The effect of landscape position on biomass crop yield

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The emergence of biofuels into agricultural systems presents new opportunities for farmers to improve economic return while providing critical ecosystem services. Integrating perennial crops can help meet food, fuel and fiber needs, but will require an understanding of biomass productivity on specific landscape positions and environments. To diversify their farms, farmers will need to know where their crops will give them the best yield.

Landscape processes, such as hill slope length and gradient, water retention and flow patterns, and soil properties have been shown to influence crop yield. In recent years, the process of describing and analyzing landscape terrain features has become more accurate and precise due to advances in Geographic Information Systems technology, allowing farmers and landowners to explore new cropping systems design strategies, such as directed placement of annual and perennial crops.

Scientists at the University of Minnesota led by Gregg Johnson investigated differences in woody and herbaceous crop productivity and biomass yield as a function of landscape position at the field scale. Results from this study were published in the 2010 March-April issue of the Agronomy Journal. The journal is published by the American Society of Agronomy. The study was supported by the Initiative for Renewable Energy and the Environment at the University of Minnesota.

The researchers sleeved seven varying landscape positions to represent a

range of topographical features common to the region with varying soil moisture and erosion characteristics. Within each landscape position, a series of woody and herbaceous annual and perennial crops were planted. Crops included alfalfa, corn, willow, cottonwood, poplar, and switchgrass.

The results of this study demonstrate that hillslope processes influence biomass productivity. Corn grain and stover yield was lowest in flat and depositional areas that retain water for longer periods of time and highest on well drained summit positions. Corn grain yield was not significantly influenced by any of the soil or terrain attributes tested, but corn stover yield was positively influenced by nitrogen, soil darkness profile, and terrain slope.

Willow productivity, on the other hand, was among the highest at the depositional position and lowest at the summit position. Alfalfa and poplar productivity was highest at a site characterized by a relatively steep slope with potentially erosive soils. Understanding landscape position preferences of crops could allow for more efficient use of field space that reduces the risks of traditional agriculture.

This research will help to develop a multifunctional approach to agricultural land management where environmental and ecological components are considered, based on a sound economic foundation. For example, a desire to improve water quality or wildlife habit while maintaining productivity and profitability may define decision making in this context.

Including perennial crops as part of the overall cropping system is one option for improving profitability while meeting water quality and/or wildlife habitat goals. Overall, this study represents a novel approach to the design of cropping system strategies that lead to optimizing the landscape through a deeper understanding of site-specific crop growth in

the context of economic, environmental, and social goals.

More information: View the abstract at agron.scijournals.org/cgi/content/full/102/2/513

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