

Growing Giant Miscanthus in Illinois

Rich Pyter¹, Tom Voigt², Emily Heaton³, Frank Dohleman⁴, and Steve Long⁵
University of Illinois

Images Courtesy of Frank Dohleman

Highlights

- Giant Miscanthus (*Miscanthus x giganteus*) is a warm-season Asian grass showing great potential as a biomass crop in Illinois; at several Illinois sites, research plantings of Giant Miscanthus have produced greater yields than switchgrass.
- Giant Miscanthus is sterile and is propagated by rhizome division.
- To grow Giant Miscanthus, plant rhizomes approximately 4-inches deep and 3-feet apart within rows and 3-feet between rows.
- Weeds must be controlled during the planting season to ensure a successful planting.
- Stems of Giant Miscanthus are harvested in winter when dormant.
- To date, there have been no biomass losses due to insects or diseases.

Introduction

In Illinois, traditional energy sources include coal, oil, and nuclear power. There is presently, however, much interest in locally produced energy sources that can reduce reliance on energy that originates outside of Illinois. Wind, corn-based ethanol, and soybean-based biodiesel are all examples of locally produced alternative energy sources.

Other potential Illinois energy sources are crop residues or dedicated plants, primarily perennial grasses, which are burned to produce heat and electricity or treated with enzymes to produce sugars that can then be used to produce cellulosic ethanol. Plants used in these ways may be termed biomass crops, biofuel crops, bioenergy crops, or feedstocks. One such biomass crop is the U.S. native prairie plant, switchgrass (*Panicum virgatum*). A warm-season grass, switchgrass can grow to six feet or more; produces short, scaly rhizomes; and is tolerant of a variety of soils. There are two distinct forms of switchgrass, an upland type adapted to the Northern U.S. and a lowland type adapted to the Southern U.S. It is readily propagated by seed and has been the subject of much research. Moreover, it is already being used in the Midwest to produce burnable biomass and is being touted as a likely source of ethanol.

In addition to switchgrass, researchers at the University of Illinois are studying another grass, Giant Miscanthus (*Miscanthus x giganteus*). Giant Miscanthus has been widely studied and grown in Europe where it is being used to produce biomass to burn for heat and electricity. The potential for using Giant Miscanthus as an alternative energy source in Illinois appears to be great: in side-by-side studies at three Illinois locations, Giant Miscanthus has produced more than double the biomass of upland switchgrass per acre. Due to the growing interest in Giant Miscanthus, this guide has been developed to answer common questions about the grass and successful methods to produce it.

¹ Former Graduate Student, Department of Natural Resources and Environmental Sciences (NRES)

² Extension Specialist and Associate Professor, NRES (tvoigt@uiuc.edu)

³ Former Graduate Student, Department of Crop Sciences (CS)

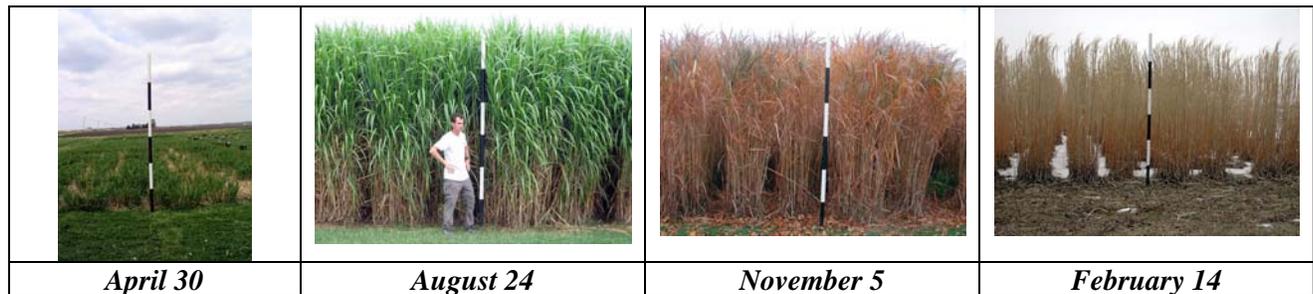
⁴ Graduate Student, Department of Plant Biology

⁵ Professor, CS

What is Giant Miscanthus?

The genus *Miscanthus* comprises a group of more than ten grass species, most of which are native to Asia. There appears to be much interspecific hybridization within the genus; Giant *Miscanthus* is a hybrid believed to have *M. sinensis* (a diploid species) and *M. sacchariflorus* (a tetraploid species) as its parents. The cross between the diploid and tetraploid produces a triploid, which is unable to produce viable seed. Though this cross occurred naturally, a similar breeding technology is used widely in the banana, tomato, and watermelon industries to produce seedless fruits. In the U.S., several species and cultivars, primarily *M. sinensis* types, have been widely used as ornamentals in landscape plantings.

