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Production of Giant Reed for Biofuel[1]

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Introduction

Giant reed (*Arundo donax)* is currently being evaluated as a potential biomass energy (bioenergy) crop in Florida, even though some scientists and those in other states (California, Texas) consider it to be a noxious or invasive weed.

This publication will discuss the adaptation and production of giant reed as a potential energy crop and will also present measures for controlling giant reed as an escaped weed. The publication is for information purposes only and is not meant to give specific recommendations on whether it is better to control giant reed or produce it for biofuel.

Current Potential for Use as Biofuel

Giant reed is a tall-growing perennial grass species found throughout the southern two-thirds of the United States and is prevalent in wetter areas of Florida, particularly in South Florida (Figure 1). It exhibits traits ideal for bioenergy crops including rapid growth, high productivity, low input requirements, and resistance to biotic and abiotic stresses.

Giant reed has potential as a bioenergy feedstock for several conversion processes. Dried giant reed has an estimated direct combustion High Heating Value (HHV) of approximately 8,000 BTUs/lb. Drying such large amounts of biomass may be difficult, thus lower actual energy values in power plants will be realized. Giant reed is also being considered as a candidate for gasification and cellulosic ethanol conversion.

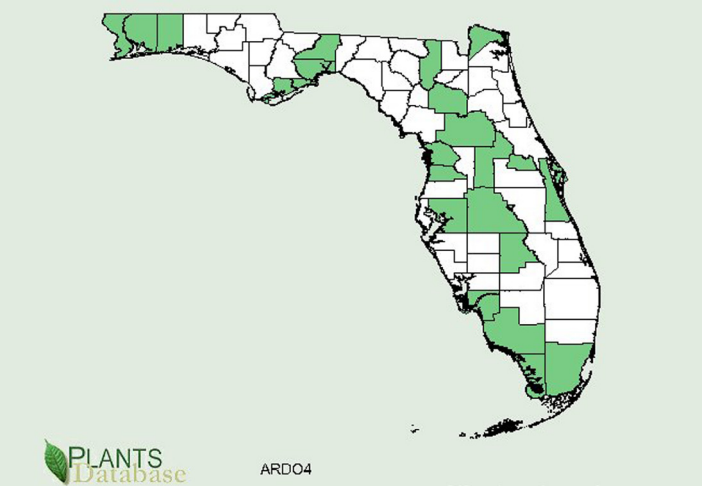

Figure 1. Occurrence of *Arundo* spp. in Florida.

Credits: USDA/NRCS Plants Database

Biology of Giant Reed

Giant reed (also known as Italian reed, Spanish cane, bamboo reed, wild cane, or giant cane) is a perennial clump-forming rhizomatous C3 grass that can grow from 5

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to 20 feet tall (Figure 2). The leaves can be 1–2 feet long and 1–2 inches wide at the base. The leaves appear alternate on the stem and point straight out. Stems are 1/2 to 1+ inches in diameter and are hollow, resembling bamboo. The roots are tough and fibrous, and along with extensive rhizomes, form knotty, spreading mats that penetrate deep into the soil. The flower heads are borne in large (1–2 foot) plume-like terminal panicles. However, neither pollen nor seed production has been documented in North America. Thus, giant reed is primarily vegetatively propagated by rhizomes or viable nodes of mature cane in North America. Nodes from immature cane do not propagate easily.

Giant reed is native to the Mediterranean area east through India and other subtropical environments. In the United States, giant reed has been reported to grow from California through the southern states to the eastern coast and as far north as Maryland. While giant reed prefers well-drained soils where abundant moisture is available, the plant has also been observed to grow well where water tables are close to or at the soil surface. Individual plants can tolerate excessive salinity. Giant reed can survive very low temperatures when dormant, but it is subject to serious frost damage after the start of spring growth or while it is still a seedling.

Giant reed is grown commercially in southern Europe where it is harvested, cured, and used to make musical woodwind instruments. In the United States, some biotypes have been grown as ornamentals for the landscape industry.

Production

Although giant reed grows widely throughout the southern states and subtropics, little is known about its biology and cultural practices for commercial cultivation. The following establishment and management practices should be considered if giant reed is grown for biomass energy, soil stabilization, or pasture.

