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Field Guide for Managing Giant Reed in the Southwest

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Cover Photos

Left: James H. Miller, USDA Forest Service, Bugwood.org

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Giant reed (*Arundo donax* L.)

Grass family (Poaceae), Arundineae tribe

Giant reed is an invasive grass common to riparian areas throughout the Southwest. It is listed on New Mexico's noxious weed list.

This field guide serves as the Forest Service's recommendations for management of giant reed in riparian areas and waterways associated with its Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also administers 4 national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Giant reed (synonyms: phragmites, carrizo, giant reed, arundo grass, donax, elephant grass, Spanish cane, wild cane, oboe cane) is a bamboo-like grass with stems that grow over 20 feet tall. It is an Asian native and was cultivated for thousands of years in southern Europe, northern Africa, and the Middle East. It was introduced into southern California for use as an ornamental and as an erosion control species along drainage ditches. From a distance, giant reed looks like a corn plant and is similar in appearance to common reed (*Phragmites australis* L.), a native grass found widely across the United States.

Growth Characteristics

- Introduced perennial grass, 20 to 30 feet tall.
- Root system consists of tough, fibrous, lateral rhizomes, and deep roots.
- Robust, hollow, stems up to 2 inches in diameter with knotty nodes.
- Pale green to blue-green alternate leaves; 1 to 2 inches wide and 1 to 2 feet long that grow at 180° angles from one another. Lower part of leaf is yellow and clasps the stem in a distinctive "S" wave.
- Flowers June through November, depending on location. Inflorescence is a dense, plume-like panicle, 1 to 2 feet long.
- Seed viability is very low, seedling establishment from germinated seed is quite rare. Primary reproduction is vegetative; sprouts from disturbed stems or rhizomes, even those buried 3 to 10 feet deep.

Ecology

Impacts/Threats

Giant reed forms dense monocultural stands and often crowds out native vegetation for soil moisture, nutrients, and space. When dry, it is highly flammable and becomes a fire danger in riparian habitats unaccustomed to sustaining fire. It uses far more water than native vegetation, thus disturbing the natural flood regime. One study showed giant reed to transpire 56,200 acre-feet of water over the course of a year, whereas native species only transpired 18,700 acre-feet. Giant reed provides limited shade along bank edges as compared to native willow or cottonwood, resulting in warmer stream temperatures and increased algae photosynthesis. Water quality in a waterway may be impacted when the nontoxic ammonium ion ($NH4^{+}$) from decaying reed materials is transformed into toxic ammonia (NH_3). There is a sharp decline in the number and variety of wildlife associated with dense giant reed stands. Giant reed also has high levels of chemical defense compounds in its stems and leaves that can inhibit other vegetation.

Site/Distribution

Giant reed is a common hydrophytic plant found along disturbed and undisturbed streambanks, desert springs, flood plains, drainages, and irrigation waterways. It thrives in moist soils (moderately saline or neutral), sand dunes, and wetland or riparian areas. Giant reed occurs with Russian olive and saltcedar in many southwestern riparian communities. It is usually limited to areas under 5,000 feet in elevation.

Spread

Giant reed can spread with or without flooding. Stem or root parts smaller than 2.5 inches in size have the potential

to re-sprout if a node is present. Grading and construction accelerate spread due to soil disturbance. Rhizomes buried 3 to 10 feet under soil will still produce surface shoots.

Invasive Features

Shoots and stems grow rapidly (as much as 4 inches per day during spring) outpacing native plant growth. Shallow parts of the root system along stream edges are susceptible to undercutting which contributes to bank collapse and spreading of reproductive parts downstream. Giant reed grows back quickly following fire, thereby increasing its dominance over native riparian species.

Management

Giant reed is not easily managed. Mechanical options for giant reed control have considerable limitations due to regeneration from root or stem fragments. In general, the most effective treatment to control giant reed is to spray a foliar systemic herbicide when plants are green and actively growing. Two insect species are currently being studied for eventual use as classical biocontrol agents.

