Management and Life Cycle Assessment of Bioenergy Crop Production

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Managing Ecosystem Functions of Forage and Grazing Lands (SY:Biofuels Adler 1.0)
Penn State University Research Farms

Hawbecker Farm
Bioenergy cropping systems trial

Russell E. Larson Agricultural Research Center, Rock Springs, PA
On-Farm Research Collaborators

Ernst Conservation Seeds, Meadville, PA

Bluestem Farms, Chestertown, MD

Monona Farms, Ligonier, PA
Recent Accomplishments

• Marginal croplands
• Grassland management practices
• Life cycle assessment
Marginal croplands: survey of conservation lands in the Northeastern US

34 grasslands were sampled in NY, PA, NJ, MD, and VA during late August through mid-October
Marginal croplands: survey of conservation lands in the Northeastern US

- plant composition
- biomass yield
- biofuel quality

280 plant species identified at 34 grasslands, most were rare.

Perennial grasses were the dominant functional group.

Aboveground biomass averaged 6.6 Mg/ha.

Grassland management practices: seasonal harvest time

- fall vs. spring harvest
- biomass yield
  * decreased up to almost 40% depending on snowfall
- biofuel quality
  * moisture 35 vs. 7%
  * ash 3.5 vs. 2.5%
  * gasification yields were similar per unit biomass.
  * ethanol yields depended on assessment method.

Grassland management practices: seasonal harvest time

–Annual summer and spring yields similar
Grassland management practices: seasonal harvest time and frequency

- biomass yield

- 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).

Life cycle assessment: GHG emissions

- conducted GHG LCA of biofuel crops
- sources and sinks
- net greenhouse gas emissions

2007 Goal: Develop a Market for Switchgrass as a Biofuel

Technical Steering Committee and Collaborators

**Feedstock Management**
Paul Adler, USDA-ARS, University Park, PA

**Feedstock Supply**
Ernst Conservation Seeds, Meadville, PA
Michael Pruss, Wildlife Biologist, Pennsylvania Game Commission, Harrisburg, PA
Matt Belding, Land Management Officer, Blue Marsh, Pennsylvania Game Commission

**Pellet Stove Evaluation**
Bruce Miller, Associate Director, The Pennsylvania State University, The Energy Institute, University Park, PA

**Pellet Stove Companies/Dealers**
Harman Stove Company, Halifax, PA
Dell-Point Technologies, Blainville, Quebec, Canada
Bixby Energy Systems, Roger, MN
Verner, Inc., distributed in US by This Warm House, Mansfield, PA
Lars Lang, Daniels Run Energy, Washington, PA

**Business Plan Development**
Ernst Conservation Seeds, Meadville, PA
Joel Morrison, Fund Administrator, West Penn Power Sustainable Energy Fund, Inc.

**Outreach/Technology Transfer**
Paul Adler, USDA-ARS, University Park, PA
Ryan Koch, RC&D Coordinator, Pocono Northeast RC&D, Mayfield, PA
Scott Singer, Wildlife Biologist, USDA-NRCS, Bloomsburg, PA
Ernst Conservation Seeds, Meadville, PA
Gary Sheppard, County Extension Director, Penn State Cooperative Extension, Westmoreland County, Greensburg, PA
Pennsylvania State Grant Proposals Funded

Governor Rendell’s Energy Harvest Program Investing $5.1 Million in PA’s Future
Pennsylvania Energy Harvest Program, Department of Environmental Protection (DEP)

LACKAWANNA County PA
• Pocono Northeast Resource Conservation & Development Council - $393,590 for a mobile pelletizing unit at the council’s Mayfield facility for pelletizing wild grasses for combustion in biomass fuel burning systems. The system will produce approximately 1,600 tons of clean-burning fuel that can be used in any flexible fuel boiler unit.

Governor Rendell Announces $6.4 Million for Clean Energy Projects
Pennsylvania Economic Development Association (PEDA)

COLUMBIA Country PA
• Benton Area School District - $350,000 for a biomass-fired boiler heating system. The flexible-fuel system would replace 37,000 gallons of heating oil a year and use local biomass materials such as native grass pellets, wood pellets and corn to provide 80 percent of the district’s heating needs. In addition to reducing the district’s heating costs, the project will provide incomes to local farmers producing the biomass.
Current Research Projects and Objectives

• Marginal croplands
  - CRP survey – biomass yield and biofuel quality

• Grassland management practices

• Life cycle assessment
Activities Planned for Next Couple of Years

- Grassland management practices
  - seasonal harvest time and frequency
  - N management – internal N cycling

- Life cycle assessment
  - DAYCENT validation – N₂O emissions, C Sequestration
  - national assessment of biofuels impact on US GHG inventory
GRACEnet (Greenhouse gas Reduction through Agricultural Carbon Enhancement network)

-develop agricultural strategies that will enhance soil C sequestration and reduce greenhouse gas emissions

Curtis Dell, Howard Skinner, and Paul Adler

Eddy Covariance Flux Tower

- quantify net CO₂ flux
- carbon sequestration

Howard Skinner and Paul Adler

Matt A. Sanderson
Penn State Biomass Energy Center

• Environment and Natural Resources Institute
• Penn State Institutes of the Environment
• Huck Institutes of the Life Sciences
• Materials Research Institute
• Energy Institute
• Hydrogen Energy Center
• Pennsylvania Transportation Institute
• Schatz Center of Tree Molecular Genetics
• Center for Metallobiochemistry
• Center for Microbial Structural Biology
• USDA-ARS Pasture Systems and Watershed Management Research Unit
Current and Planned Collaborations

Within USDA-ARS
Steven J. Del Grosso, Soil Plant Nutrient Research Unit, USDA-ARS, Fort Collins, CO
Akwasi A. Boateng, Eastern Regional Research Center, USDA-ARS, Wyndmoor, PA
Kenneth P. Vogel, Grain, Forage, and Bioenergy Research Unit, USDA-ARS, Lincoln NE
Hans-Joachim G. Jung, Plant Science Research Unit, USDA-ARS, St. Paul, MN
Michael D. Casler, US Dairy Forage Research Center, USDA-ARS, Madison, WI
Peter Vadas, US Dairy Forage Research Center, USDA-ARS, Madison, WI
Paul J. Weimer, US Dairy Forage Research Center, USDA-ARS, Madison, WI
Gary M. Banowetz, Forage Seed and Cereal Research Unit, USDA-ARS, Corvallis, OR

Outside of USDA-ARS
Thomas L. Richard, Director, Biomass Energy Center, Penn State University, University Park, PA
William E. Easterling, Director, Penn State Institutes of the Environment, University Park, PA
William S. Curran, Penn State University, University Park, PA
William J. Parton, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO

On-Farm
Calvin Ernst, Ernst Conservation Seeds, Meadville, PA
Evan Miles, Bluestem Farms, Chestertown, MD
Tom Stickle, Monona Farms, Ligonier, PA