Giant *Miscanthus* is a perennial warm-season (C4) grass, with a growing season in Central Illinois that begins in late April and is completed as it goes dormant following the first killing frost, usually in October. Growth each year originates from the buds on scaly rhizomes. In Central Illinois, established plants typically reach more than 6' tall by the end of May and greater than 12' at the end of each growing season. In established Giant *Miscanthus* plantings, approximately 5-to-10 shoots per square foot are developed. The grass does not flower every year, and when flowering does occur, it takes place in late September or early October in Central Illinois. As a sterile hybrid, no viable seeds are produced.



As temperatures cool in the fall, the dark green foliage fades to buff and drops, leaving stems (and sometimes sterile flowers at their terminus). Stems are the most commercially important portions of Giant *Miscanthus*, and harvesting the dried stems takes place during winter. Harvestable stems resemble bamboo and are usually 1/2 to 3/4 inch in diameter and more than 9 feet long.

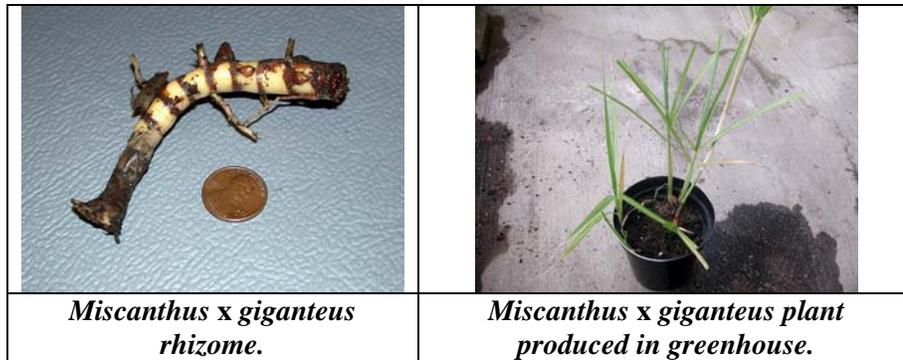
How Do I Propagate Giant Miscanthus?

Being sterile, Giant *Miscanthus* is propagated asexually, usually by dividing the rhizomes. Rhizomes are underground storage organs. The 1/4-to-1/2 inch diameter buff-colored rhizomes have multiple nodes and are scaly and variably branched. Producing new plants using tissue culture and rooted stem cuttings has also been successful, but the resulting plants often fail to survive transplanting to field settings.

For greenhouse propagation, plant one-ounce to two-ounce rhizomes (usually three-to-five inches long) in five-inch square pots using a soil-less greenhouse mix. The pots are grown under sixteen-hour per day supplemental lighting, irrigated as necessary, and fertilized every two weeks using a soluble greenhouse fertilizer. These potted plants can usually be divided every 4-to-8 weeks. While much of the rhizome stock at the University of Illinois has been propagated in this manner, it is likely that propagation in the field will be more common on an industrial scale.

To propagate stock in the field, use rhizomes that are approximately four-to-six inches long weighing 1.5 to 2.0 ounces. The ideal planting time in Central Illinois is mid April through May, but with irrigation, rhizomes have successfully been planted as late as mid-July. Plant the rhizomes approximately

four inches deep. If clumps are to be divided after one growing season, plant the rhizomes in rows 2 feet apart, but increase spacing to 2.5-to-3 feet apart the clumps are to be divided following two years of growth. Under ideal conditions, one-year clumps typically yield 7 to 10 harvestable rhizomes and two-year clumps 25 or more rhizomes.



To optimize propagation success, irrigation should be available to supplement precipitation during dry periods and weeds should be controlled. University of Illinois studies have shown that Giant Miscanthus tolerates application of several pre-emergence and postemergence herbicides used to control annual grassy and broadleaf weeds (Table 1). **FOR THE SAFEST AND MOST EFFICIENT PEST CONTROL, ALWAYS READ, UNDERSTAND, AND FOLLOW ALL LABEL INTRUCTIONS BEFORE USING ANY PESTICIDE.**

What Growing Conditions Are Required to Produce Giant Miscanthus?

Giant Miscanthus has successfully been established and survived in northern, central, and southern Illinois sites ranging from DeKalb to Dixon Springs.

Adequate water is necessary for successful Giant Miscanthus establishment, as well as to optimize production. While it will not withstand continuously waterlogged soils, yield usually increases as more water is available to the crop. Normally, the summer rains and humidity in Illinois, along with the State’s moisture-retentive soils, are adequate to produce high yields.

