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Fueling the Future: Potential Biomass Crops for Michigan

By Mark Seamon, Michigan State University Extension

Plant biomass—aboveground plant material that is not grain—is widely considered a promising replacement for petroleum for energy (including transportation fuels), plastics, composite materials, textiles and pharmaceuticals. The potential for the production of large amounts of plant biomass in the United States has been well documented[1], and the end use of the plant biomass will be a factor in determining which biomass crops to grow. Some composite materials can utilize the strength of plant fibers to create durable products, thereby replacing the need for fiberglass. For example, flax, corn, jute and native grasses have strong fiber strength. Biomass heating and electrical generation industries may need biomass with high energy density, measured in Btu (British thermal units) per pound. For cellulosic ethanol production—making ethanol from plant biomass—an assurance of large volumes of biomass produced at low cost is a concern. The conversion of plant biomass to liquid fuel (ethanol) is similar to the process of converting corn grain to ethanol with an additional first step of converting the cellulose in the biomass to starches. This additional step requires new technology to make cellulosic ethanol financially competitive with corn grain ethanol and petroleum. Woody biomass is another practical option for petroleum replacement. Issues related to its production and processing are being addressed by a series of MSU Extension fact sheets, "Woody Biomass Energy for Michigan".

MSU Extension biomass crop trial.

A careful evaluation of the potential dedicated biomass crops, sometimes referred to as energy crops, and research on their geographical adaptation are critical. Many species have been identified and are being evaluated for their fit in Michigan (see table below). Switchgrass (*Panicum vergatum*) holds great potential as an energy crop and has a wide adaptation range in Michigan, from the southern border of the Lower Peninsula and throughout the Upper Peninsula. Switchgrass has been the target of a great deal of research at Michigan State University and elsewhere, including variety evaluation, weed control, establishment methods and nutrient management. Variety selection and management practices should be adjusted depending on geographical location—see *Growing the Future: Switchgrass Management for Cellulosic Ethanol*[2] for more information.

Perennial grasses such as Miscanthus (*Miscanthus giganteus*) and switchgrass have significant potential to produce large amounts of biomass with relatively low nutrient removal and carbon sequestration potential. Miscanthus is a non-native species that has been successfully grown in some Midwestern states[3] and is being evaluated in Michigan with special interest in its ability to adapt to our cold climate, especially overwinter survival. These perennial species need up to three years to establish and achieve a mature crop yield, have high establishment costs (for seed and rootstock), and require specialized equipment for production and harvest. Annual crops such as corn (*Zea mays*) and sorghum (*Sorghum X almum*) can be used as biomass crops, but they have significantly higher costs of production than perennial crops as a result of annual seed costs, multiple field operations and cost of replacing nutrients removed. These crops have benefited from many years of genetic improvement by commercial seed companies. This genetic improvement, the efficient production methods used by today's farmers and our current energy conversion technology make these crops difficult to beat in energy production.

The economics of a given biomass crop will be a critical consideration of farmers. For energy crops to be competitive, more research is needed on production practices. Likewise, the sustainability of various biomass crops is a key factor in determining which biomass crops should be produced. Michigan State University scientitsts and others are evaluating the economic and environmental sustainability of various biofuel crops and cropping systems as part of the Great Lakes Bioenergy Research Center's efforts to perform the basic research that generates technology to convert cellulosic biomass to ethanol and other advanced biofuels.[4] Federal government support is also a factor in the early development of this industry. The 2008 Farm Bill offers subsidies for cellusic ethanol and biomass feedstock for biofuels.

Potential dedicated biomass crops for Michigan

	Biomass crop	Potential uses	Pros	Cons
	Switchgrass	Direct combustion, cellulosic ethanol, pelleted fuel	Perennial, low input, native, potential to build soil carbon	Slow to establish; weed management can be an issue in establishment years
	Miscanthus	Direct combustion, cellulosic ethanol, pelleted fuel	Perennial, low input, high yield, potential to build soil carbon	Slow to establish, established by root stock; winter hardiness, cost and availability of rootstock; rotating out of it with its dense root biomass
	Mixed prairie	Direct combustion, cellulosic ethanol, pelleted fuel	Perennial, native species, potential to support many ecosystem services	Expensive and slow to establish; more research needed on management for high levels of production
	Sorghum	Direct combustion, cellulosic ethanol, pelleted fuel, possible sugar to ethanol	Fits present cropping systems, high yield	Relatively high levels of nutrient removal, potential to reduce soil carbon
	Corn	Direct combustion, cellulosic ethanol, pelleted fuel	High yield, multiple uses, well-known production and marketing system	Relatively high levels of nutrient removal, potential to reduce soil carbon

[1] http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf
[2] Switchgrass Fact Sheet reference
[3] http://miscanthus.illinois.edu
[4] http://www.greatlakesbioenergy.org/