Sustainable Feedstocks for Advanced Biofuels

September 28-30, 2010
Embassy Suites, Centennial Olympic Park ◊ Atlanta, GA

Agenda

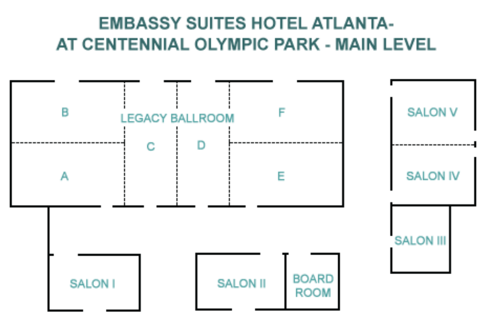
Tuesday, September 28th — **Legacy Ballroom**
8:00 a.m. to 7:00 p.m.
- Lunch (Noon) — Atrium
- Poster Reception (5-7p) — Legacy Ballroom

Wednesday, September 29th — **Legacy Ballroom**
8:00 a.m. to 4:30 p.m.
- Lunch (Noon) — Atrium
- Speaker: Jody Endres, Energy Biosciences Institute

Thursday, September 30th — **Legacy Ballroom**
8:00 a.m. to 11:45 a.m.

Breakout session room assignments for workshop:

Region	***Facilitator***	***Recorder***	***Room***
Corn/Soybean Belt	*Dave Dornbusch*	*Newell Kitchen*	*Legacy Ballroom*
Northeast	*Mark Risse*	*Jason Evans*	*Legacy Ballroom*
Southeast	*Gary Hawkins*	*Chere Peterson*	*Salon IV*
Mid-South	*Pradip Das*	*John Snider*	*Salon V*
Great Plains	*Jim Doolittle*	*Alan Franzluebbers*	*Salon I*
West of Rockies	*Don Wysocki*	*Stefanie Aschmann*	*Salon II*



Workshop hosted by the
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Sustainable Feedstocks for Advanced Biofuels

A workshop to create regionally specific roadmaps for feedstock supply chains.

September 28-30, 2010

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<table>
<tr><th>Tuesday</th><th>Session Description</th><th>Writing Team & Presenter*</th></tr>
<tr><td>8:00 a.m.</td><td>Workshop Welcome — Goals & Desired Outcomes</td><td>Doug Karlen, USDA-ARS
Jeff Steiner, USDA-ARS
Jim Gulliford, SWCS</td></tr>
<tr><td>8:10 a.m.</td><td>Landscape Management and Sustainable Feedstock Production: Enhancing Net Regional Primary Productivity while Minimizing Externalities</td><td>Timothy C. Strickland, USDA-ARS*
Richard Lowrance, USDA-ARS
Fernando Miguez, Iowa State University
Bill Anderson, USDA-ARS
Tom Sauer, USDA-ARS
Joe Knoll, USDA-ARS</td></tr>
<tr><td>8:45 a.m.</td><td>Bioenergy Sustainability at the Regional-Scale</td><td>Richard Lowrance, USDA-ARS*
Virginia Dale, Oakridge National Lab
Patrick Mulholland, Oakridge National Lab
Phil Robertson, Michigan State University</td></tr>
<tr><td>9:20 a.m.</td><td colspan="2">Regional Discussions: Participant groups, organized by geographic region, will each have a facilitator and recorder. The facilitator will work with the participants to complete the “Roadmap Templates” (see page 7) and guide the discussion.

Breakout session room assignments and facilitators:
<table>
<tr><th>Region</th><th>Facilitator</th><th>Recorder</th><th>Room</th></tr>
<tr><td>Corn/Soybean Belt</td><td>Dave Dornbusch</td><td>Newell Kitchen</td><td>Legacy Ballroom</td></tr>
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<tr><td>West of Rockies</td><td>Don Wysocki</td><td>Stefanie Aschmann</td><td>Salon II</td></tr>
</table></td></tr>
<tr><td>10:00 a.m.</td><td colspan="2">Break</td></tr>
<tr><td>10:15 a.m.</td><td>Feedstock & Conversion Platform Interactions
Identifying Industry Needs</td><td>Corey Radtke, Shell*
Evan DeLucia, University of Illinois*
Michael Desmond, BP
Mike Ladisch, Purdue
David Agneta, Verenium
Robert Brown, ISU</td></tr>
</table>

Tuesday	Session Description	Writing Team & Presenter*
10:45 a.m.	Water Resource Impacts of Feedstock Production and Conversion	Jerad Bales, USGS* Carl Bernacchi, USDA-ARS Noel Gollehon, NRCS
11:15 a.m.	**Regional Discussions**	
Noon	Lunch (Provided)	Informal discussions
	OUR FEEDSTOCK KNOWLEDGE BASE	
1:00 p.m.	Crop Residues – Balancing feedstock and soil carbon needs by enhancing productivity with conservation tillage, cover crops, and biochar.	Jane Johnson, USDA-ARS – MN* Rattan Lal, The Ohio State Univ. Gary Banowetz, USDA-ARS – OR David Laird, USDA-ARS – IA Francisco Arriaga, USDA-ARS – AL Dave Huggins, USDA-ARS – WA
1:25 p.m.	Herbaceous Perennials – Where should they be placed, what are their benefits, and what are the challenges of incorporating them into diversified landscapes?	Rob Mitchell, USDA-ARS – NE* Vance Owens, SDSU Neal Gutterson, Mendle Biotech Jacob Barney, Virginia Tech Edward Richard, USDA-ARS
1:50 p.m.	Woody Feedstocks – What do we know about their management and how will the different sources vary regionally?	Tim Volk, SUNY* Jim Perdue, FS Marilyn Buford, FS Brian Stanton, Greenwood Res. Ron Saranich, FS Leroy Reitsma, Pinnacle Pellet
2:15 p.m.	Oilseed and Algal Oils as Biofuel Feedstocks	John Gardner, Washington State Univ.* Nigel W. T. Quinn, Berkeley National Lab John Van Gerpen, Univ. Idaho
2:40 p.m.	**Regional Discussions**	
3:00 p.m.	**Break**	
3:20 p.m.	Where will N, P, and K come from to support a 32 billion gal biofuel industry?	Scott Murrell, IPNI* Paul Fixen, IPNI John Kovar, USDA-ARS Paul White, USDA-ARS
3:45 p.m.	Economics of Feedstock Production, Harvest, Storage, and Transport	John Miranowski, ISU* Madhu Khanna, EBI – UIUC Mike Ladisch, Purdue Richard Hess, INL
4:10 p.m.	Balancing Feedstock Economics & Ecosystem Services	Manik Anand, Auburn Univ. David Archer, USDA-ARS* Jason Bergtold, Kansas State University Elizabeth Canales, Kansas State University
4:35 p.m.	**Regional Discussions**	
5:00 p.m. to 7:00 p.m.	**Cash Bar & Review of Poster Presentations**	