Patches of giant reed growing in riparian areas often cross jurisdictional land boundaries. Successful management in these areas depends on close cooperation and coordination among affected parties. The following actions may be useful when different land ownerships are involved:

1. Consult with all interested landowners and land managers and conduct planning meetings for coordination purposes.
2. Acquire information that is helpful for planning and management purposes including a map database showing locations of giant reed infestations, land ownership, land use, hydrology, and potential project sites. Areas rich in native vegetation and biodiversity values (such as habitats of rare or endangered flora and fauna) should also be included.
3. Identify priority areas for treatment from acquired sources of information.
4. Establish site-specific goals and assess risks of various treatment options for priority areas.
5. Develop a site-specific action plan to meet goals and objectives for priority areas.

Table 1 summarizes management options for some common situations involving giant reed. Further details on these management options are explained below. Choice of control method for giant reed depends on the extent of infestation, site conditions, current land use, terrain, and accessibility. Other considerations include treatment effectiveness, cost, and the number of years needed to achieve control. More than one control method may be needed for each site.

Physical Control

Manual Methods

Hand removal is very difficult, but digging can be used for individual plants (usually < 6 feet tall). To improve handling, first cut the canopy near the surface by using a chain saw, machete, or pruning shears before pulling up remaining portions of reed stems, rhizomes, and roots. Shovels, mattocks, or pick-ax are the most commonly used tools. The root mass and associated rhizomes must be entirely removed from the soil. Rain-moistened loose soils are most conducive to hand-pulling. Uprooted material should be removed or burned onsite to prevent re-rooting. For recommendations on handling debris of giant reed, see table 2.

Mechanical Methods

Mechanical methods used to control giant reed range from individual plant treatment (digging up with hand tools, backhoes, etc.) to broad-scale clearing with hammer-flail mowers, root plows, rakes, etc. Broad-scale mechanical control usually causes major soil disturbance and interferes with native plant establishment. In some cases, other noxious weeds may invade cleared sites, which will require additional management. Mechanical control is usually more effective when combined with chemical control and planting and/or seeding of desired native species as follow-up. For recommendations on handling giant reed debris, see table 2.

If using machinery to manage giant reed, the equipment should be cleaned after use to prevent movement of root fragments or stems into un-infested areas.

Table 1. Management options*

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Dense, nearly pure stand of giant reed located along a waterway; goal is to suppress or provide high mortality.	Complete root removal is necessary for effective control but this is extremely difficult to accomplish using only physical methods. Mowing or burning followed later by spraying regrowth is usually the most practical approach.	Coordinate control efforts with other landowners.	Consider grazing with goats to suppress sprouting. A gall wasp (*Tetramesa romana*) and a scale insect *(Rhizaspidiotus donacis)* may become available as classical biocontrol agents (see "Biological Control" segment below).	Targeted broadcast or individual plant treatment (IPT) application with a herbicide approved for use in aquatic or riparian areas. Methods include cut-stump, ground foliar applications, and aerial application by helicopter.
Site with a uniform older dense stand of giant reed on accessible level terrain (< 30% slope) such as open areas on a flood plain.	Cut dormant top growth using a hammer-flail mower in fall-winter, followed by application of herbicide to re-sprouts the following year; and again in summer of the third year. Can also cut with a rotary brush cutter, chain saw, or tractor mounted mower.	Same as above.	Same as above.	Same as above.
Site is difficult to access and targeted control is needed. May also be used when giant reed is < 6 feet tall and protection of other resources (sensitive native plants, wildlife, endangered species, etc.) is necessary.	Remove localized populations with shovels or picks; cut top growth first to make root removal more manageable. Care should be taken to pull up rhizomes. Remove and properly dispose of all biomass from the site or burn piled material onsite. Most effective in rain-moistened loose soils. Anticipate re-sprouting and the need for follow-up spraying.	Same as above.	Same as above.	Use individual plant treatment (IPT) methods such as cut stump or direct foliage spraying with a hand-held or backpack sprayer.

* Choice of a particular management option must be in compliance with existing regulations for the land resource.

Excavating using a backhoe or excavator and grapple can be used to remove small, dense stands of giant reed. Pre-cutting is unnecessary since the long stems may be an aid to pull roots up. Excavating is not recommended in the streambed or along streambanks since root material may be washed downstream.

