Dec 3rd, 12:00 AM

Nutrient management PLUS with perennial grass STRIPS

Matt Liebman
Iowa State University, mliebman@iastate.edu

Tim Youngquist
Iowa State University, timyoung@iastate.edu

Ken Moore
Iowa State University, kjmoore@iastate.edu

Jill Euken
Iowa State University, jeuken@iastate.edu

Nutrient management PLUS with perennial grass STRIPS

Matt Liebman, Agronomy, Iowa State University; Tim Youngquist, Agronomy, Iowa State University; Ken Moore, Agronomy, Iowa State University; Jill Euken, Bioeconomy Institute, Iowa State University

This session will share learnings from two applied research projects conducted in Iowa that are designed to 1) decrease soil erosion; 2) improve water quality; 3) provide feedstocks for bioprocessors; and, 4) improve farm profitability.

Spreading prairie strips to Iowa farms for improved water quality, soil conservation, and biodiversity

Finding ways to balance the enormous productivity of corn and soybean farms with conservation of soil, water, and other natural resources is a priority in Iowa and throughout the Midwestern United States. Current signs of environmental stress in the Corn Belt include impaired water quality, shrinking wildlife populations, and rates of soil erosion on farm fields that exceed rates of soil formation.

The Science-based Trials of Row-crops Integrated with Prairie Strips (STRIPS) project seeks to improve water quality, biodiversity, and soil conservation in the Corn Belt by assisting commercial farmers with implementing, on their own fields, a new conservation practice that is compatible with corn and soybean production. Three concepts form the core of the STRIPS approach. The first building block is that small, strategically targeted changes in how farm landscapes are managed can result in disproportionately large conservation benefits. The second is that native prairie grasses and broadleaf species are more effective in minimizing the flow of water and sediment than are cool-season forage grasses like smooth brome. Under high rainfall and heavy flow conditions, stiff-stemmed prairie species remain upright, slowing the movement of water and impeding the movement of soil. In contrast, brome and other species commonly used in grassed waterways lay flat, allowing water and soil to move downslope. The third foundational concept is that diverse biological communities require appropriate habitat. Prairie species can provide excellent habitat for insects that attack crop pests and serve as pollinators, and for game birds and other wildlife.

Since 2007, the STRIPS team has collected data from experimental watersheds at the Neal Smith National Wildlife Refuge in Jasper County, IA, that indicate that converting 10% of the area occupied by no-till corn and soybean production to strips of reconstructed prairie led to a 95% increase in soil retention, a 90% increase in total phosphorus retention, an 84% increase in total nitrogen retention, and a 63% increase in rainfall infiltration (Helmers et al. 2012, Hernandez-Santana et al. 2013, Zhou et al. 2014). We also have documented a 3.9-fold increase in plant diversity and a 1.6-fold increase in native bird abundance (MacDonald 2012, Hirsh et al. 2013).

In 'Phase II' of the STRIPS project, we seek to achieve similar improvements in a broad area by assisting private farmer cooperators establish prairie strips in farm fields. Economic analyses indicate that prairie strips are affordable, costing approximately $25-40 per treated acre (based on establishment, management and opportunity costs), much less than common conservation practices, such as terraces and reconstructed wetlands (Tyndall et al. 2013). Prairie strips also have low labor requirements for establishment and maintenance. Conversations with Natural Resource Conservation Service leaders in Iowa suggest that the use of prairie conservation strips fits within existing contour buffer (CP332) and filter strip (CP393) practice standards, making the practice compatible with federal cost-share programs, such as the Environment Quality Incentives Program (EQIP).

The STRIPS team began on-farm work with a cooperator in Taylor Co., IA, in fall 2012. Since then, strip designs and implementation has been carried out with additional cooperators throughout Iowa and northern Missouri. By December 2014, we expect to have prairie conservation strips on at least 20 farms. These sites will be monitored in the coming years with regard to soil, water, and wildlife indicators; farm operators and STRIPS team members will share information from these sites with the agricultural community and general public. In the future, we seek to understand the potential for harvesting prairie strips as feedstocks for fuels and other bio-products.

CenUSA Bioenergy

CenUSA Bioenergy is a project funded by the USDA that is developing a regional system for producing advanced transportation fuels and bio-products derived from perennial grasses grown on land that is either unsuitable or marginal for row crop production.

The project has developed and released a new higher yielding switchgrass variety named "Liberty."

Table 1. Switchgrass yields at four locations.

