

NEWBio Energy Crop Profile: Giant Miscanthus

Note: “NEWBio” is the Northeast Woody/Warm Season Bioenergy Consortium, a USDA-AFRI funded regional project promoting next generation bioenergy production in the Northeast US.

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 U.S. as an ornamental plant in the 19th 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 3.5 meters (12 feet) and in research trials has shown to be among the highest yielding perennial energy crops, producing an annual average of up to 19-29 dry tonnes per hectare (8-12 tons per acre).



Giant Miscanthus Farmer John Griswold with a Mature Stand

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 of hybridization Giant Miscanthus is sterile, so 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

Miscanthus is planted using rhizomes (root growths) which make it more expensive to establish than other energy crops from seed. The planting rate is about 15,000 plants per hectare (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 shrimps, growing off the roots of the plant

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 nitrogen is counterproductive by encouraging greater weed growth during establishment.

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.

Uses of the Crop

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. Non-energy possibilities for Miscanthus include animal bedding, absorbents, and bio-based materials such as fiberboard.



Densified Miscanthus bales ready for transport

Economics

The largest expense for establishing Miscanthus is purchasing planting material. Assuming rhizomes at 10-25 cents each and about 6,000 rhizomes per acre comes to at a minimum over \$600 just for plant material. Other planting expenses are similar to other row crops at about \$400/acre. Harvest cost range from \$300 to \$500 per acre depending on the type of machinery used for harvest. Depending on the yields, breakeven prices range from \$40-80 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.

Prepared by Michael Jacobson, Penn State Department of Ecosystem Science and Management

References

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

For more information on the NEWBio project, visit <http://www.newbio.psu.edu>



Visit the Penn State Extension renewable energy programs website: <http://energy.extension.psu.edu>

Penn State is an equal opportunity university

An OUTREACH program of the
College of Agricultural Sciences