Wednesday	Session Description	Writing Team & Presenter*
8:00 a.m.	Review of Workshop Goals & Desired Outcomes	Doug Karlen & Jeff Steiner
8:10 a.m.	**Regional Discussion Report Out:** Facilitators will report on (1) agreements and/or disagreements with first day presentations and (2) the three primary feedstocks for their region. The entire group will participate in a discussion of poster presentations or other questions from Day 1.	
9:20 a.m.	**SELECTED FEEDSTOCK CASE STUDIES**	
	Challenges and opportunities with implementing commercial lignocellosic biofuel plants	Thomas Robb, Abengoa* Mike Roth, POET
10:00 a.m.	**Break**	
10:20 a.m.	Experiences with co-Mingling Municipal Solid Waste and Herbaceous Feedstock	Donna Perla, EPA* Bill Orts, USDA-ARS
10:45 a.m.	The DAM Stover Removal Project	Mike Edgerton, Monsanto* Pradip Das, Monsanto John Hickman, John Deere
11:10 a.m.	Pyrolysis and Biochar – Opportunities for Distributed Production and Soil Quality Enhancement	David A. Laird, Iowa State University Natalia P. Rogovska, Iowa State University Manuel Garcia-Perez, Washington State University Harold P. Collins, USDA-ARS, Prosser, WA Jason D. Streubel, Washington State University
11:35 a.m.	Practical experiences with Woody Feedstock Production	Bill Berguson, University of Minnesota* Jake Eaton, GWR Brian Stanton, Greenwood Resources Tim Eggeman, ZeaChem Carrie Atiyeh, ZeaChem
Noon	Biomass Sustainability Standards: Can Existing Agricultural Conservation Programs Provide a Foundation for Planning, Measurement, and Verification of Renewability?	Jody Endres, Energy Biosciences Institute
1:00 p.m.	**Regional Discussion:** Facilitators will continue “Roadmap Discussions” focusing on how the Case Studies or Policy Considerations may have affected feedstock priorities or raised important research questions.	
1:30 p.m.	**TOOLS FOR ENSURING SUSTAINABLE FEEDSTOCK SUPPLIES**	
	Sustainable solutions from field to fuel for advanced biofuel production	Kyle Althoff, DuPont Danisco Cellulosic Ethanol, LLC (DDCE)* Robin Jenkins, DuPont* Jennifer Hutchins, DDCE Christopher Johnas, DuPont Carina Alles, DuPont Doug Haefele, Pioneer

Wednesday	Session Description	Writing Team & Presenter*
2:15 p.m.	Modeling tools and strategies for developing sustainable feedstock supplies.	Fernando Miguez, Iowa State University* Mike Dietze, University of Illinois, Urbana-Champaign Armen Kemanian, Penn State University
3:00 p.m.	**Break**	
3:20 p.m.	Are Local, State, and Federal Biofuel Efforts Synchronized?	Steve Kaffka, UC Davis* Ward Lenz, NC State Energy Office Kelly Tiller, Genera Energy, LLC Lloyd Ritter, Green Capitol Michael McAdams, Brownstein Hyatt Farber Schreck
3:50 p.m.	**Regional Discussions**	
4:30 p.m.	**Adjourn for day.** Evening on your own – identify gaps in your regional roadmap	

Thursday	Session Description	Writing Team & Presenter*
8:00 a.m.	Review of Workshop Goals & Desired Outcomes	Doug Karlen & Jeff Steiner
8:10 a.m.	**Regional Discussion:** Facilitators will lead discussion identifying unanswered feedstock questions for each of the regions	
8:40 a.m.	Climate Change – What to Expect and How Will it Affect Feedstock Production Options?	Jerry Hatfield, USDA-ARS*
9:10 a.m.	Can the U.S. really meet emerging food, feed, fiber, fuel, and export demands – all at the same time?	Harry Baumes, OCE – Office of Energy Policy & New Uses* Chris Field, Stanford
9:40 a.m.	**Break**	
10:00 a.m.	The President's Interagency Working Group Biofuel Strategy – The importance of sustainable feedstock production	Jeff Steiner, USDA-ARS*
10:45 a.m.	**Regional Discussion:** Continued Discussion and finalization of Regional Roadmaps. Identification of research gaps for which we currently lack answers.	
11:30 a.m.	Workshop Wrap-Up & Adjourn Chapter & Roadmap publication timelines.	Doug Karlen & Jeff Steiner

WORKSHOP TEMPLATE:
A Roadmap for Sustainable Feedstocks for Advanced Biofuels

Purpose: This document was developed as an outcome of the Soil and Water Conservation Society (SWCS) workshop entitled "Sustainable Feedstocks for Advanced Biofuels: A workshop to create regionally specific roadmaps for feedstock supply chains."

Region: This plan was developed for the ____________________ region of the U.S.

Participants: Name, Affiliation & email will be listed

Section I. Broad Overview Issues

1. Based on the regional net primary productivity (NPP), what are the three (or more) most promising advanced biofuel feedstock sources for this region?
    a. What characteristics make these the most suitable?
    b. What is the current availability of each feedstock source?
2. What research and development questions must be answered to ensure sustainable supplies of these feedstock sources?
3. What points made by the presenters of the two background papers do you agree with or disagree with?
4. Based on the information received regarding feedstock and conversion platform interactions and potential water resource limits, are the feedstock sources identified above still correct?
    a. What changes are needed?
5. What points made by the presenters of the two background papers do you agree with or disagree with?
6. Which of the conversion platforms do you see as being most probable for this region?

7. What water resource considerations do you see as being most limiting for sustainable feedstock production in this region?

8. What research and development questions related to conversion platforms and/or water resource limits must be answered to ensure sustainable supplies of your chosen feedstock sources?

