

NP213 (307) BIOENERGY Planning and Coordination Meeting

Management and Life Cycle Assessment of Bioenergy Crop Production

Paul R. Adler

USDA-ARS Biofuel Research Program
University Park, Pennsylvania

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

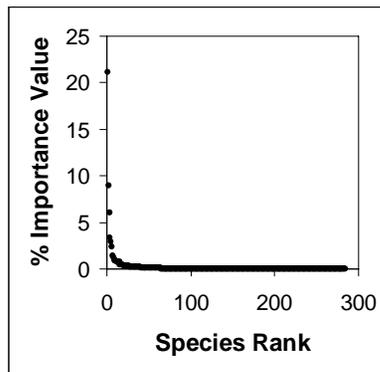
Marginal croplands: survey of conservation lands in the Northeastern US



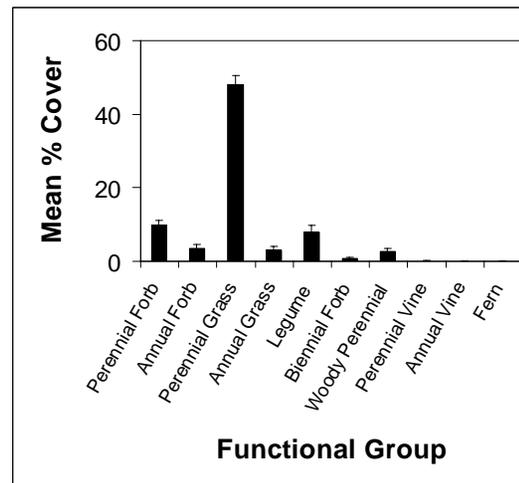
34 grasslands were sampled in NY, PA, NJ, MD, and VA during late August through mid-October

Marginal croplands: survey of conservation lands in the Northeastern US

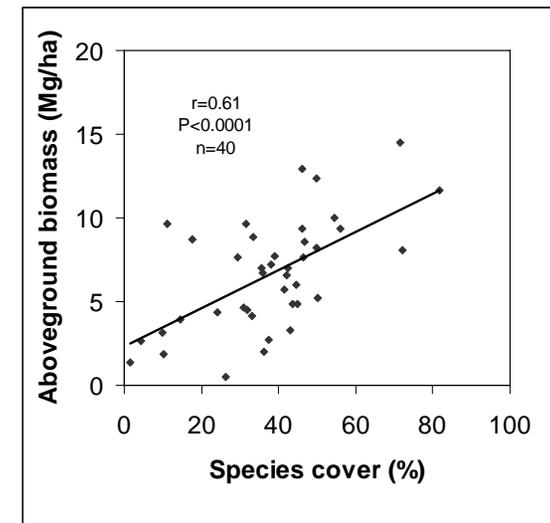
- plant composition
- biomass yield
- biofuel quality



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



Perennial grasses were the dominant functional group.



Aboveground biomass averaged 6.6 Mg/ha.

*Adler, P.R., M.A. Sanderson, and S.C. Goslee. 2007. Plant species diversity of conservation lands in the Northeastern United States. *Plant Ecology*

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%

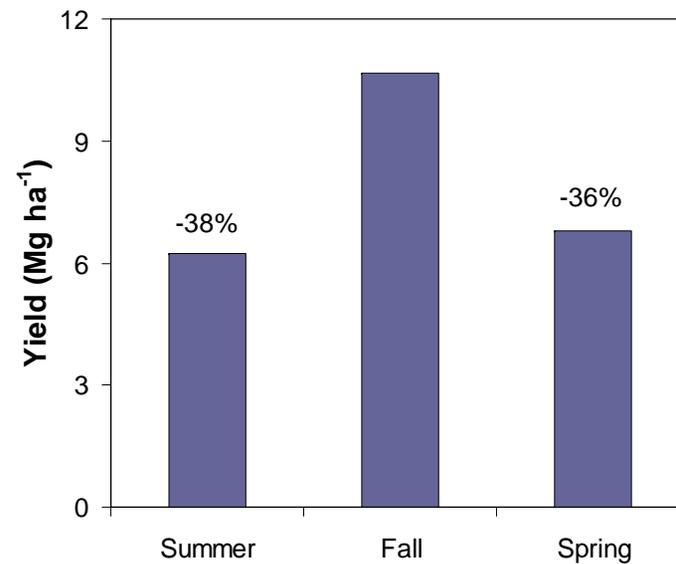
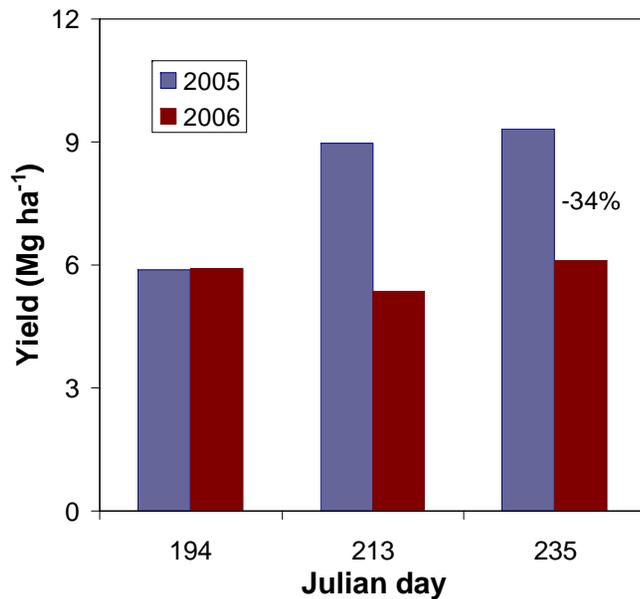
 - *gasification yields were similar per unit biomass.

