13 July 2016

**Fertilizer use could reduce climate benefit of cellulosic biofuels**

The importance of minimizing nitrogen fertilizer use in biofuel crops.

**The Science**

This study showed that applying nitrogen (N) fertilizer to the cellulosic biofuel crop switchgrass has the potential to cause an exponential increase in nitrous oxide (N2O) emissions, a major greenhouse gas. N fertilizer therefore has the potential to curtail the climate benefit of cellulosic biofuel production.

**The Impact**

Though cellulosic biofuels offer the potential for greater environmental benefits compared to other grain-based biofuels, crop management practices, including fertilizer use, can reduce those benefits. Minimizing nitrogen fertilizer use will be necessary to meet the full climate mitigation benefits of cellulosic biofuels.

**Summary**

We measured soil N2O emissions, CH4 uptake, NO3- leaching, and soil organic carbon accumulation for switchgrass under various N fertilizer rates over a three-year period after establishment. We found for annual N2O emissions by fertilizer rate an exponential increase that was stronger every year, and also that switchgrass yields became less responsive each year to N fertilizer. Nitrate leaching also increased exponentially in response to added N, but methane uptake and soil organic carbon didn’t change detectably. Overall, N fertilizer inputs at rates greater than crop need curtailed the climate benefit of ethanol production almost two-fold, from a maximum mitigation capacity of −5.71 ± 0.22 Mg CO2e ha−1 yr−1 in switchgrass fertilized at 56 kg N ha−1 to only −2.97 ± 0.18 Mg CO2e ha−1 yr−1 in switchgrass fertilized at 196 kg N ha−1. Minimizing N fertilizer use will be an important strategy for fully realizing the climate benefits of cellulosic biofuel production.

**Contacts (BER PM)**

N. Kent Peters
Program Manager, Office of Biological and Environmental Research
kent.peters@science.doe.gov, 301-903-5549

**(PI Contact)**

Phil Robertson
Michigan State University
robert30@msu.edu

**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**

Ruan, L, Bhardwaj AK, Hamilton SK, Robertson GP. “Nitrogen fertilization challenges the climate benefit of cellulosic biofuels”. *Environmental Research Letters* (2016) [DOI: 10.1088/1748-9326/11/6/064007]

**Related Links**

<http://iopscience.iop.org/article/10.1088/1748-9326/11/6/064007/pdf>

**PM Recommendation for SC Web Publication**

[Yes or No]