate and shrink in volume; it can be used in compost or as mulch if feasible. Specialized harvesters are also available, but slow removal rate and high cost of operation make this less appropriate for larger infestations. Up to six harvests per year are often necessary to maintain a clear surface due to hydrilla's rapid growth.

Drawdowns - When growing in bodies of water where water levels can be controlled, hydrilla in shallow water may be controlled by seasonal drawdowns. Drawdowns are most effective while the tubers are developing in the fall and before regrowth occurs in the spring. Tubers remain dormant and viable in the soil even after the lake or pond has been drained, so drawdowns are limited in effectiveness.

Chemical –As with any other control method, herbicide application requires the submittal of a Treatment Proposal to TPWD no less than 14 days (two weeks) prior to application, as well as notification of adjacent landowners and other interested lake users. If an herbicide treatment proposal is not denied by TPWD at the end of the two

week review period, a licensed applicator may proceed with the work. A non-licensed applicator must wait to hear from TPWD as to their review result, even if the two week review period has passed.

Fluridone is a selective, systemic herbicide but success depends on application rates, contact times, and timing of application. Application rates depend on site-specific factors such as infestation size, water depth and chemistry, and water flow rates. It is intended for use on whole ponds and large-scale infestations (greater than 2 ha). It has been used successfully with minimal long-term effects to native plants. Long contact times (30 days or more) and use restrictions (> ¼ mi from potable water intake for certain concentrations) limits its use in riverine reservoirs with

potable water intakes like Lake Austin. Fluridone doesn't impact isolated tubers (w/ 4-5 yr dormancy) so multiple treatments are often required.

Chelated copper formulations can be used in flowing systems (such as riverine reservoirs), but are contact herbicides and only kill the part of the plant they touch.

This means they act much like a harvester and provide no long-term control. Refer to manufacturer's label for specific information and restrictions regarding use.

Biocontrol Triploid grass carp are sterile plant-eating fish that prefer hydrilla but will eat a

variety of plants including native species, so overstocking can result in significant loss of non-target vegetation. The use of sterile grass carp requires a permit from Texas Parks and Wildlife Department, who also determines appropriate stocking rates based on water body characteristics and level of plant coverage.

Section 5

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