Section II. Feedstock Specific Issues

9. What points in the four feedstock specific presentations do you agree with or disagree with?

10. Based on the information received regarding crop residue, herbaceous perennials, woody species, and lipid-based, oilseed and algal feedstock sources, are the feedstock choices identified in Section I still correct?

11. If not, what changes are needed?

12. For this geographic region, is the existing knowledge base regarding advanced biofuel feedstock sources, availability, and management requirements sufficient to develop a sustainable supply?

    a. Is this true for all potential conversion platforms?

13. What research and development questions related to your specific feedstock selections remain unanswered and therefore could hinder development of sustainable advanced biofuel feedstock supplies?

Section III. Potential Limiting Factors

14. What points in the three limiting factor presentations do you agree with or disagree with?

15. For your advanced biofuel feedstock selections, what nutrient supply and/or management questions are most likely to limit sustainable feedstock supplies?

16. For your advanced biofuel feedstock selections, which production, harvest, storage, and/or transportation factors are most likely to limit sustainable feedstock supplies?

17. For your advanced biofuel feedstock selections, what challenges related to balancing economics and ecosystem services do you anticipate could limit sustainable feedstock supplies?

Section IV. Selected Feedstock Case Studies

18. What points in the five case-study presentations do you agree with or disagree with?

19. What research and development questions related to your specific feedstock selections have these practical experiences raised for you with regard to developing sustainable advanced biofuel feedstock supplies?

Section V. Lifecycle, Modeling and Policy Issues

20. What points in these three presentations do you agree with or disagree with?

21. What research and development questions related to life cycle analysis, modeling, and policy need to be addressed to ensure the development of sustainable advanced biofuel feedstock supplies?

Section VI. Climate Change, Global Realities, and Federal Research Programs

22. What points in these three presentations do you agree with or disagree with?

23. What research and development questions related to climate change, global export demands, and federal research programs need to be addressed to ensure the development of sustainable advanced biofuel feedstock supplies?

Section VII. Recommendations and Action Items

24. What are the most critical take-home messages, research and development needs, and policy actions that are needed to ensure the development of sustainable advanced biofuel feedstock supplies for this region?

Please add additional comments, questions, and evaluations of this workshop now or send to doug.karlen@ars.usda.gov.

NOTES

Poster Presentations & Technology Demonstrations

Economic and Social Impact	
1. Comparison of Ownership Cost for Round vs. Square Baler for Harvesting Perennial Grasses in the Upper Southeast	John Fike, Virginia Tech
2. Valuing Environmental Assets Derived from Sustainable Biofuel Lifecycles	Rory Gopaul, Carbon Solutions Group
3. The Case for Producer Ownership and Management of Multiple Segments of the Biomass Supply Chain	Joseph J. Molnar, Auburn University
4. Biofuel Feedstock from Claypan Soils for Annual Grain and Perennial Switchgrass	Gregory W. Landers, Univ. of Missouri
5. A Web-Based Biomass Site Assessment Tool (BIOSAT)	Timothy M. Young, University of Tennessee
Ecosystem Service Impact	
6. Cover Crop Biomass Harvest for Bioenergy: Implications for Crop Productivity	Francisco J. Arriaga, USDA-ARS
7. Will the Non-native Biofuel Switchgrass Be Invasive In California? A Case Study	Jacob Barney, Virginia Tech
8. Impact of second-generation biofuel agriculture on greenhouse gas emissions in the corn-growing regions of the US	Evan H. DeLucia, University of Illinois
9. Development and optimization of an Agro-BGC ecosystem model for C4 perennial grasses	Alan Di Vittorio, Energy Biosciences Institute, University of California at Berkeley
10. Role of corn cob residue fraction in carbon and nutrient dynamics	Brian J. Wienhold, USDA-ARS
11. USDA/ARS REAP Data to Support National Impact on Soil	Greg Wilson, USDA-ARS

Harvest-Storage-Transport (HST)	
12. In Search of an Advanced Biofuel Technology that is Profitable at a Small Scale	David Bransby, Auburn University
13. Drying Sorghum Biomass for Advanced Biofuels Production in Southeastern U.S.	Alexandre Caldeira Rocateli, Department of Agronomy and Soils, Auburn University
Production	
14. Biomass Production of Perennial Grasses Under No Inputs in South Georgia	William F. Anderson, USDA-ARS, Tifton, GA
15. Inorganic and Organic Nitrogen Sources for Optimal Rye Cover Crop Biomass Production	Kip Balkcom, USDA-ARS
16. Lifecycle Energy and Greenhouse Gas Emissions from an Ethanol Production Process Based on Blue-Green Algae	Dong Gu Choi, Georgia Institute of Technology
17. Bio-fiber Feedstock Production Model	Donald L. Cordes, Ph.D., CEO IABF
18. Biofuels Research Program at Tennessee State University	Jason P. de Koff, Tennessee State University
19. Biofuel Potential of Cellulosic Double Crops across the U.S. Corn-Soybean Belt	Gary W. Feyereisen, USDA-ARS
20. Penn Center Germplasm Switchgrass for Coastal Carolina	David N. Findley USDA-NRCS
21. Twenty-year Biomass Yields for Eight Switchgrass Cultivars in Alabama	Ping Huang, Auburn University
22. Assessing Production and Ecosystem Function for Grain and Bioenergy Feedstock Crops Across Variable Soil Landscapes	Newell Kitchen, USDA ARS Cropping Systems and Water Quality
23. Managing Nutrients for Sustainable Bio-energy Feedstock Production	J.L. Kovar, USDA-ARS-NLAE
24. Site-specific assessments of corn stover removal thresholds and environmental impacts in the Upper Mississippi River Basin	Manyowa Norman Meki, Texas AgriLife Research, Blackland Research and Extension Center
25. Fall Armyworm Resistance in Sweet Sorghum	Xinzhi Ni and Bill Anderson, USDA-ARS Crop Genetics and Breeding Research Unit, Tifton, GA

