United States Department of Agriculture
Agricultural Research Service

PASTURE SYSTEMS AND WATERSHED MANAGEMENT RESEARCH UNIT FACT SHEET

University Park Pennsylvania USDA-ARS Biofuel Research Program

Management and Life Cycle Assessment of Bioenergy Crop Production

Background. The focus of the program has been on the potential use of marginal croplands for biofuel production conducting research at multiple scales on the ecology and management of grasslands, developing sustainable bioenergy production systems including investigation of suitable biomass crops for the Northeastern US, and life cycle assessment of a range of bioenergy crop production systems, including net greenhouse gas emissions, energy balance, and the impact of climate change.

Marginal croplands: survey of conservation lands in the Northeastern US

We surveyed 34 sites across the northeast US (NY, PA, NJ, MD, and VA) during late August through mid-October in 2002 and 2003 that included CRP, CREP, wildlife habitat improvement program (WHIP), mine reclamation, and other conservation lands as a resource assessment for biomass production.

•More than 280 plant species were identified across all sites with an average species richness of 34 species per 0.1 ha (range of 12 to 60 plant species).

•Aboveground biomass at these sites averaged 6.6 Mg ha^{-1}

•The top 5 native plant species accounted for more than 65% of plant cover; top 5 exotic plants accounted for only 12%. Switchgrass, big bluestem, and indiangrass cover correlated with biomass yield best among plant species.

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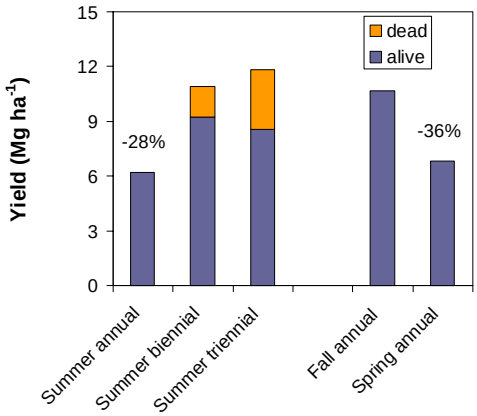
Adler, P.R., Sanderson, M.A., and Goslee, S.C. 2005. Management and composition of conservation lands in the Northeastern United States, p. 187-200. In Thomas G. Barnes and Linda R. Kiesel (ed.) Proceedings of the Fourth Eastern Native Grass Symposium. The University of Kentucky Department of Forestry, Lexington, KY, October 3-6, 2004.

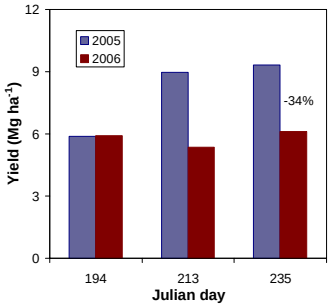
Grassland management practices: seasonal harvest time and frequency

The season when switchgrass is harvested can affect the yield and quality of its biomass (stem, leaves) to make biofuels like ethanol and feedstock for thermochemical conversion. Based on recent studies in central Pennsylvania over the last five years, for example, switchgrass yield generally decreased when harvest was delayed from fall to spring—except for winters with little snowfall. However, biofuel quality generally improved.



Biofuel yield – Based on studies underway in central Pennsylvania, long term, mid- to late-summer annual yields were similar to spring-harvest yields after the initial high yield the first year of summer harvest. Energy yields from gasification and ethanol are similar per unit biomass between seasons.

Switchgrass yield of annual summer harvest after August 1 decreased in succeeding years, stabilizing at yields similar to mid-July harvests.

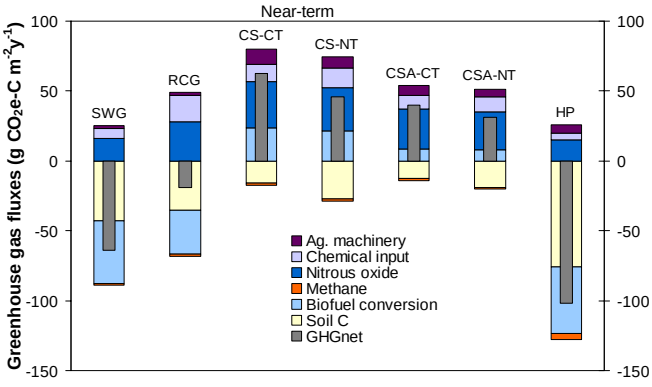


Biofuel quality – summer (> 1% N, highest in other elements, < 18% water content), fall (0.5% N, other elements lower, typically > 30% water content), spring (0.5% N, other elements lowest compared with other seasons, typically < 10% water content).

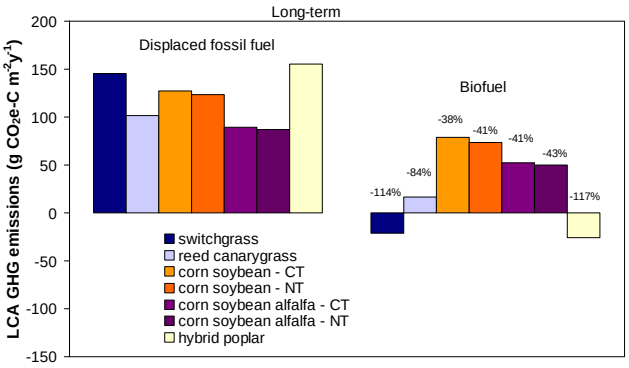
Adler, P.R., M.A. Sanderson, A.A. Boateng, P.J. Weimer, and H.G. Jung. 2006. Biomass yield and biofuel quality of switchgrass harvested in fall or spring. Agron. J. 98:1518–1525.

Life cycle assessment: greenhouse gas emissions

Sources and sinks – Displaced fossil fuel was the largest greenhouse gas sink followed by soil carbon sequestration. N_2O emissions were the largest greenhouse gas source.



Adler, P.R., S.J. Del Grosso, and W.J. Parton. 2007. Net greenhouse gas flux of bioenergy cropping systems using DAYCENT. Ecol. Appl. (In press, ESA press embargo date March 2007).



Net greenhouse gas emissions – Compared with the life cycle of gasoline and diesel (displaced fosil fuel), ethanol and biodiesel from corn rotations reduced greenhouse gas emissions in the long term by about 40%, reed canarygrass by about 85%, and by about 115% for switchgrass and hybrid poplar.