Mulching can be used on accessible sites that have less than 30 percent slope and do not have sensitive terrain. A hammer-flail mower attached to a tractor or a rotary brush-cutter is often used to cut top growth. Cut in late fall or winter and follow up with herbicide spraying the next season, and again in summer of the 3rd year.

Prescribed Fire

Prescribed fire as a single control method is not recommended for giant reed management. As a caution, wildfires in some areas have shifted riparian communities toward a monoculture of giant reed, which has resulted in a greater long-term fire hazard. However, broadcast burning to remove standing dried plants before or after herbicide spraying is a feasible option in certain situations.

Onsite burning is also an effective way to dispose of piled, previously cut or pulled rhizomes and stems.

Cultural Control

Education, collaboration, and coordination among landowners are necessary for monitoring and the labor-intensive efforts used to control giant reed. Managing native plants solely to increase competition with giant reed is likely to fail due to the invasive nature of this weed. Nurseries still stock giant reed as an ornamental, which can serve as a source of escaped stock in non-invaded areas if planted too close to waterways.

Biological Control

Grazing

Although giant reed is not very palatable to livestock, animals will graze young green shoots during the dry season. Angora or Spanish goats may be used to suppress re-sprouts after other treatments have been made.

Classical Biological Control

Two introduced insects, the arundo gall wasp (*Tetramesa romana*) and the arundo scale (*Rhizaspidiotus donacis*) were recently released in Arizona and Texas as biocontrol agents (see table 3). Larvae of the gall wasp create galls in primary and lateral shoots thereby reducing plant growth and development. Arundo scale attacks the rhizomes and developing underground buds of giant reed. Both of these insects may become available for biocontrol throughout the Southwest in the future.

Organisms (insects, pathogens, etc.) used as biocontrol agents in southwestern States should be adaptable to arid environments and local conditions. Public, tribal, and private land managers may obtain biocontrol agents for release directly from local offices of the USDA Animal and Plant Health Inspection Service (APHIS) when these agents are available. Other sources for biocontrol agents include locally developed insectaries or private companies.

A permit must be obtained from APHIS before biocontrol agents can be transported across State lines. Regulations and permit applications (PPQ 526 permit forms) pertaining to interstate shipment of biocontrol agents can be found at *https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/regulated-organism-and-soil-permits/sa_apply/ct_plantpest_howtoapply*. Although biocontrol agents may be collected and released internally in a given State without an APHIS permit, the State's department of agriculture or

Table 2. Debris management options

Debris Management Option	Associated Control Methods	Rationale/Recommendations	Special Considerations
Leave in place	Systemic herbicide spray; mulch-spray.	Cutting or removing sprayed plants before the herbicide has fully impacted the rhizome and roots may result in re-sprouting.	In some situations, sprayed plants left in place can create a fire hazard or impede flood control.
Burn onsite	All control methods	Broadcast burning before or after other planned mechanical or chemical treatments reduces standing biomass. Burning piled debris prevents potential re-sprouting.	Obtain required permits and alert local fire departments about activities. An air quality management district may have restrictions such as drying time before burn.
Mulching, chipping, or composting onsite	Use in combination with other methods such as cutting and later spraying.	Re-sprouting from debris is unlikely as long as plant parts are kept well away from wet situations; best used in remote areas.	Locate debris piles away from flowing water to prevent redistribution of plant parts. Debris is difficult to chip or mulch.
Remove debris	Manual methods, such as cut only or mechanical methods.	Plant parts will no longer be onsite to re-sprout; use choke-chain or rope to bundle debris or pile debris on a tarp to haul.	Labor intensive and finding a disposal company may be difficult because debris is hard to transport.

Table 3. Classical biocontrol agents for giant reed being studied in Arizona and Texas

Species	Type of Agent	Site of Attack/Impact	Use/Considerations for Release	Remarks
Tetramesa romana	gall wasp	Primary and lateral shoots resulting in shorter, thinner shoots compared to ungalled shoots; shoot mortality also observed	Impacts are subtle and take time to manifest.	Releases have been made in watersheds of the Verde River in Arizona and Rio Grande River in Texas; not readily available at this time.
Rhizaspidiotus donacis	armored scale	Causes lateral shoot deformities.	Still being developed.	Releases have been made in Rio Grande River watershed in Texas; not readily available at this time.

agricultural extension service should be consulted for any regulations relating to movement of these agents within the State.

