

Production of *Miscanthus x giganteus* for Biofuel¹

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Introduction

Miscanthus is a genus of tall perennial grass species native to parts of Asia, Polynesia, and Africa. It is currently grown as an ornamental in North America, including Florida. *Miscanthus* has received attention as a biofuel crop because it has relatively high dry matter yields across a range of environmental and soil conditions. The *Miscanthus* genotype most commonly recommended for biofuel production is a sterile hybrid (*Miscanthus x giganteus*) believed to be a *M. sacchariflorus* x *M. sinensis* hybrid. *Miscanthus x giganteus* probably originated in Japan and was brought to Europe in 1935. It subsequently spread throughout Europe and more recently North America.

Current Potential for Use as Biofuel

The bioenergy industry has primarily used *Miscanthus* for combustion in power plants. It has desirable properties of low water and ash contents following a dry-down period before harvest. Current research is focused on its potential as a biomass crop for direct combustion and for lignocellulosic conversion to ethanol and other biofuels.

Biology of *Miscanthus x giganteus*

Miscanthus x giganteus is an erect, warm-season grass that has a C4 photosynthetic pathway. It is a very cold-tolerant grass that will develop leaves at temperatures below 50°F,

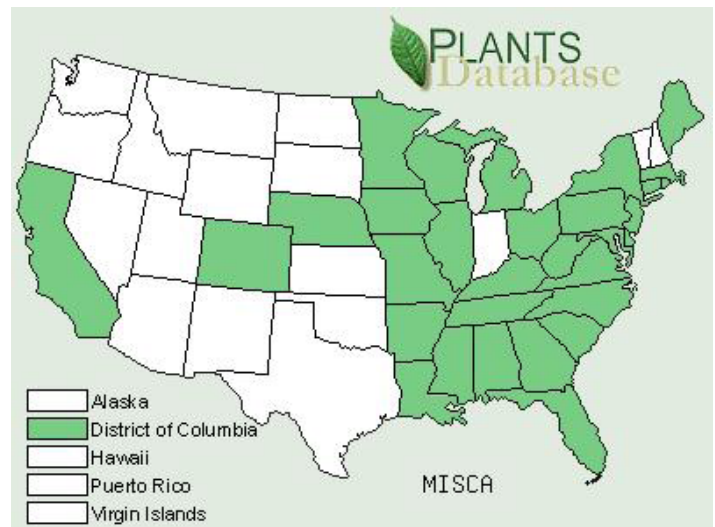


Figure 1. Occurrence of *Miscanthus* spp. in the United States. Credits: USDA Plants Database

and its root system has survived winters with temperatures below -10°F. As a sterile hybrid that produces no seed, it must be propagated vegetatively. *Miscanthus x giganteus* is a short-day plant, meaning that its growth and development are sensitive to day length. Thus, it will flower in fewer days in the southern United States than in the northern United States and typically will be shorter in stature. The general appearance of the plant is that of a loose bunchgrass, but it will spread slowly via short rhizomes (horizontal underground stems) that can form dense stands. Stems are 5–12 feet tall with very deep roots.

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Production

Miscanthus x giganteus is generally established vegetatively from rhizome pieces, resulting in high establishment costs. Recent research has indicated that it may be propagated vegetatively from stem cuttings. Presently, no commercially available mechanical planters can be found in the United States, but potato or similar planters have been modified for planting *Miscanthus x giganteus* rhizomes. Rhizomes should be planted approximately 2–4 inches deep, 3 feet apart within rows, and 3 feet between rows (approximately 4,840 rhizomes per acre).

Weed control is critical for rapid establishment. Fertilization during establishment is not recommended because it only encourages weed growth. Maintenance fertilization (approximately 50–75 pounds of N per acre per year based on some European studies) is required after establishment. Crops can be harvested two years after planting. Maximum yields should be obtained on ratoon crops within 3 years on fertile sites. It has a lengthy stand life, but replanting may be necessary after 5–15 years. It requires about 25 inches of water per year to survive (but more to be highly productive), tolerates brackish water, and uses a minimal amount of nutrients from the soil. *Miscanthus x giganteus* can be harvested following maturity and dry-down in the fall, and regrowth can occur in the spring with a modified forage harvester or a sugarcane harvester.

Potential Yields

Miscanthus x giganteus has shown relatively high dry matter yields of 5–15 tons per acre in non-irrigated studies at high latitudes after stand development (2–4 years). Yields were limited on shallow, droughty, or waterlogged soils. In the Midwest, it has been shown to produce 3–4 times the yield of ‘Cave in Rock’ switchgrass across a range of soil and environmental conditions. UF/IFAS researchers found that *Miscanthus x giganteus* was not well adapted for Florida, and biomass yield potentials for Florida were relatively low. Annual yields at three sites across Florida for two years following establishment were in the range of 4–8 dry tons per acre. *Miscanthus x giganteus* does not appear to be well adapted to photoperiods and temperatures in Florida. UF/IFAS researchers observed flowering in July, and limited growth and early senescence were seen after flowering (see Figure 2).

Production Challenges

In Florida, less is currently known about *Miscanthus x giganteus* production compared to other potential biofuel crops such as sugarcane, sweet sorghum, and elephantgrass,



Figure 2. Stands of *Miscanthus x giganteus* reach maturity in July (top) in Florida, and continued growth is limited through November (bottom).

Credits: John Erickson

which have been more widely studied for biomass and agricultural production. An advantage of *Miscanthus x giganteus* in North Florida is its relative cold tolerance compared to other warm-season grasses. However, plants are difficult and slow to establish because it must be done vegetatively from expensive rhizomes. The production and use of plantlets as well as other seeded *Miscanthus* genotypes are being developed and evaluated. At present, there is no market in Florida or the United States for *Miscanthus x giganteus*. However, markets will grow as biomass combustion plants are developed and the lignocellulosic conversion to ethanol process advances and becomes more economically competitive.

Estimated Production Costs

Miscanthus x giganteus has not been commercially produced in Florida, so production costs are not well known. Costs are expected to be similar to other vegetatively propagated perennial grasses.

Environmental Concerns

Total water use can be relatively high because of high overall biomass production, but *Miscanthus* is relatively

efficient with water use for a warm-season perennial grass. As with other perennial grasses, *Miscanthus* has been shown to increase soil carbon. *Miscanthus x giganteus* is not native to the United States, but it was assessed as not a problem species using the IFAS Assessment of Non-Native Plants in Florida's Natural Areas (IFAS Invasive Plant Working Group 2009).

Summary

More research is needed on *Miscanthus x giganteus* production in the United States and Florida, but it appears to be better adapted to higher latitudes and is not as well adapted for the lower Southeast. At present, other perennial grasses offer greater yield potential and are better adapted for the region. Ongoing breeding efforts may soon have varieties of *Miscanthus* better adapted for the southeastern United States.

Additional Information

- *Miscanthus* – A Review of European Experience with a Novel Energy Crop: <http://www.p2pays.org/ref/17/16283.pdf>
- *Miscanthus* at the University of Illinois: <http://miscanthus.illinois.edu/>
- Plants Profile – *Miscanthus*: <http://plants.usda.gov>

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