NEWBio Energy Crop Profile: Giant Miscanthus

The genus *Miscanthus* comprises twelve perennial grass species native to Asia. A close relative of sugarcane, this tall reed, or cane-like plant, was introduced to the United States as an ornamental plant in the nineteenth century. Recognizing its growth potential and ability to withstand cold conditions and poor soils, it has become widely known for biomass production. Giant miscanthus (*Miscanthus x giganteus*), a sterile hybrid of *Miscanthus sinensis* and *Miscanthus sacchariflorus*, is the species most commonly used for bioenergy. The plant reaches heights of up to 12 feet and in research trials has shown to be among the highest-yielding perennial energy crops, producing an annual average of up to 8–12 tons per acre.

Although the plant can tolerate drought, it does better under wetter conditions. This makes it ideal for soils that are often too wet for traditional field crops like corn or soybeans. Environmentally, the plant has deep roots reaching down to 8 feet, breaking up hard soils and improving drainage. Because hybridization giant miscanthus is sterile, there is no concern about invasiveness from seed. Some other varieties of miscanthus can be invasive, so it is important to choose true giant miscanthus rather than other varieties.

**Planting**


Giant miscanthus is planted using rhizomes (root growths), which makes it more expensive to establish than other energy crops from seed. The planting rate is about 6,000 plants per acre. Planting is typically done in late spring after the last frost. Later spring/early summer establishment is not recommended apart from very specific situations. Rhizomes are becoming more available, but a specialized equipment agreement is needed for planting.

Rhizomes look a little like shrimp growing off the roots of the plant. Photo courtesy of Daniel Ciolkosz.

**Establishing the Crop**

Establishment of giant miscanthus takes two to three growing seasons before a full crop can be expected. Weed control is essential in the first year and possibly the second year. A critical establishment issue is frost kill during the first winter after planting. However, once it gets through its first winter, it usually survives subsequent winters and is weed free, as it tends to crowd out all other plants in the field. Miscanthus has low nutrient requirements during establishment and has not shown much response to nitrogen fertilizers. In fact, some studies show that nitrogen is counterproductive by encouraging greater weed growth during establishment.

“NEWBio” is the Northeast Woody/Warm-season Bioenergy Consortium, a regional project funded by the United States Department of Agriculture’s National Institute of Food and Agriculture (USDA-NIFA) to promote next-generation bioenergy production in the northeastern United States.
**Harvest**

Harvest can occur in the second year, and conventional hay or silage harvesting equipment is used. Although the highest biomass yield occurs from a late summer harvest, it is more common to harvest the crop in the late winter or early spring to allow nutrients to translocate down into the crown and rhizomes for use by the plant the following year. This annual harvest can be carried out for an estimated 15–20 years before the field needs to be replanted.

**Crop Uses**

While the current market is limited, giant miscanthus can be pressed into fuel pellets or biomass logs for combustion, or it can be used as a feedstock for cellulosic biofuel production. Nonenergy possibilities for miscanthus include animal bedding, absorbents, and biobased materials such as fiberboard.

**Economics**

Purchasing planting material is the largest expense for establishing miscanthus. Assuming rhizomes are 10–25 cents each, about 6,000 rhizomes per acre comes to more than $600 at minimum just for plant material. Other planting expenses are similar to that of other row crops at about $400 per acre. Harvest costs range from $300 to $500 per acre depending on the type of machinery used. Depending on the yields, breakeven prices range from $40 to $80 per ton at the farm gate.

**NEWBio Project Work**

Miscanthus trials are ongoing across the eastern and midwestern United States. A NEWBio partner, Allotera LLC, is increasing miscanthus biomass and rhizome availability by planting up to 50,000 acres of miscanthus primarily in Ohio and Pennsylvania.

**Summary**

One of the highest-yielding perennial energy crops in the region, miscanthus requires little maintenance, no annual replanting, and only one annual harvest. It has excellent traits as an energy crop on marginal land due to its high productivity in colder climates, its deep roots exploiting soil nutrients, and its high water-use efficiency. However, there are some constraints with planting material availability and costs, planting costs, and ensuring first-year winter survival. However, over a life of 20 years, the returns for growing miscanthus are favorable compared to other crops.

**Reference**

eXtension Farm Energy COP: “Miscanthus (Miscanthus x giganteus) for Biofuel Production.” www.extension.org/pages/26625/miscanthus-miscanthus-x-giganteus-for-biofuel-production

**For more information on the NEWBio project, visit www.newbio.psu.edu and Penn State Extension’s Renewable Energy website, extension.psu.edu/natural-resources/energy.**

Prepared by Michael Jacobson, professor of forest resources, Penn State Department of Ecosystem Science and Management.

extension.psu.edu

Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Where trade names appear, no discrimination is intended, and no endorsement by Penn State Extension is implied.

This publication is available in alternative media on request.

Penn State is an equal opportunity, affirmative action employer, and is committed to providing employment opportunities to minorities, women, veterans, individuals with disabilities, and other protected groups.

Nondiscrimination: http://guru.psu.edu/policies/AD85.html

Produced by Ag Communications and Marketing

© The Pennsylvania State University 2013

Code EE0079 8/14pod