Chemical Control

Herbicide application is effective for controlling giant reed, but 3 to 5 years of repeated management with herbicides will probably be necessary for complete, long-lasting control. Herbicides primarily used to control giant reed are imazapyr and/or glyphosate (table 4). These herbicides are nonselective so caution should be taken if non-target plants, including woody species, need to be protected. Both herbicides have labels approved for aquatic use that allow plants growing near the water's edge to be sprayed. When using aquatic formulations, an aquatically approved surfactant should be added to the spray mix. It is important to read the label carefully and follow all instructions and guidelines when mixing and applying either herbicide. Special permits may be necessary when treating near some public lakes or streams.

Herbicide Application

Herbicides may be applied to giant reed with a cut-stump method or a foliar application:

Cut stump treatment involves hand-cutting giant reed stems 2 to 4 inches above the ground surface and then applying a concentrated herbicide solution (50 to 75 percent glyphosate) to the cut stump surface. Apply herbicide immediately (within 1 to 3 minutes of cutting) using a paintbrush, sponge-tipped wand, hand-held spray bottle, or backpack sprayer. The lower ratio is used when applications are made with a backpack sprayer or hand-held spray bottle whereas the higher ratio is used when the solution is brushed directly onto the cut stump. A nonionic surfactant (0.5 percent by volume) and a blue indicator dye should be added to the spray mixture.

A cut-stump treatment with herbicide may be used from October through December. Timing for cut stump treatments is not as sensitive as other methods; however, late fall application is optimal due to high translocation rates. Avoid treating when the plant is dormant. Cut debris should be appropriately disposed of to prevent re-rooting (see table 2). The short window of time required between stem cutting and herbicide application adds to the difficulty in successful use of this method.

Foliar treatment of giant reed includes application by helicopter or fixed wing aircraft, truck and ATV-mounted sprayers, towed sprayers, and backpack or hand-held sprayers. Any equipment used to spray herbicide should be calibrated. Choice of method for spraying giant reed is usually dictated by site and growing conditions. For foliar applications, actively growing plants that are in full to late flower should be targeted. This timing ensures that the maximum amount of herbicide will be moved through the upper portions of the plant to the root system. In the Southwest, the optimal time for spraying is generally from August to late November.

IPT foliar spraying is best used to treat shorter giant reed plants (< 6 feet in height). A hand-held, pump-up or backpack sprayer is practical for low growing plants. When mixing the spray solution, add a 0.5 percent by volume nonionic surfactant and an indicator blue spray dye to easily see coverage on the foliage. Wet the entire canopy without allowing dripping to occur. Consider

Table 4. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example[1]	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution)[2]	Time of Application	Remarks
Glyphosate	Rodeo, Roundup, Accord, and many other products are available. Read the label carefully (products may have either 2 or 4 pounds active ingredient (a.i.) per gallon depending on manufacturer)	0.5–1 pint (using a product with 2 pounds a.i. per gallon)	2–5% + 0.25% nonionic surfactant	Healthy green plants in flower but before dormancy (August to late October).	Rodeo is approved by EPA for use in wetland and riparian areas. Nonselective amino acid inhibitor in glyphosate will kill desirable vegetation. Glyphosate causes new growth to yellow, and death will occur within 2 to 3 weeks.
Imazapyr	Habitat, Arsenal, and other available products	1–2 quarts	1–3% + 0.25% nonionic surfactant	Same as above.	This herbicide causes new growth to die slowly and results may not be observed until the next season. Habitat is approved by EPA for use in wetland and riparian areas. Imazapyr is a nonselective herbicide that will kill desirable vegetation. In addition to spray drift, non-target plants may be killed or injured by imazapyr through runoff, residue movement in soil, or root exudates from treated plants.
Glyphosate + imazapyr	Rodeo + Habitat	Tank mix 1 quart Rodeo with 1 quart Habitat	1% + 1% mixed with 0.25% nonionic surfactant	Same as above.	Effective individual plant treatment or ground application. Spray to wet the entire canopy and foliage. Injury or death for non-target plants may occur from overspray of both active ingredients and by (1) movement of imazapyr in soil or (2) imazapyr contained in root exudates.

