Hybrid grass may prove to be valuable fuel source

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Giant Miscanthus (Miscanthus x giganteus), a hybrid grass that can grow 13 feet high, may be a valuable renewable fuel source for the future, researchers at the University of Illinois at Urbana-Champaign say.

Stephen P. Long, a professor of crop sciences and of plant biology, recently took that message to Dublin, Ireland, where the British Association for the Advancement of Science sponsored the annual BA Festival of Science Sept. 3-10.

Closer to home, two of Long's doctoral students, Emily A. Heaton and Frank G. Dohleman, delivered their Miscanthus findings at the 49th annual Agronomy Day, held on campus Aug. 18 and attended by more than 1,100 visitors from across the Midwest.

"Forty percent of U.S. energy is used as electricity," Heaton said. "The easiest way to get electricity is using a solid fuel such as coal."

Dry, leafless Miscanthus stems can be used as a solid fuel. The cool-weather-friendly perennial grass, sometimes referred to as elephant grass or E-grass, grows from an underground stem-like organ called a rhizome. Miscanthus, a crop native to Asia and a relative of sugarcane, drops its slender leaves in the winter, leaving behind tall bamboo-like stems that can be harvested in early spring and burned for fuel.

Rhizomatous grasses such as Miscanthus are very clean fuels, said Dohleman, who is studying for a doctorate in plant biology. Nutrients

such as nitrogen are transferred to the rhizome to be saved until the next growing season, he said.

Burning Miscanthus produces only as much carbon dioxide as it removes from the air as it grows, said Heaton, who is seeking a doctorate in crop sciences. That balance means there is no net effect on atmospheric carbon dioxide levels, which is not the case with fossil fuels, she said.

Miscanthus also is a very efficient fuel, because the energy ratio of input to output is less than 0.2, Heaton said. In contrast, the ratios exceed 0.8 for ethanol and biodiesel from canola, which are other plant-derived energy sources.

Besides being a clean, efficient and renewable fuel source, Miscanthus also is remarkably easy to grow. Upon reaching maturity, Miscanthus has few needs as it outgrows weeds, requires little water and minimal fertilizer and thrives in untilled fields, Heaton said. In untilled fields, various wildlife species make their homes in the plant's leafy canopy and in the surrounding undisturbed soil.

Illinois researchers have found that Miscanthus grown in the state has greater crop yields than in Europe, where it has been used commercially for years, Long said. Full-grown plants produce 10-30 tons per acre dry weight each year. Miscanthus yields in lowland areas around the Alps, where the climate is similar to the Midwest, are at least 25 tons per acre dry weight, wrote Heaton and colleagues in a paper published in 2004 in the journal Mitigation and Adaptation Strategies for Global Change.

Last year, Illinois researchers obtained 60 tons per hectare (2.47 acre), Long said at the BA Festival of Science.

Using a computer simulator, Heaton predicted that if just 10 percent of Illinois land mass was devoted to Miscanthus, it could provide 50 percent

of Illinois electricity needs. Using Miscanthus for energy would not necessarily reduce energy costs in the short term, Heaton said, but there would be significant savings in carbon dioxide production.

The Illinois Miscanthus crop began three years ago when Heaton planted 400 Miscanthus rhizomes, which were generated from three rhizomes donated by the Turfgrass Program in the department of natural resources and environmental sciences. Because Miscanthus is sterile, cuttings of Miscanthus rhizomes must be used to create new plants.

Now in their third year, the three 33-by-33 feet Miscanthus plots at the intersection of South First Street and Airport Road in Savoy, Ill., are considered mature. Their 10-foot tall stems are twice as high as switchgrass, a prairie grass native to Illinois. Grown side by side, Miscanthus produces more than twice as much biomass as switchgrass, Heaton said.

To investigate how Miscanthus is so productive, Dohleman and others take measurements of photosynthesis throughout the day. He measures the intensity of the sun and then places a leaf in a chamber, allowing him to measure the rate of photosynthesis depending upon ambient sunlight. Preliminary results show that Miscanthus has a 27 percent greater rate of photosynthesis at midday compared with switchgrass.

Nine different fields across the state are being used to help estimate Miscanthus productivity, Heaton said. Plots in Champaign and Christian counties each have more than 2 acres of Miscanthus, and DeKalb, Pike, Pope, Wayne, Fayette and Mason counties have smaller plots. Plots in Champaign County have shown the greatest yearly yields, according to Long's 2004 progress report to the Illinois Council on Food and Agricultural Research, which funded the experiments.

"It is my hope that Illinois will take the lead in renewable energy and that

the state will benefit from that lead," Long said.

Other varieties of Miscanthus have been grown successfully in Indiana, Michigan and Ohio. However, the giant Miscanthus being grown by the Illinois researchers has the greatest potential as a fuel source because of its high yields and because it is sterile and cannot become a weed, Heaton said. "Miscanthus sacchariflorus and some of the other fertile Miscanthus species can be quite invasive," she said.

At a research station near Hornum, Denmark, giant Miscanthus has been grown for 22 years in Europe's longest-running experimental field. The crop has never been invasive and rhizome spread has been no more than 1.5 meters (4.92 feet), said Uffe Jorgensen, senior scientist for the Danish Institute of Agricultural Sciences.

The next step, Long said, is to demonstrate how Miscanthus goes from a plant to a power source. Existing U.S. power plants could be modified to use Miscanthus for fuel as in Europe, he said.

Long collaborates with researchers at the Institute of Genomic Biology to study whether Miscanthus could be converted to alcohol, which could be used as fuel.

Source: University of Illinois at Urbana-Champaign