

Giant Miscanthus for Biomass Production

Miscanthus has received widespread attention as a biomass crop in Europe where it is used primarily for combustion in power plants. It is desirable for this use because of its low water and ash contents and high energy output to input ratio. In the U.S., *Miscanthus* is being investigated as a biomass crop for bioenergy and biofuel. Research into *Miscanthus* production and use has been conducted for more than 30 years in Europe, but is in its early stages in the U.S.

Origin and Distribution

The *Miscanthus* genotype with the greatest biomass potential to date is Giant *Miscanthus* (*Miscanthus* x *giganteus*), a sterile hybrid of *M. sacchariflorus* and *M. sinensis* parentage. The material being studied for biomass production is completely unimproved.

Giant *Miscanthus* is unable to produce seed so is less likely to be invasive. *M. sacchariflorus* and *M. sinensis* have escaped cultivation and can be invasive.

Lifecycle and Growth Habitat

Giant *Miscanthus* is a perennial crop; it does not need to be reseeded each spring. Giant *Miscanthus* grows from a rhizome and will spread slowly. It has erect stems which are 8- to 12-foot tall.

Giant *Miscanthus* is a warm-season grass but can grow even at relatively low temperatures (as low as 43°F). Autumn frost stops annual growth. Maximum dry matter yield is reached in late-summer but harvest is typically delayed until winter or early spring after dry down. This allows nitrogen to move into the rhizome for use by the plant the following season. Regrowth in Iowa begins in late April.

Yield

European research has shown dry matter yields from 5 to 11 tons per acre with an average of 8 tons per acre (non-irrigated, fully-established crop). The highest yields are reported in southern Europe, generally south of 40° N latitude.

US Research has shown dry matter yields from 10 to 15 tons per acre (Illinois), an increase of 30% to 50% over Europe. Yields decrease at more northerly latitudes. Yield trials are currently underway in Iowa.

Dry matter yield of Giant *Miscanthus* in the establishment year is typically insufficient to merit harvest. Yield increases each year reaching maximum potential by year three or four.

(continued on reverse)



Photo courtesy University of Illinois at Urbana-Champaign.

Giant Miscanthus Quick Facts

- Potential Benefits:
 - High yielding biofuel feedstock
 - Soil stabilization/improvement
 - Water filtration
 - Wildlife cover
 - Carbon sequestration
 - Low inputs after establishment
- Challenges:
 - Difficult propagation
 - Expensive establishment
 - Transportation of harvested material

Miscanthus species are native to Eastern Asia. They are now grown in various temperate and tropical areas.

In the U.S., many varieties have been bred and used ornamentally for over 100 years. In Japan, *Miscanthus* varieties have been successfully cultivated and managed in a prairie-like setting for use as a forage and building material for thousands of years.

A stand of Giant *Miscanthus* has a lifespan of 15 to 30 years.

(continued from front)

Soil and Site Adaptation

Giant Miscanthus is adapted to many soil conditions, including marginal land, but is most productive on soils well suited for corn production.

Giant Miscanthus is adapted to a broad growing range. Europe has shown successful stands from southern Italy (37° N latitude) to Denmark (56° N latitude). In the U.S. it has been successful from the Gulf of Mexico to central Canada.

Establishment

Giant Miscanthus produces no seed, so it must be established vegetatively by planting divided rhizome pieces or live plants. This process results in high up-front establishment costs relative to crops established from seed, but comparatively reduced costs over the lifetime of the stand. The planting rate is about 4,000 plants per acre.

Weed control at establishment is very important. Labeled herbicide choices are limited making a clean field at planting critical. Planting an herbicide tolerant crop in the previous year and using a cover crop prior to Miscanthus establishment can reduce weed pressure.

As with other vegetatively propagated crops, adequate soil moisture at planting greatly favors establishment success. Establishment success may be limited by death of plants in the first winter after planting.



Giant Miscanthus rhizome. Photo courtesy of Ceres, Inc.

Fertility and Weed Management

The plant's efficient use of nitrogen implies that, once established, the crop will require relatively low annual application rates.

Nitrogen fertilizer is not needed in the first two years and is counter productive by encouraging greater weed growth during establishment. Soils should have phosphorus and potassium levels adequate for corn planting.

Nutrient application should be adjusted to replace the amounts exported in harvested biomass, though optimal rates are still being tested.

Annual estimated nutrient removal:

- Phosphorus - 1.5 lbs. per ton of biomass
- Potassium - 8 lbs. per ton of biomass
- Nitrogen - 8 to 10 lbs. per ton of biomass

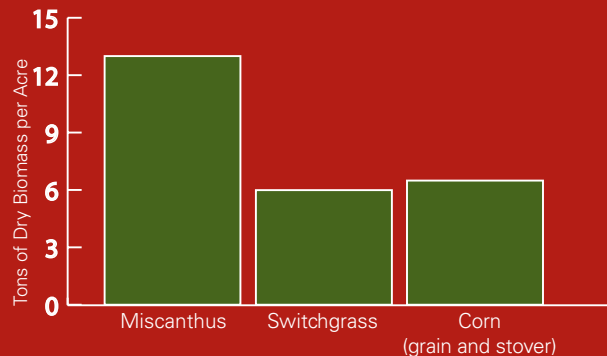
Harvest

Harvests can be taken between maturity in the fall and regrowth the following spring. Mowing or harvesting while the crop is still green harms plant growth and regeneration and reduces fuel quality.

There is a tradeoff between yield and fuel quality with harvest timing — late winter and spring harvests reduce yields by 30–50 percent due to leaf drop, but the harvested biomass is a higher quality product because of the dry down time in the field. Recommended harvest time in Iowa is late November to early December.

Comparison of Dry Matter Yields

The potential for Giant Miscanthus lies in its biomass yield. Established plants can yield 10 to 15 tons of dry matter per acre. The same area yields between six and seven tons of dry matter for both corn and switchgrass.



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