[1] Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with giant reed.

[2] Spray solution is the herbicide/water ratio in a spray mix that may be used for spot treatment with backpack or hand-held sprayers. The amount of product applied during an annual growing season must not exceed the maximum application rate per acre as specified by the product label – refer to the product label for the site type and application.

covering non-target vegetation with a tarp or cutting down nearby native plants that will grow back (such as willow) before applying herbicide. Do not spray during high winds or before anticipated rainfall as these conditions reduce the effectiveness of foliar application methods. Unless the canopy growth creates a fire or flood hazard, consider leaving the sprayed stems in place to insure complete herbicide activity.

Helicopter spraying is particularly useful for areas with very dense populations of giant reed, such as stands with more than 80 percent cover that are difficult to access with ground application methods. A helicopter is the preferred method for application since it is able to spray difficult, "tight" areas that require precision application, such as the edge of a meandering river or marsh. However, aerial application may not be suitable for areas with powerlines, high-use roads, or areas with desirable trees and other flora.

Integrated Control Methods

The following combinations of control methods should be considered for managing giant reed:

Cut–regrow–spray is often used in areas where giant reed is mature and overgrown with little space between canes. Cut stalks using a brush cutter, chain saw, or loppers early in the growth season. Remove debris (see table 2). Wait 3 to 6 weeks or until plants grow to a height of about 3 feet, then apply Rodeo® as a 2 to 5 percent foliar spray solution. Spray healthy green plants. Benefits of this method include a reduction in herbicide usage and plants that are of uniform height when sprayed. Follow-up monitoring and spraying regrowth should be anticipated the next growing season.

Mulch–excavate–spray is useful for treating highly dense stands of giant reed. A hammer-flail mower attached to a tractor or a rotary brush cutter can be used on canes in the fall (October to November). A track-mounted excavator is used after mulching to remove roots and stack debris (see table 2). Follow-up herbicide treatment is the same as the **cut–regrow–spray** treatment sequence described above. It is highly recommended that the site be monitored and spot treated for re-sprouting plants for 3 to 5 years after the initial treatment.

Management Strategies

Controlling giant reed is difficult, and complete eradication may be unrealistic under many situations. Therefore, primary objectives for managing giant reed are often focused on suppression of existing infestations and reducing giant reed spread through maintenance of healthy plant communities. When implementing giant reed control, consideration should be given to the following:

- Address giant reed populations near waterways and wherever the likelihood is high for plant parts to be spread via flowing water. Then address populations that would only be affected by high water or by 100-year-flood events. When possible, begin treatment of giant reed at the uppermost parts of waterways and work downstream from there.
- Choose a control approach that is most likely to complement future restoration efforts. Remove giant reed from high quality areas first. These areas are likely to respond favorably to restoration. Then work on controlling dense, accessible stands that are most easily managed.

Without special planning and care, invasive plants other than giant reed may rapidly invade treated areas. Before treating giant reed, always evaluate how the plant community is likely to respond once the grass is removed. A contingency plan should be in place to monitor and treat invasive weeds after treatment. In many instances, treated areas will naturally return back to the desired riparian community without revegetation. However, artificial plantings or seeding may be necessary for complete restoration in other situations.

It should be anticipated that consecutive years of field treatments will be necessary to substantially reduce

giant reed. Control efforts will likely require 3 to 5 years of persistent, repeated treatment. Since it is ordinarily useless to treat an area only one time without re-treatment, sufficient resources must be allocated for the area where control is attempted. After initial treatment, it is especially important that resources are also available to respray or retreat the treated area successfully. Previously treated areas should always be continuously monitored and retreated when necessary to control recovering giant reed. Failure to perform follow-up management may result in a return of the infestation.

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http://www.fs.usda.gov/goto/r3/invasivespecies