26. What Would It Take for the US South Simultaneously to Meet Renewable Electricity and Greenhouse Gas Mandates and be a Major Producer of Biofuel?	Adaora Okwo and Seth Borin, Georgia Tech
27. Determining Climate, Weather, and Soil Impact on Bioenergy Production Sustainability, An Example from the Southeastern USA	Tomas Persson, Dept Biol and Agric Engineering, The University of Georgia
28. Ethanol Production Yield of Five Warm-Season Perennial Forage Grasses	John J. Read, USDA ARS
29. Native Legumes for Advanced Biofuel Production	John Lloyd-Reilley, USDA-NRCS
30. Producing Sorghum Cellulosic Feedstock for Advanced Biofuels Production and its Impact on Soil Physical Properties	Alexandre Caldeira Rocateli, Department of Agronomy and Soils, Auburn University
31. Comparison of five sorghum cultivars for biomass and alcohol production	Carla E. Shoemaker, Auburn University
32. Biofuels Production Options and Potentials in the Southeast	Timothy C. Strickland, USDA-ARS Tifton, GA
33. A Spatial Decision Support Tool to Evaluate the Environmental Impacts of Biofeedstocks	Mark A. Thomas, Purdue University

Technology Demonstrations	
1. Accelerate HST Innovation with Group Decision Support Tools	Alan G. Chute, Ph.D., Iowa Agricultural Bio-Fibers (IABF)
2. Getting it Right The First Time - Simple Approaches to Planting Native Warm Season Species in South Carolina.	David N. Findley, USDA-NRCS
3. Herbaceous perennials: placement, benefits and incorporation challenges in diversified landscapes	Rob Mitchell, USDA-ARS
4. Development of a Generalized Sustainable Agricultural Residue Assessment Tool	David Muth, Idaho National Laboratory

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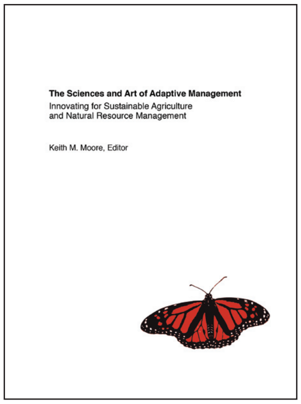


The Sciences and Art of Adaptive Management

This book is the newest addition to the SWCS publications. The 25 authors represent a rich international knowledge base related to sustainable agriculture and natural resource management.

As Keith M. Moore describes in the preface, "Adaptive management is a structured process of learning by doing." Adaptive management is not just a trendy term of the day; it is an approach that will become even more essential in the future to adequately understand the interlinking systems that affect landscape health and to successfully mitigate negative impacts on the environment.

Edited by Keith M. Moore

264 pages

$28/copy

Relationship with the Land

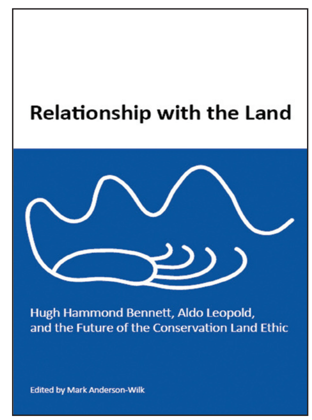
This book presents an analysis of Hugh Hammond Bennett and Aldo Leopold as developers of the conservation land ethic. Key essays included in this book represent the past, current, and future of environmental ethics.

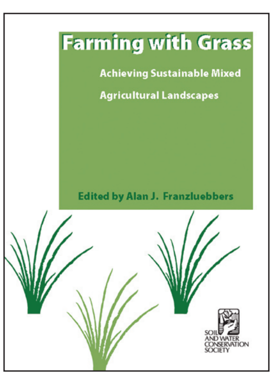
This is an easy to read and thought-provoking book that has applications to policy, science, and practice. It offers a multidisciplinary look at conservation philosophy.

Edited by Mark Anderson-Wilk

150 pages

$18/copy





Farming with Grass: Achieving Sustainable Mixed Agricultural Landscapes

While much of United States farm policy, agricultural research, and SWCS advocacy have focused on cropland issues, over half of US agricultural land is in grass. There is great potential to increase the role of grasslands within agricultural landscapes to address diverse environmental concerns.

The Farming with Grass Conference was created to address these issues, and this book assembles the invaluable information from the conference.

Jean Steiner, USDA ARS; Farming with Grass Conference organizer

Edited by Alan J. Franzluebbers

E-book, 238 pages

$24/copy

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Economic and Social Impact Posters

Poster #1
Ownership Cost Comparisons for Round or Square Balers in the Upper Southeast

John Fike, Virginia Tech
jfike@vt.edu
1. J. Cundiff, Virginia Tech, jcundiff@exchange.vt.edu
2. R. Grisso, Virginia Tech, rgrisso@vt.edu

Baling is the most probable harvest method for perennial grasses that will be used as feedstock for advanced biofuels. Our objective was to compare ownership costs for a round (5 ft diameter x 4 ft long) vs. square (4 ft x 4 ft x 8 ft) baler when amortized over a 9-month harvest season (Jul through Mar) in the Upper Southeast. The database chosen was a set of production fields identified as Section 5 within a 30-mi radius of Gretna, Virginia. This area has 57 Satellite Storage Locations (SSLs) with a maximum of 271 fields associated with any SSL, thus creating a production field matrix of 57 x 271. Harvest days ranged from 7 for month 1 (Jan) to 15 for months 7-9 (Jul to Sep). Total productive harvest time was 863 h/y for the round baler and 796 h/y for the square baler. Field efficiency was input as a function of only field size. Harvesting 138,830 Mg from the production fields over the 9-month harvest season will require 17 round balers versus 11 square balers. Purchase price of the round baler is $30,000 and to recover this investment in 3 years of operation (9-month harvest season), the cost is $1.37/Mg. To recover the $120,000 purchase price of a square baler in 3 years, the cost is $3.57/Mg, or more than 2.5 times the cost of the round baler. This comparison includes only the purchase costs for both machines amortized for an optimistic 9-month harvest season. No operating costs for tractors, the balers, pick-up systems, or labor cost are included. Production scale data such as this are vital to develop viable biomass harvest strategies for sustainable feedstock production.
Keywords: square bale, round bale, bailing cost, perennial grasses, baler ownership

Poster #2
Valuing Environmental Assets Derived from Sustainable Biofuel Lifecycles

Rory Gopaul, Carbon Solutions Group
rmgopaul@carbonsolutionsgroup.com
1. Dan Szeezil, Carbon Solutions Group, dszeezil@carbonsolutionsgroup.com

Carbon Solutions Group would like to present market information and analysis that needs to be taken into consideration when pricing commodity biomass. Environmental assets associated with biomass can have a large impact on profitability and sustainability of projects. Factors to be discussed include: Renewable Energy Credits (RECs) from power generation, Renewable Identification Numbers (RINs) from advanced liquid biofuels, and the inherent value of avoided CO2 in biomass utilization.
The discussion will also include an overview of each type of environmental asset/incentive and the impact on the economic value of commodity biomass to each counterparty in the chain of ownership. An overview of the avoided soil carbon sequestration issues associated with removal of carbonaceous agricultural waste from land and its opportunity cost will be examined. Lastly, the value of biomass to

a utility will be compared to the value of biomass to the pulp & paper industry, export to Europe or cellulosic biofuel producers.

