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Field Guide for Managing Giant Reed in the Southwest

Forest Service

Southwestern Region

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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. This field guide serves as the U.S. 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 includes four 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 as an ornamental, and was used 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.
- Primary reproduction is vegetative; sprouts from disturbed stems or rhizomes, even those buried 3 to 10 feet deep.
- 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, has fine hairs, 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, and seedling establishment from germinated seed is quite rare.

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 nontoxic ammonium ($NH4^{+}$) 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, which is likely due to lack of food and acceptable cover. Giant reed also has high levels of chemical defense compounds in its stems and leaves that can inhibit other vegetation.

Location

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 freshwater), on sand dunes, and in wetland or riparian areas. It occurs with saltcedar and Russian olive in many southwestern riparian communities. It is usually limited to areas under 5,000 feet in elevation.

Spread

Giant reed spreads with or without flooding. Stem or root parts smaller than 2.5 inches in size have the potential to resprout if a node is present. Grading and construction

accelerates spread due to soil disturbance. Rhizomes buried 3 to 10 feet under soil will 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 control options for giant reed are limited, and there are no classical biological control agents (insects, pathogens, etc.) currently available. In general, the most effective treatment to control giant reed is to spray a foliar systemic herbicide when plants are green and actively growing. Table 1 summarizes management options for some common situations involving giant reed. Control efforts will usually require 3 to 5 years of persistent, repeated treatment.

When implementing giant reed control, priority should be given to the following:

- Choose a control approach that is most likely to complement future restoration efforts.
- 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.
- Remove giant reed from high quality areas first. These areas are likely to respond favorably to restoration activities. Then work toward controlling dense, accessible stands that are most easily managed.

Without special planning and care, treated areas may rapidly be invaded by other invasive plants. 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 return naturally to the desirable riparian community without revegetation. However, artificial plantings or seeding may be necessary for complete restoration in other situations.

Physical Control

Manual Methods

Hand removal is very difficult, but digging can be used to target 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 the 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. Loose, rain-moistened soils are most conducive to hand pulling. Uprooted material should be removed or burned onsite to prevent rerooting. For recommendations on handling giant reed debris, see table 2.

Mechanical Methods

Mechanical methods used to remove giant reed range in scale from individual plant treatment (digging out with a hand tool, backhoe, excavator, etc.) to broad scale clearing with hammer-flail mowers, root plows, rakes, etc. Mechanical control of areas with giant reed is usually more effective when used in combination with chemical control and the planting and/or seeding of desired native species as followup. Large-scale mechanical control usually causes major soil disturbance and interferes with native plant establishment. In some cases, there may be an increase invasion from other noxious weeds on cleared sites that will require additional later management. For recommendations on handling giant reed debris, see table 2.

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

Table 1. Management options*

Site	Physical Methods	Cultural Methods	Biological Methods	Chemical Methods
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 scale insect *(Rhizaspidiotus donacis)* may be available as a biological control agent in the future (see "Biological Control" section).	Targeted broadcast or individual plant treatment (IPT) application with a lethal herbicide approved for use in aquatic or riparian areas. Methods include foliar application; cut–resprout–spray and cut-stump; 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 resprouts 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 loose, rain-moistened soils. Anticipate resprouting and the need for followup spraying.	Same as above.	Same as above.	Use individual plant treatment (IPT) methods, such as the cut stump or direct foliage spray with a hand-held or backpack sprayer.

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

Mulching can be used on accessible sites that are not complex, 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, wildfire in some areas has 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 select situations. Onsite burning is also an effective way to dispose of piled cut or pulled rhizomes and stems.

Cultural Control

Education, collaboration, and coordination with landowners, volunteer work groups, and monitoring are important

components in the labor-intensive efforts 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, if planted too close to waterways, can serve as a source of escaped stock in noninvaded areas.