Giant reed is often established vegetatively, utilizing rhizome or stem pieces from locally grown biotypes; this is because there are few, if any, commercially available cultivars in the United States and also giant reed seed is not viable. Commercial production of plantlets through micro-propagation of embryogenic callus has also become available. Large rhizomes with well-developed buds can be transplanted directly into furrows 8–10 inches deep in the early spring after the threat of frost. Mature stem cuttings or whole stems with two or more nodes can also be planted 4–6 inches deep. Row spacings of 36- to 40-inch centers, with a final population of 4,000–8,000 initial plants/A is

Figure 2. Giant reed with flower heads

Credits: D. C. Odero

adequate for complete coverage within one year. Sufficient moisture is needed after planting in the first year to assure a good stand that can last for many years.

Although giant reed is noted for not requiring significant amounts of fertilizer nutrients, soil tests should be taken prior to establishment, and nutrients applied similar to those used on corn silage. Approximately 60 lbs/A of N should be applied after each cutting and is especially beneficial on soils with low organic matter. Soil tests should be followed for P and K since large amounts of these nutrients will be removed if high tonnage is produced.

Giant reed has few known diseases or insect pests. However, as cultivation becomes extensive, scouting should be conducted on fields. No herbicides are currently labeled for controlling weeds in giant reed, but cultivation may suffice in early stages until plants are well established.

Giant reed can likely be harvested every 7–12 months. However, earlier repeated clipping will not sustain high growth rates, and total production will decline. In South Florida, plantings in late December into February are ready for harvest by late August to October once heading has occurred.

Potential Yields

Yields of giant reed can vary widely depending on available moisture, stand density, and period of growth. Initial trials on muck soils at the UF/IFAS Everglades Research and Education Center (EREC) in Belle Glade have produced green weights (50%–60% moisture) ranging from 20 to more than 40 T/A on an annualized basis when harvesting from 7 to 12 or more months of growth. In a subsequent trial conducted from 2008 to 2010 on marginal sandy soils

in South Florida where production is proposed, giant reed fresh and dry biomass yields were 4.5 and 2.4 T/A, respectively. The lower biomass yield reported in South Florida was attributed to poor stands that resulted from propagating giant reed from stem cuttings rather than rhizomes. But as reported elsewhere, yields may increase once stands of giant reed are well established. In addition, giant reed recorded low moisture and higher lignin concentration, which makes it more appropriate for thermal conversion.

Production Challenges

Many producers of other agronomic crops may be more interested in the control of giant reed in their production fields rather than the lack of developed varieties or knowledge about best management practices. However, there are no labeled herbicides for control of giant reed in row crops such as sugarcane, so any chemical control practices will have to be conducted during a fallow period when total vegetative control measures can be used. Herbicides such as glyphosate (in the form of labeled formulations in wetland areas) have proved effective when applied immediately (within 5 minutes) to cut stubble following removal of top growth. Additionally, spot spraying with glyphosate (5% solution) or imazapyr (1% solution) will also likely be effective.

Giant reed has been reported as having a high invasive potential in Florida where cultivation is proposed. Because giant reed is being introduced as a bioenergy crop and has the potential to escape and invade sugarcane crops, we tested for its management in sugarcane using sugarcane grass herbicides asulam (Asulox®) and trifloxysulfuron (Envoke®) in trials conducted at EREC. In these trials, asulam and trifloxysulfuron applied at the sugarcane labeled use rate of 6–8 pt/A and 0.3 oz/A did not control giant reed. In addition, application of these herbicides at twice the sugarcane labeled use rate was ineffective in providing control. The results from these trials indicated that containing giant reed escapes in sugarcane would not be possible with currently available herbicide options. Culturally, giant reed has been reported to be greatly suppressed by repeated close mowing (mowed biomass should be removed from the site) or grazed by sheep or goats. Further details concerning control of giant reed is available in the EDIS publication SS-AGR-301, *Giant Reed* (*Arundo donax*): *Biology, Identification and Management* (available at http://edis.ifas.ufl.edu/ag307).

Estimated Productions Costs

Because giant reed has not been a commercially grown species, there are no established production costs. It is reasonable to believe that costs of establishment and harvest will be similar to costs for sugarcane, but costs of water, fertilizer, and pesticide should be lower than those for sugarcane.

Enviromental Concerns

There is important concern about giant reed's potential as an invasive or problematic weed. On the cultivation side, giant reed, unlike some cultured crops, does not require large amounts of pesticides or fertilizers. However, repeated cuttings of any high-yield crop will remove high rates of N, P, and K nutrients.

Summary

While little is known of the culture of giant reed, and there is guarded concern about its invasive potential, the species has demonstrated the ability to produce large amounts of biomass with moderate inputs. Its energy potential is similar to other perennial grass species on a per-unit weight basis.

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