Miscanthus-based ethanol boasts bigger environmental benefits, higher profits

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Miscanthus and switchgrass. Credit: University of Illinois

A recent study simulated a side-by-side comparison of the yields and costs of producing ethanol using miscanthus, switchgrass, and corn stover. The fast-growing energy grass miscanthus was the clear winner. Models predict that miscanthus will have higher yield and profit, particularly when grown in poor-quality soil. It also outperformed corn stover and switchgrass in its ability to reduce greenhouse gas emissions.

"One of the reasons for interest in these second-generation cellulosic feedstocks is that if they can be grown on low-quality soil, they wouldn't compete for land with food crops, such as corn. This study shows that although miscanthus yield was slightly lower on marginal, low-quality land, a farmer would have an economic incentive to grow miscanthus on the lower quality land first rather than diverting their most productive cropland from growing corn," said University of Illinois agricultural economist Madhu Khanna who co-authored the study along with a team of economists and environmental and crop scientists from the Energy Biosciences Institute at U of I.

According to Evan DeLucia, professor in integrative biology at the University of Illinois, "There has been skepticism about whether energy crops can be grown on low-quality land. What's been lacking is a side-by-side analysis that isolates the effect of soil quality on yield. In this study, we do that. We were able to keep all of the conditions the same and only change the soil attributes," he said.

The study used real data from the University of Illinois energy farm and other locations across the country to calibrate the model so that the findings are generalizable. The model simulated yields and greenhouse gas savings under 30 years of variable weather conditions as well.

Another goal of the study was to examine the cost and greenhouse gas implications of using these sources of biomass for biofuel production. The study found that even if corn stover is harvested responsibly (removing only 30 to 50 percent depending on tillage choice) there was still a loss in soil carbon and the overall savings in greenhouse gas emissions were much smaller than those with switchgrass and miscanthus.

"It's tempting to use corn stover because it's already there—farmers who grow corn don't have to plant another crop to produce biofuel

feedstock," Khanna said. "But in some cases corn stover is only about 59 percent cleaner than gasoline while miscanthus is about 140 percent cleaner. So if we want to reduce greenhouse gas emissions and lower the carbon intensity of our fuel, energy grasses such as miscanthus and switchgrass are going to result in the biggest reductions, not corn stover."

Making the choice of miscanthus-based ethanol more pleasing at the pump for consumers is another consideration. Khanna says that a price on carbon would be one way to equalize the cost of using gasoline and ethanol for consumers when filling up their tank.

"Ethanol made from miscanthus would need a much smaller carbon price to make it desirable to produce and for consumers to purchase as compared to ethanol from switchgrass and corn stover. Even though corn stover may in some cases be cheaper to produce, it is a much more expensive way to reduce greenhouse gas emissions than energy grasses," Khanna said.

More information: "Cost of Abating Greenhouse Gas Emissions with Cellulosic Ethanol" was written by Puneet Dwivedi, Weiwei Wang,Tara Hudiburg, Deepak Jaiswal, William Parton, Stephen Long, Evan DeLucia, and Madhu Khanna. The article was published in *Environmental Science and Technology*.

Provided by University of Illinois at Urbana-Champaign