Keywords: Commodity, biomass, Renewable Energy, Biofuels, Renewable Energy Certificates, Renewable Identification Numbers, Carbon Credits, Economic Value, Environmental Assets

Poster #3

The Case for Producer Ownership and Management of Multiple Segments of the Biomass Supply Chain

Joseph J. Molnar, Auburn University
molnajj@auburn.edu

Non-ethanol bioenergy products from biomass crops can help to diversify farm products and therefore create an alternate source of income for farmers and others in the supply chain (Abrahanson et al. 1998). Producer ownership may provide greater opportunity for wealth creation in rural areas and greater opportunities for rural development. Such initiatives are expected to foster rural economic stabilization and job growth by helping farms to remain profitable, providing new employment opportunities, and providing income for non-farming landowners (i.e. retired farmers, absentee and non-farming landowners). Employment and community impacts are created in the supply chain that transports, stores and processes the material. The jobs and income associated with bioenergy crops are connected to production of biomass, preprocessing, transportation. The biorefineries themselves provide employment but also have the known impacts of industrial facilities on local community environments (trucking, noise, odor, effluent) (Freudenburg and Gramling 1992; Lindell and Earle 2006). Bender (1999) concludes that farmers' biodiesel cooperatives should be most successful for farmers who are diversified in both crop and livestock, especially in regions where a large spread exists between the price that farmers receive for their oilseed and the price they pay for protein meal. The economics of biodiesel are volatile due to the large effects of feedstock cost and meal credit. Technology will shape the possibilities and incentives for producer participation in biofuel systems. Producer groups have advantages in developing biofuel projects if they have some certainty about demand and price expectations for the operation. Kenkel and Holcomb (2007) argue that the producer's comparative advantage lies in the production, ownership, and control of feedstock sources. They maintain that future project development depends on the ability to assemble, transport, and store plant materials for regular delivery to central facilities. Whether the project organizers are farmers or energy companies, the adoption of alternative energy crops will be a crucial component of the process. Recruiting sustained sources of supply will require incentives and participatory mechanisms that attract farmers and sustain their commitment to a long term process. The aim of this study is to elucidate these processes as a context for empirical research on the impacts of biofuel development.

Keywords: Adoption, participation, sustained involvement

Poster #4
Biofuel Feedstock from Claypan Soils for Annual Grain and Perennial Switchgrass
Gregory W. Landers, Univ. of Missouri
gwlmr6@mail.missouri.edu
1. A.L. Thompson, Univ. Missouri, thompsona@missouri.edu
2. N.R. Kitchen, UDSA-ARS CSWQ Unit Columbia, MO, kitchenn@missouri.edu
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Crop production on the claypan region soils of the U.S. Midwest is an important contributor for agricultural production. However, because of their tendency for grain yield fluctuations caused by water stress, claypan soils may have potential for conversion from grain to grass production in support of biomass energy markets and conservation programs. While corn grain production has been shown to be highly correlated with topsoil depth (a soil property highly variable within fields), we hypothesize a weaker correlation between switchgrass productivity and topsoil thickness. From this we also hypothesize that switchgrass will have a lower risk for production than corn on claypan soils. This study examines the economic potential of transitioning from grain crops to perennial switchgrass production on claypan soils. Baseline data from two sites with varying topsoil depths and underlying claypan layer were used to establish a partial budget analysis to evaluate the stability of a switchgrass system. Specifically, yield and price requirements were used to establish a switchgrass market for Missouri claypan soils. Comparisons include biomass production useful for bioenergy conversion as heating fuel and fluid energy conversion as cellulosic feedstock. Results show that with an average switchgrass yield of 6 ton/acre, the farmgate price would need to be $50/ton in order to compete with 110 bu/acre corn production on the same soils. Alternatively, projections based on cellulosic ethanol conversion and heating values (coal) suggest a required yield range between 12 and 28 tons per acre, respectively, in order to remain competitive with annual corn production (based on $4/bu). Data collected from research plots with four topsoil depth treatments (<2, 2-7, 7-15, & >15 in) included grain and biomass yield, and switchgrass plant density (during establishment) by topsoil thickness and landscape position. Results indicate successful stand densities (20+ plants/m2) are achievable across varying topsoil thicknesses; however, the effect of topsoil depth on biomass yield will not be evaluated until this fall. Modeling of annual grain crop production using the ALMANAC model accounted for 67% of the variability in measured yields across varying topsoil thicknesses. Switchgrass production will be evaluated with this same model.
Keywords: switchgrass, claypan, economic, biomass

Poster #5
A Web-Based Biomass Site Assessment Tool (Biosat)
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Key to ensuring long-term, sustainable cellulose supply is the assessment of the economic availability of woody and agricultural-derived biomass feedstocks. The genesis for any emerging or existing industry is the ability to successfully secure

commercial business loans with a defendable business plan for the expansion of existing plants or development of new manufacturing facilities. A key component of any business plan must include a profitable strategy for the geographic location of a cellulose using facility. This study addresses the problem with the development of web-based system for optimal siting of cellulose using mills called the Biomass Site Assessment Tool (BioSAT) The project integrates contemporary web-based information technology (e.g., Virtual Earth and Microsoft SQL) with existing U.S. Forest Service FIA data, agricultural data, harvesting, and transportation models. BioSAT has real-time database update capabilities. Transportation networks of truck and truck/rail combinations are presented for least cost solutions by zip code tabulation areas for a potential demand site. Least cost sites are selected for 33 Eastern United States using logistic regression models. Producers' marginal cost curves are presented for least cost site locations.
Keywords: Biomass, economic availability, siting model, BioSAT, wood feedstocks, agricultural residue feedstocks.

