Why develop a portfolio of biofuel feedstocks?

Bioenergy feedstocks can reduce dependence on foreign oil. The 2007 Energy Independence and Security Act mandated the production of 36 billion gallons of renewable biofuel by 2022, with 44 percent from cellulosic sources. Developing U.S. bioenergy systems will help address the rising costs and uncertain future of fossil fuels.

Bioenergy feedstocks can have positive effects on society, rural economies and the environment. Alternative cropping systems often can meet multiple goals for energy, water, soil, productivity and profitability; however, it is unlikely that a single system will meet all goals in all landscapes. This experiment seeks to develop a portfolio approach that will provide dependable income for farmers while preserving Iowa's vital natural resources.

Bioenergy feedstocks can be compatible with existing agriculture. While Iowa has largely focused on meeting the national biofuel demand with grain-based ethanol from corn, alternative cropping systems can improve the resiliency of agriculture and ensure its continuance into the future.

Harvesting switchgrass. Photo by John Sellers.

Learn more

Visit the project website:
www.nrem.iastate.edu/landscape/projects/ls_biomass/ls_biomass.htm

See videos, photos and other info:
www.leopold.iastate.edu/landscape-biomass-research-team

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Landscape Biomass Experiment

Growing options for Iowa's bioenergy future

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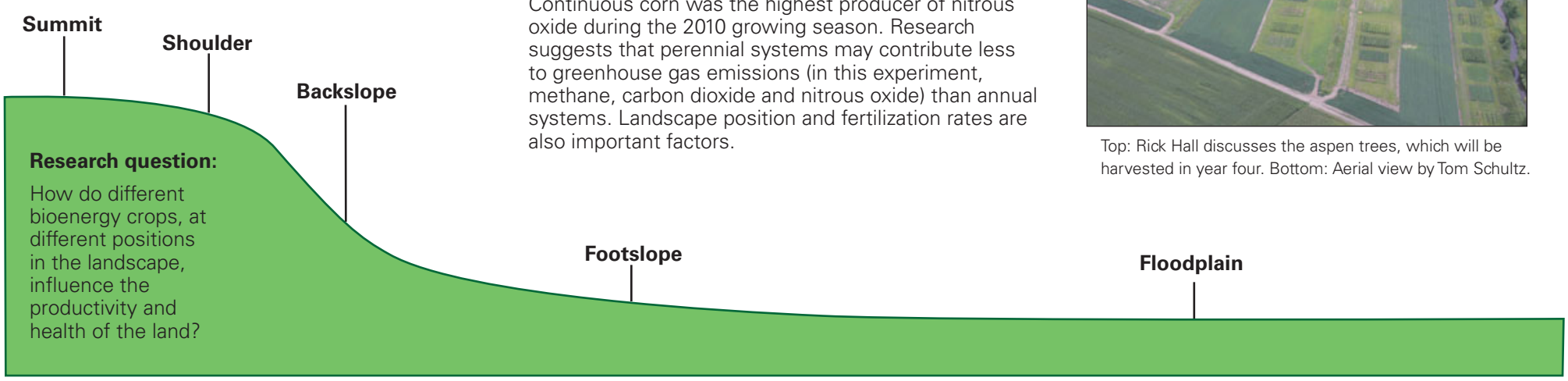
Iowa State University
Uthe Farm

What is the experiment?

The Landscape Biomass Experiment seeks to develop, refine and implement a portfolio of cropping systems that supply sustainable bioenergy feedstocks. Researchers established the experiment in 2008 on Iowa State University's Uthe Farm and plan to continue it for at least ten years. They planted three replicated plots of five cropping systems at five different positions in the landscape, from the summit of a hill to the floodplain:

- Continuous corn
- Corn-soybean-tritcale/soybean
- Corn-switchgrass
- Tritcale/sorghum
- Tritcale/aspen trees

Triticale, a wheat-rye hybrid, did not perform as well as expected in the first few years, and will be replaced with miscanthus, a perennial grass.



What have researchers found?

Productivity

The researchers are evaluating biomass yields across the different landscape positions. Corn was the highest yielding crop in 2009, 2010 and 2011. Researchers expect corn yields to stabilize and perennial crop yields to increase as they mature. Landscape position affected yields, which were highest in the floodplain and lowest on the backslope.

Water quality

Cropping systems with lower fertilization requirements and longer periods of growth (such as aspen trees and switchgrass) are expected to have fewer water quality impacts. Soil water under corn had the highest nitrogen concentrations in 2010 and 2011, whereas soil water under the triticale/aspen system had almost no nitrogen. In general nitrogen concentrations decreased as the growing season progressed from June to November.

Soil health

Microbes play an important role in soil health by releasing enzymes that recycle carbon, nitrogen and other nutrients. By measuring this enzyme activity, researchers learn how the different crops and different landscape positions influence decomposition and nutrient availability, and ultimately the health of the land. Initial results suggest that switchgrass may be particularly effective for building soil organic matter.

Greenhouse gas emissions

Continuous corn was the highest producer of nitrous oxide during the 2010 growing season. Research suggests that perennial systems may contribute less to greenhouse gas emissions (in this experiment, methane, carbon dioxide and nitrous oxide) than annual systems. Landscape position and fertilization rates are also important factors.

What's next for the project?

At present, none of the alternative systems are economically competitive with corn. Yet the experiment shows that corn systems have serious environmental impacts, particularly on water quality, a top concern in Iowa. Researchers will work to improve yields and reduce costs of the alternative systems, as well as develop an approach to value non-market benefits such as clean water and healthy soil. A fully integrated analysis of the data will eventually help inform basic science and agricultural policy.

Top: Rick Hall discusses the aspen trees, which will be harvested in year four. Bottom: Aerial view by Tom Schultz.