Cultivar	DeKalb, IL 42° N	Arlington, WI 43° N	Marshfield, WI 45° N	Spooner, WI 46° N	Mean
			---------- Mg/ha ----------		
Summer	8.48	7.24	8.31	9.20	8.31
Kanlow	9.20	4.57	3.16	2.52	4.87
Liberty	16.38	9.05	11.11	12.45	12.25
% increase	78%	25%	34%	36%	38%

Table 2. Grass and grass mixture yields from field scale plots in eastern Nebraska. Transported Yield = baled, transported off the field and weighted to estimate loss.

Feedstock	2012 Yield	2013 Yield	2013 Transported Yield
Liberty switchgrass (Mg/ha)	7.6	18.5	11.4
Big bluestem (Mg/ha)	2.7	12.7	9.2
LD Mixture (Mg/ha)	4.3	14.5	11.2
Corn (bu/acre)	103 (1.4 tons)	149 (1.9 tons)	---

The project has identified germplasm characteristics amenable to pyrolytic conversion and evaluated the performance of the different grasses when processed via pyrolysis into biofuels. (Pyrolytic biofuels are produced by deconstructing the biomass with heat and catalysts to produce a liquid "bio-oil" that can be upgraded to biofuels and biobased chemicals. The pyrolytic process can also be controlled to produce either bio-oil or sugar-rich products. Bio-oil is refined like petroleum into synthetic gasoline and biodiesel.)

The CenUSA project has also created educational modules for use in middle-school and high school learning programs (science, math, vocational-ag and 4-H), as well as undergraduate and graduate programs. The project has established on-farm perennial grass demonstration plots in IA, NE, MN, and IN; and developed a host of extension publications, videos and decision tools for farmers and agricultural industry leaders that are available at: http://www.extension.org/pages/68136/resources-from-cenusa-sustainable-production-and-distribution-of-bioenergy-for-the-central-usa#.VF0fw_PnaM8.

ADM and Renmatix (industrial biomass processors) are testing the grasses produced in this project in their pilot scale plants and are providing valuable feedback to the project team regarding commercialization opportunities.

References cited

Helmers, M.J., X. Zhou, H. Asbjornsen, R. Kolka, M.D. Tomer, and R. Cruse. 2012. Sediment removal by perennial filter strips in row-cropped ephemeral watersheds. Journal of Environmental Quality 41: 1531-1539.

Hernandez-Santana. V, X. Zhou, M. Helmers, H. Abjornsen, R. Kolka, M. Tomer. 2013. Native prairie filter strips reduce runoff from hillslopes under annual row-crop systems in Iowa, USA. Journal of Hydrology 477: 94-103.

Hirsh, S.M., C.M. Mabry, L.A. Schulte, and M. Liebman. 2013. Diversifying agricultural catchments by incorporating tallgrass prairie buffer strips. Ecological Restoration 31: 201-211.

MacDonald, A.L. 2012. Blurring the lines between production and conservation lands: Bird use of prairie strips in row-cropped landscapes. M.S. thesis, Iowa State University, Ames, IA.

Tyndall, J.C., L.A. Schulte, M. Liebman and M. Helmers. 2013. Field-level financial assessment of contour prairie strips for enhancement of environmental quality. Environmental Management 52: 736-747.

Zhou, X., M.J. Helmers, H. Asbjornsen, R. Kolka, M. Tomer, and R. Cruse. 2014. Nutrient removal by prairie filter strips in agricultural landscape. Journal of Soil and Water Conservation 69: 54-64.

Information resources

STRIPS project website: www.prairiestrips.org

STRIPS project videos: www.leopold.iastate.edu/news/strips-video

Prairie Conservation Strips on My Land: Frequently Asked Questions: www.leopold.iastate.edu/sites/default/files/STRIPS-FAQ.pdf

Small Changes, Big Impacts: Prairie Conservation Strips: www.leopold.iastate.edu/pubs-and-papers/2014-07-small-changes-big-impacts-prairie-conservation-strips

The Cost of Prairie Conservation Strips: www.leopold.iastate.edu/pubs-and-papers/2013-08-cost-prairie-conservation-strips

A Landowner's Guide to Prairie Conservation Strips: www.leopold.iastate.edu/pubs-and-papers/2013-08-landowners-guide-prairie-conservation-strips

Resources from CenUSA - Sustainable Production and Distribution of Bioenergy for the Central USA: http://www.extension.org/pages/68136/resources-from-cenusa-sustainable-production-and-distribution-of-bioenergy-for-the-central-usa#.VF0fw_PnaM8