Ecosystem Service Impact Posters

Poster #6
Cover Crop Biomass Harvest for Bioenergy: Implications for Crop Productivity

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Winter cover crops, such as rye (Secale cereale), are usually used in conservation agriculture systems in the Southeast. Typically, the cover crop is terminated two to three weeks before planting the summer crop, with the cover biomass left on the soil surface as a mulch. However, these cover crops can produce a large amount of dry biomass (>2 ton/ha) if managed properly. Therefore, a study was established in a coastal plain soil of Alabama to determine the potential impacts of cover crop biomass harvest on productivity and soil quality. Results thus far indicate that full benefits are achieved when the cover crop is left on the field as mulch. Cotton (Gossypium hirsutum) yields were between 17 and 28% greater with the cover crop left on the soil surface when compared to no cover in the first four years of this study. Cover crop harvest reduced yields compared to retaining the cover biomass; however cotton yields were between 2 and 11% greater than with no cover. Additionally, differences on soil carbon were observed after only two years. Total soil carbon and particulate organic matter contents on the surface 2.5-cm of soil were significantly greater with cover retained compared to cover harvested and no cover. Similarly, carbon contents of the harvested cover crop treatment were significantly greater to no cover at this depth. There were no differences in carbon content between cover retained and harvested at the 2.5 to 5-cm depth, but these were significantly greater than the no cover control. A system that includes the harvest of cover crop biomass may be feasible for the Southeast since the cover can still provide some benefits to the agroecosystem, such as protecting the soil from erosion during the winter months, while at the same time potentially provide producers with an additional source of income. Producers of this region may be able to harvest cover crop biomass and still maintain productivity.
Keywords: winter cover crop, productivity, soil carbon

Poster #7

Will the Non-native Biofuel Switchgrass Be Invasive In California? A Case Study

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To meet mandated energy demands for liquid transportation fuels and biomass-based electricity, dedicated energy crops will soon be planted on millions of hectares of US land. Switchgrass (Panicum virgatum L.), non-native to the western US, is a leading contender as a biomass crop due to its high yields, broad adaptability, and tolerance of poor growing conditions-traits that typify many of our worst invasive species. We have conducted a series of experiments to evaluate the probability of switchgrass escaping the cultivated environment and becoming an invasive species in California. The standard Weed Risk Assessment suggests that switchgrass has a high invasive potential in California unless a sterile cultivar is used-suggesting that the invasive potential lies in seed production and dispersal. A greenhouse study demonstrated that switchgrass is tolerant of both very dry (-11 MPa) and flooded soils, which increases the environments switchgrass can survive in moisture-limited California. However, a modeling study shows that riparian areas are the habitats of most concern as dryland areas are too dry for switchgrass, though we have demonstrated that roots can reach nearly 3m deep in the establishment year. An ongoing field experiment is evaluating the survival and establishment potential of switchgrass using a controlled introduction in a local stream. Survival is low in upland (rain-fed) conditions with or without competition from resident vegetation. Survival and establishment is much higher in lowland conditions with most individuals growing large and flowering. Switchgrass appears to be a minor threat in dryland California due to limited soil moisture availability. However, riparian areas may serve as propagule reservoirs as switchgrass is capable of germinating, surviving, and establishing when water is not limiting. If sterile cultivars are introduced for biofuel production the invasive potential of switchgrass appears very low.

Keywords: invasive species, switchgrass, California

Poster #8

Impact of second-generation biofuel agriculture on greenhouse gas emissions in the corn-growing regions of the US

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Land use for bioenergy crops is controversial because terrestrial resources that supply food, livestock feed, and ecosystem services already compete for geographical space in some regions of the world. Currently, in the US, both feed and bioenergy are produced from the food crop Zea mays L. (corn), despite the

water and air pollution that are associated with the mass production of this species. We estimated the effects of replacing corn ethanol feedstocks with alternative crops on both food and ecosystem services. If cellulosic feedstocks were planted on cropland that is currently used for ethanol production in the US, we could achieve 82% more ethanol, 4% more grain for food, 16% reduction in nitrogen leaching, and 452% reduction in greenhouse gas emissions without incurring any indirect land use change.
Keywords: carbon storage, greenhouse gases, nitrate, land use change

Poster #9

Development and optimization of an Agro-BGC ecosystem model for C4 perennial grasses

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Field data for ligno-cellulosic bioenergy crops are spatially and temporally sparse and the land surface is highly heterogeneous. Thus, understanding regional potential productivity and environmental impacts of bioenergy crops requires spatially explicit numerical simulation. Furthermore, simulation is an effective tool for evaluating bioenergy crop agro-ecosystems under projected climate scenarios. We investigated a method for extrapolating bioenergy crop simulations beyond data-rich sites using a process-based ecosystem model and numerical estimation of spatially generalizable vegetation parameter values. For biophysical accuracy we added C4 perennial grass functionality and agricultural practices to the Biome-BGC (BioGeochemical Cycles) ecosystem model. The new model, Agro-BGC, includes enzyme-driven C4 photosynthesis, individual live and dead leaf, stem, and root carbon and nitrogen pools, separate senescence and litter fall processes, fruit growth, optional annual seeding, flood irrigation, a growing degree day phenology with a killing frost option, and a disturbance handler that simulates nitrogen fertilization, harvest, fire, and incremental irrigation. We numerically optimized five unavailable vegetation parameters for Panicum virgatum (switchgrass) using biomass yield data from three sites: Mead Nebraska, Rockspring Pennsylvania, and Mandan North Dakota. We verified simulated switchgrass yields at three independent sites in Illinois (IL). Agro-BGC is more accurate than Biome-BGC in representing the physiology and dynamics of C4 grass and management practices associated with agro-ecosystems. The single-site Rockspring optimization with mature plant data gave the most accurate results. Twenty-four of twenty-six simulated annual yields were within 95% confidence intervals (CIs) of IL site measurements during the mature fourth and fifth years of growth. Ten of eleven simulated two-year average mature yields were within 65% CIs of IL site measurements and the eleventh was within the 95% CI. Agro-BGC accuracies are comparable to those of two published models: Agricultural Land Management Alternatives with Numerical Assessment Criteria (ALMANAC) and Integrated Farm System Model (IFSM). Agro-BGC suffers from static vegetation parameters that can change seasonally and annually. Using mature plant data for optimization mitigates

this deficiency. Our results suggest that a multi-site optimization scheme using mature plant data from more sites would be adequa
Keywords: ecosystem model, perennial grass

