29 June 2017

**Cellulosic biofuel contributions to a sustainable energy future**

Understanding the effect of management choices is key to realizing climate and other environmental benefits provided by cellulosic bioenergy crops.

**The Science**

Cellulosic bioenergy offers environmental benefits not available from other biofuels, but requires substantial amounts of land and creates the potential for environmental harm. It is therefore important to understand how different bioenergy crop and management choices will simultaneously affect climate mitigation, biodiversity, reactive nitrogen loss, and water use in future biofuel landscapes.

**The Impact**

Recent empirical work based on field observations and experiments has improved our empirical understanding of potential tradeoffs and synergies from different cellulosic bioenergy crops, management strategies, and landscape configurations. This knowledge allows us to form the emerging principles and policies that will ensure that cellulosic biofuels deliver as many climate and other benefits as possible without unintentionally causing environmental harm.

**Summary**

Recent experimental work, much of it from the Great Lakes Bioenergy Research Center, has revealed that planting perennial cellulosic biofuel crops such as grasses and short-rotation trees on marginal lands (i.e., lands currently not used for food production) can potentially avoid food-fuel conflict and the effects of indirect land use change, while providing substantial climate mitigation and biodiversity benefits. Researchers have also found that that establishing crops on these lands can minimize direct carbon costs by avoiding tillage of lands with extensive carbon stocks such as forests and wetlands. They conclude that native perennial species offer superior environmental outcomes over non-native species, and that there is currently no best crop for all locations. Further, diverse crop mixtures, whether planted as polycultures within the same field or as near-monocultures within the same landscape, can provide conservation benefits that include pest protection, pollination, and wildlife protection. They also point out the importance of avoiding nitrogen fertilizer use as much as possible, and note that cellulosic biofuels are not likely to affect landscape water balances because they use no more water overall than do other plants in places with moderate rainfall. Finally, based on economic analysis, they note that biofuel crops grown on arable lands are unlikely to ever be economically competitive with food crops on these lands, underscoring the importance of research to overcome the challenges of growing cellulosic biofuels on less fertile soils. Overall, these findings demonstrate that environmental and climate concerns cellulosic biofuels are addressable and that perennial cellulosic crops can be highly beneficial if properly managed.

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**Funding**

The DOE Great Lakes Bioenergy Research Center is supported by the US Department of Energy, Office of Science, Office of Biological and Environmental Research, through contract number DE-FC02-07ER64494.

**Publications**

Robertson, GP. *et al.* “Cellulosic Biofuel Contributions to a Sustainable Energy Future: Choices and Outcomes.” *Science* **356**(2017),[DOI: 10.1126/science.aal2324]

**Related Links**

<http://science.sciencemag.org/content/356/6345/eaal2324>

**PM Recommendation for SC Web Publication**