Biological Control

Grazing

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

Classical Biological Control

No classical biological control agents are currently approved for use on giant reed. Native invertebrates do not appear interested in giant reed although invertebrates do feed upon it in Eurasia and Africa. Arundo scale (*Rhizaspidiotus donacis*) is an insect that attacks the rhizomes and developing underground buds of giant reed within its native range. The insect is anticipated to become available in the United States as a biological control agent sometime in the future.

Chemical Control

Herbicide application is effective for controlling giant reed, but experience has shown that 3 to 5 years of repeated management with herbicides will probably be necessary for complete, long-lasting control. The primary herbicides used on giant reed are imazapyr and/or glyphosate. Mixture rates for both of these herbicides are given in table 3. These herbicides are nonselective so caution should be taken if nontarget 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. 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.

Herbicides may be applied to giant reed by a cut-stump method or by foliar application. A cut-stump treatment with herbicide may be used from October through December.

Table 2. Debris management options

Debris Management Option	Associated Control Method	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 resprouting.	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 resprouting.	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.	Resprouting 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 resprout; 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.

For foliar applications, actively growing plants that are in full to late flower should be targeted when spraying. 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. Many different application methods may be employed for treatment of giant reed including aerial application by helicopter or fixed wing aircraft, truck and ATV-mounted sprayers, towed sprayers, backpack sprayers, and hand sprayers. Choice of method for spraying giant reed is usually dictated by site and growing conditions.

Herbicide Control Methods

IPT 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 low volume 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. 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 rerooting (see table 2). The short window of time required between cutting and herbicide application adds to the difficulty in successful use of this method.

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 covering nontarget vegetation with a tarp or cutting down nearby native plants that will grow back (such as willow) before applying herbicide. Do not spray under 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 on 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 "tight," difficult areas that require precision application, such as the edge of a meandering river or marsh. Aerial application may not be suitable for areas with powerlines, high-use roads, or areas with desirable trees and other flora.

Control Strategies

Control of giant reed is difficult, and complete eradication may be unrealistic under many situations. Although a high percentage of plants can be controlled, complete elimination is rare. Instead, 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. The following combined methods for treatment of giant reed may be considered for meeting these objectives:

- **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. Followup monitoring

Table 3. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example[1]	Product Example Rate per Acre (broadcast)	Backpack Sprayer Treatment Using Product Example[2]	Time of Application	Remarks
Glyphosate	Rodeo, Roundup, Accord, and many other available products. 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% solution with 0.25% nonionic surfactant	Green healthy 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% solution with 0.25% nonionic surfactant	Same as above.	Habitat is approved by EPA for use in wetland and riparian areas. Imazapyr is a nonselective herbicide that will kill desirable vegetation. This herbicide causes new growth to die slowly and results may not be observed until the next season. In addition to overspray, death or injury for nontarget plants may occur from root transfer of imazapyr between intertwined root systems.
Glyphosate + imazapyr	Rodeo + Habitat	Tank mix 1 quart Rodeo with 1 quart Habitat	1% + 1% mixed solution 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 nontarget plants may occur from overspray of both active ingredients and by root transfer of imazapyr between intertwined root systems.

[1] Product names are provided fro 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] Herbicide/water ratio - As an example, a 3 percent mixture of a gallon of spray water is made by adding a sufficient volume of water to 4 ounces of liquid herbicide until a volume of 1 gallon is reached (4 oz - 128 oz/gal = 0.03 or 3 percent).

and spraying regrowth should be anticipated the next growing season.

- **Mulch–excavate–spray** is a useful approach for treating a high density stand of giant reed. A hammer-flail mower attached to a tractor or a rotary brush cutter can be used to mulch canes in the fall (October to November). A track-mounted excavator is used after mulching to remove roots and stack debris (see table 2). Followup herbicide treatment is the same as the cut–regrow–spray method above. It is highly recommended to monitor for and spot treat resprouting plants for 3 to 5 years after the initial treatment.

Giant reed growing within riparian corridors often crosses jurisdictional land boundaries. Successful management in these areas depends on close cooperation and coordination among affected parties. When considering control strategies that will involve different land ownerships, the following actions may be useful:

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.

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