Poster #10

Role of corn cob residue fraction in carbon and nutrient dynamics

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The cob fraction of corn (Zea mays L.) residue has been identified as a potential feedstock for ethanol production. However, the role of the cob in carbon and nutrient dynamics is largely unknown. A decomposition study was undertaken at two sites in eastern Nebraska. The first site was under rainfed no-tillage continuous corn and the second site was under irrigated no-tillage continuous corn. Cobs were collected after harvest in 2008, placed in litter bags, and returned to the field. One set of bags was placed on the surface and a second set was inserted vertically in the 0- to 10-cm soil layer. Litter bags were collected 0, 63, 122, 183, 246, 304, and 370 days after insertion. Cob dry matter loss, C, N, P, K and S content was determined. At the rainfed site cob biomass production in 2008 was 1162 kg ha-1 and contained 527 kg C ha-1 C, 4.3 kg N ha-1, 0.3 kg P ha-1, 13.4 kg K ha-1, and 0.3 kg S ha-1. After 370 days surface cob dry matter was reduced 49% to 592 kg ha-1, and contained 168 kg C ha-1 C, 3.5 kg N ha-1, 0.4 kg P ha-1, 1.5 kg K ha-1, and 0.4 kg S ha-1 while buried cob dry matter was reduced 59% to 471 kg ha-1, and contained 197 kg C ha-1 C, 4.1 kg N ha-1, 0.2 kg P ha-1, 0.4 kg K ha-1, and 0.4 kg S ha-1. At the irrigated site cob biomass production in 2008 was 1754 kg ha-1 and contained 795 kg C ha-1 C, 6.4 kg N ha-1, 0.5 kg P ha-1, 20.2 kg K ha-1, and 0.5 kg S ha-1. After 370 days surface cob dry matter was reduced 42% to 1023 kg ha-1, and contained 382 kg C ha-1 C, 6.7 kg N ha-1, 0.5 kg P ha-1, 2.6 kg K ha-1, and 0.7 kg S ha-1 while buried cob dry matter was reduced 64% to 640 kg ha-1, and contained 285 kg C ha-1 C, 6.5 kg N ha-1, 0.4 kg P ha-1, 0.7 kg K ha-1, and 0.7 kg S ha-1. Dry matter loss as a percentage of initial mass was greater for buried samples than for surface samples. At both sites N, P, and S were immobilized and would contribute little to subsequent crop nutrient needs. In contrast, C and K content decreased. The C was likely lost to respiration while K was likely leached from the biomass and would be available for subsequent crop use. Harvesting the cob fraction for use as a biofuel feedstock would likely have little impact on soil C and nutrient availability.
Keywords: corn, cobs, carbon, nutrients

Poster #11

USDA/ARS REAP Data to Support National Impact on Soil

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The USDA Agricultural Research Service (ARS), in partnership with the Department of Energy's Renewable Energy Assessment Project (REAP) is studying domestic ethanol production as a strategy for reducing dependence on imported energy and release of greenhouse gases from use of fossil-energy-derived motor vehicle fuel.

Adapting farm management practices to maximize ethanol production would impact the long term soil quality. The ARS is capturing diverse data at sites across the country to study the impact of residue removal for bio-fuel production on soil. To facilitate national analysis, we will be assembling, organizing, documenting, preserving, and making data accessible for current and future research efforts. Few research efforts sufficiently address the complexities and resources required to build research data systems needed for making data accessible. This poster describes proposed information management methods to define, build, implement, and support a research information data system for the USDA/ARS REAP. A multi-discipline team including data managers, researchers, IT professionals, librarians, and others, is essential to developing a data system. The IT project management emphasizes understanding and agreeing on the functional requirements, innovative designs, using current technologies for development, and support of scientists who contribute their research data. The poster contains information on how you can be involved on the USDA-ARS team developing a research data system in support of the REAP efforts.
Keywords: data, database, data management

Harvest-Storage-Transport (HST) Posters

Poster #12
In Search of an Advanced Biofuel Technology that is Profitable at a Small Scale

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All cellulosic and advanced biofuel technologies under development in the United States appear to be relatively sensitive to economies of scale, requiring fairly large processing plants in order to be profitable. However, especially due to the low bulk density of cellulosic biomass, transport costs increase with hauling distance, and therefore, with plant size. Attempts to mitigate this problem have included various approaches to densification of cellulosic material, but costs of densification are typically greater than associated reduction in transport costs. An alternative approach to addressing this problem is to develop technologies that are profitable at a small scale. In this regard, the dairy industry can serve as a model: biomass (feed) is produced close to relatively small processing plants (cows and a milking barn), thus minimizing transport costs. The liquid (milk) produced is then hauled in tankers to local markets. Since there appears to be no advanced biofuel technology under development in the United States that is economically viable at a small scale, an international search for such a technology was undertaken. In particular, pilot plants were visited in Germany (www.mmeag.de), Denmark (www.organicfueltechnology.com) and China in June and July, 2010. On site review of these plants suggested that they might well be economically competitive with petroleum fuels at a small scale, thus deserving further evaluation and, if satisfactory, partnering with the owners to deploy them in the US. For example, the German company (MME) proposes to build plants that produce 1.3 million gallons per year of cellulosic diesel from 15,000 dry tons of biomass, with a capital cost of $6 million and production costs of less than $2.00 per gallon. Larger plants can be constructed by building multiple modules. If such a technology could be successfully deployed, it would solve the transport problem related to cellulosic biomass, and

also allow vertical integration, with landowners becoming producers of fuel instead of producers of biomass.
Keywords: feedstock logistics, small scale processing plants