 - *ethanol yields depended on assessment method.

*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.

Grassland management practices: seasonal harvest time

–Annual summer and spring yields similar



Grassland management practices: seasonal harvest time and frequency

–biomass yield

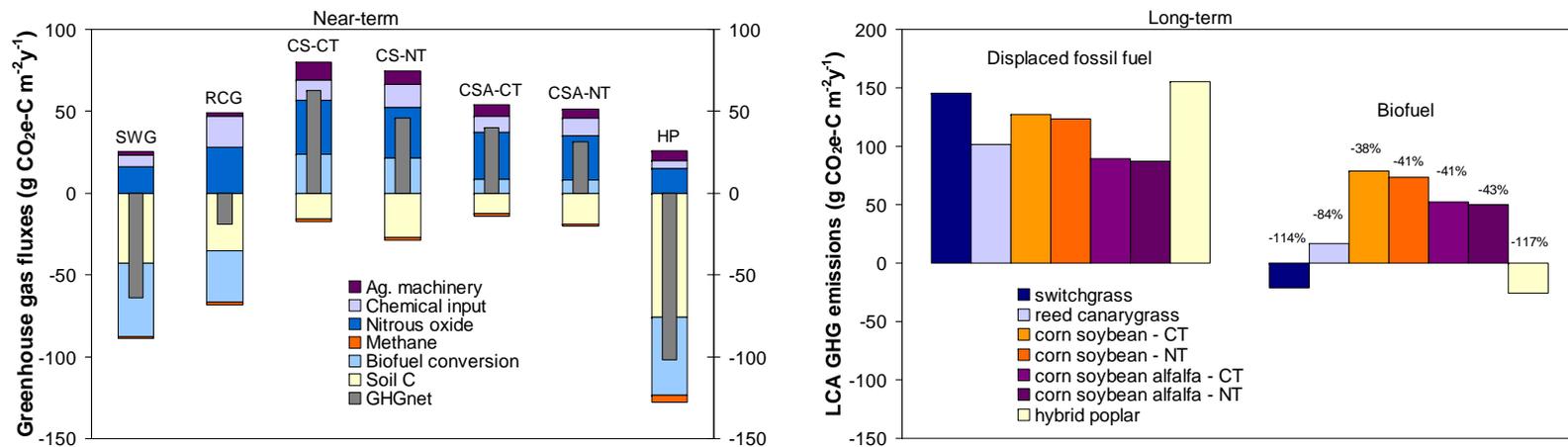
–biofuel quality

- 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).

*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: GHG emissions

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



*Adler, P.R., S.J. Del Grosso, and W.J. Parton. 2007. Life cycle assessment of net greenhouse gas flux for bioenergy cropping systems. Ecological Applications (in press)

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

- *Adler, P.R., M.A. Sanderson, A.A. Boateng, P.J. Weimer, and K.P. Vogel. 2007. Biomass yield and biofuel quality of conservation lands in the Northeastern United States.

- 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

USDA-ARS Scientists at University Park, PA collaborating with bioenergy research program

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



N₂O measurements

Eddy Covariance Flux Tower

– quantify net CO₂ flux
– carbon sequestration

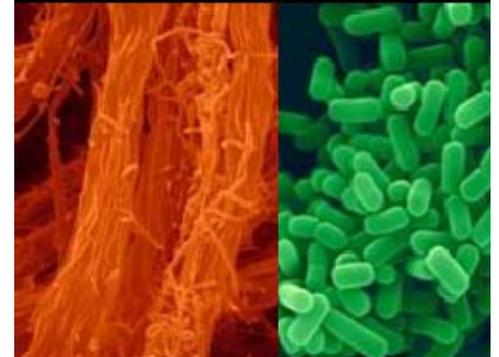
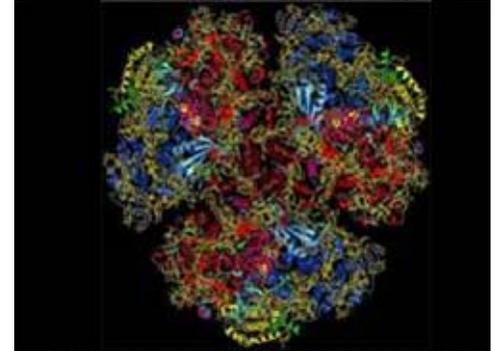
Howard Skinner and Paul Adler

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
Akwasí 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. Banowitz, 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