Giant Miscanthus is a very cold-tolerant warm-season grass. Not only is it able to develop leaves that can photosynthesize at temperatures as low as 50 °F, but stands at the University of Illinois in Urbana, planted nearly 20 years ago, have survived winters with periods below -10 °F without loss.

In Illinois trials at seven sites, establishment was slowest at the two least fertile sites. Maximum yields should be obtained within three years on fertile soils, but may require 4-to-5 years on poor soils. Following establishment, Giant Miscanthus appears to be remarkably efficient at capturing and retaining nitrogen; in European trials, there was no significant effect of nitrogen fertilization on yield. Yield reductions were not observed even at sites where no nitrogen had been applied. Anecdotally, an ornamental planting in Central Illinois has grown eighteen years without being fertilized and continues to reach 12-to-14 feet and produce numerous stems. Obviously, more fertility research in Illinois is needed and is ongoing so that yields can be optimized through proper fertilization.

How Do I Grow Giant Miscanthus?

Giant Miscanthus plantings are occasionally started using potted plants produced in greenhouses or by planting rhizomes. When using potted plants, remove the plants from the greenhouse in mid April

to mid May and place the pots in a protected outdoor area for a week to harden. After hardening, plant using a spacing of three feet between rows and three feet between plants in the rows (approximately 4,850 plants per acre). Field plant at the same depth as the grass was growing in the pots. Water the plants following planting and continue to water through the first growing season as necessary to ensure establishment. Control weeds as necessary during the first growing season mechanically or by applying herbicides (Table 1).

At the University of Illinois, unfertilized demonstration plots of potted Giant Miscanthus planted in May 2004 required no weed control after the planting season, developed a closed cover by the end of the second growing season, and were at least 10 feet tall by the end of the third growing season.

More commonly, large plantings of Giant Miscanthus are established using rhizomes. Healthy rhizomes should be relatively free of soil and weigh approximately one-to-two ounces and measure approximately four-to-six inches long. They should also be firm, not shriveled, and without apparent disease or harvest damage. Based on University of Illinois findings, plant the rhizomes approximately four-inches deep into a fine seed bed in spring as soon as soils are workable. As with potted plants, plant rhizomes using a spacing of three feet between rows and three feet between plants in the rows (approximately 4,850 rhizomes per acre), and control weeds as necessary during the first growing season mechanically or by applying herbicides (Table 1). Expect that not all rhizomes will sprout and field skips will require re-planting in years two or three.

Herbicide Combination Treatments

- pendimethalin + 2,4-D ester
- pendimethalin + dicamba
- pendimethalin/atrazine + 2,4-D ester
- pendimethalin/atrazine + dicamba
- S-metolachlor + 2,4-D ester
- S-metolachlor + dicamba
- S-metolachlor/atrazine + 2,4-D ester
- S-metolachlor/atrazine + dicamba

Table 1. Preemergence and postemergence herbicide combinations safely applied to Giant Miscanthus in 2006 in Urbana, Illinois.

Presently in the U.S., there are no commercially available mechanical planters or harvesters specifically designed to work with Giant Miscanthus rhizomes. In Europe, potato planters and harvesters have been successfully modified for Giant Miscanthus rhizomes. In addition, a British company (www.bical.net/) has developed a mechanical planter specifically for Giant Miscanthus rhizomes. Stems have been harvested using hay cutters and balers. In some cases, the stems are chopped at harvest, while they are baled for storage in other settings.

Illinois yields have varied depending on the crop age and the weather during the growing season. At three Illinois sites in replicated studies, the end-of-season biomass yields of unfertilized Giant Miscanthus planted in 2002 averaged over the 2004, 2005, and 2006 growing seasons were 9.8 tons per acre in Northern Illinois, 15.5 tons per acre in Central Illinois, and 15.8 tons per acre in Southern Illinois. In the same three-year period, yields for unfertilized upland switchgrass, ‘Cave in Rock’, seeded in 2002 were 2.2 tons per acre in Northern Illinois, 5.2 tons per acre in Central Illinois, and 2.7 tons per acre in Southern Illinois. A separate demonstration in Urbana yielded approximately 14.1 tons of dry Giant Miscanthus biomass per acre in 2006 at the end of the third growing season. Obviously, Giant Miscanthus is a crop worthy of continued investigation!



Cutting, chopping, and baling Miscanthus x giganteus in late winter.

Should I Grow Giant Miscanthus?

The decision to grow Giant Miscanthus or any other biomass crop should be made after careful deliberation. At present, there are no markets in Illinois for Giant Miscanthus, but as the U.S. pushes for more domestic energy production, biomass markets will no doubt develop and Giant Miscanthus will be one of several viable options for Illinois growers.