Poster #13
Drying Sorghum Biomass for Advanced Biofuels Production in Southeastern U.S.
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The Southern U.S. has an ideal climate that may aid in growing large amounts of biomass potentially suitable for advanced biofuel production; however, short-term droughts during the growing season may reduce yields. Sorghum (Sorghum bicolor L.) may have great potential as an energy crop, because it is capable of high biomass yields and is drought tolerant. Sorghum could be integrated into a conservation system as part of a crop rotation. However, sorghum biomass has relatively high moisture content and should be conditioned and dried before transported to reduce costs. The objective was to evaluate if adequate drying could be obtained for baling sorghum within a relatively short time period in southeastern U.S. conditions. Therefore, sorghum-sudan hybrid was harvested with two different headers on a self-propelled windrower: a Massey Ferguson 9145 (sickle) and a Massey Ferguson 9185 (disc). The sickle header was evaluated using Company's setting recommendation. However, the disc header which was comprised of two pairs (rear / front) of metal conditioner rollers was evaluated with three different pressures (0, 3500 and 7000 kPa), and with two different gaps (0 and 0.02 m) applied in the roller pairs. Sorghum biomass samples were collected after harvest and moisture content (%) evaluated daily until biomass reach moisture content less than 20%. Results revealed that the higher pressures and smaller gaps resulted in faster drying of biomass for disc header. Thus, the best settings for the disc header were "7000 kPa – 0 m" or "7000 kPa – 0.02 m" which showed, respectively, moisture content levels of 13.6 % and 16.8 % after 14 days. Additionally, the disc header showed moisture content of 24.1 % at same period. These results indicate that high biomass crops such as sorghum can be successfully dried within a relatively short time period (14 days) for baling in southeastern U.S. when proper machinery and settings are selected.
Keywords: moisture content, settings, disc, sickle, windrower

Production Posters

Poster #14
Biomass Production of Perennial Grasses Under No Inputs in South Georgia
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A number of warm-season perennial grasses have been studied for potential use as biomass feedstocks in the Southeast. Theoretically, the larger root systems of perennial crops should be able to adapt to lower inputs of water and fertilizer, and should also contribute to soil carbon sequestration. A study was initiated in fall 2005 at Tifton, GA, to compare the performance of perennial grasses under rainfed conditions with no fertilizer inputs. The test consisted of four replications in a randomized complete block design, and included two energycane cultivars, two napiergrass genotypes, two switchgrass cultivars, and Erianthus arundinaceum. Total shoot biomass was harvested and weighed each year (2006 – 2009) in winter, and was analyzed for fiber quality by NIR spectroscopy and for N content by combustion. Soil samples were collected periodically to assess possible changes in soil carbon and nitrogen. Averaged over the first three years, DM yields of energycanes, napiergrasses, and Erianthus were significantly higher than switchgrass. Switchgrass had higher nitrogen use efficiency, based on the nitrogen content of the harvested plants. In the fourth year, yields of all entries decreased substantially, likely due to total soil nutrient loss. Biomass fiber quality parameters varied between entries and also between years. From 2007 to 2009, soil carbon in the surface layer and nitrogen did not vary significantly.
Keywords: Perennial grass, no inputs, nitrogen use

Poster #15

Inorganic and Organic Nitrogen Sources for Optimal Rye Cover Crop Biomass Production

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Winter cover crops are an integral part of conservation systems and have traditionally been utilized in the Southeast to protect soils by controlling erosion, improving infiltration, and increasing organic C inputs. Growers are encouraged to maximize biomass production, but are reluctant to apply N fertilizer to a cover crop not harvested for monetary gain, although potential benefits are enhanced. Utilizing a winter rye (Secale cereale L.) cover crop as an alternative energy source could justify higher N rates, and an organic N source, such as poultry litter, could be more sustainable. An experiment was implemented at the Wiregrass Research and Extension Center in Headland, AL on a Fuquay sand (loamy, kaolinitic, thermic Arenic Plinthic Kandiudults) during 2006-2008 to compare N fertilizer sources, rates, and time of application for a rye cover crop to optimize biomass production. Main plots were time of application (fall and spring), subplots were N source (commercial fertilizer and poultry litter), and sub-subplots were N rate (0, 34, 67, and 101 kg N ha-1 as commercial fertilizer and 0, 2.2, 4.5, and 6.7 Mg ha-1 as poultry litter on an as-sampled basis). Fall application of N fertilizer, regardless of source or rate, resulted in more biomass production. Poultry litter was comparable to fertilizer as an N source, but surface application may result in ammonia volatilization. As expected, the greatest biomass production (8000 kg ha-1) occurred with the highest N rate, but there was no difference between N sources.

These results indicate that growers with access to poultry litter may utilize it as a substitute to costly N fertilizer for biomass production.
Keywords: poultry litter, commerical fertilizer, fertilizer timing

Poster #16
Lifecycle Energy and Greenhouse Gas Emissions from an Ethanol Production Process Based on Blue-Green Algae

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Ethanol can be produced via an intracellular photosynthetic process in blue-green algae (cyanobacteria), excreted through the cell walls, collected from closed photobioreactors as a dilute ethanol-in-water solution, and purified to fuel-grade. Our objective was to calculate the lifecycle energy and greenhouse gas emissions for three energy system scenarios for that process. We evaluated energy and emissions input-output balances of all lifecycle stages, from harvesting algae to ethanol combustion in vehicle. We also evaluated a several engineering process variables, such as the initial ethanol concentration. With a lead scenario based on natural-gas-fueled combined heat and power, the lifecycle energy consumption ranged from 0.52 MJ/MJEtOH down to 0.20 MJ/MJEtOH, and the lifecycle greenhouse gas emissions ranged from 28 g CO2e/MJEtOH down to 12 g CO2e/MJEtOH, for initial ethanol concentrations from 0.5 wt% to 5 wt%. In comparison to gasoline, these values represented 70% and 87% reductions in the carbon footprint. Energy consumption and greenhouse gas emissions could be further reduced with higher efficiency heat exchangers or with use of solar thermal for some of the process heat. In conclusion, we have shown that with sufficiently high initial concentrations of ethanol, fuel ethanol can be produced that has low net energy inputs and low lifecycle greenhouse gas emissions.
Keywords: blue-green algae, ethanol

Poster #17
Bio-fiber Feedstock Production Model

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Energy, its production and use, is becoming one of the most critical issues facing America and the world today. Alternative approaches for energy production must be sustainable from economic, environmental and social perspectives.
Because of global fiber demands, driven by the rapid expansion of newly industrializing countries like China and India, the traditional supplies of fiber will be increasingly pressed to meet demand. Add to this the emphasis on switching to non-fossil energy sources such as fuels from bio-fibers, and a shortage of bio-fibers is likely. This suggests that the US will of necessity begin to develop new sources of bio-fibers to meet emerging demand. The USDA predicts that there will be 88.8

million acres of corn planted in the US in 2010 that will yield approximately 200 million dry tons of corn stover bio-fiber.

To successfully harvest, store and transport (HST) high quality crop fiber such as corn stover, special knowledge and skills are required. Working with agri-fibers is not like working with wood fiber or other agricultural crops and therefore requires different equipment and expertise. The team of experts assembled by Iowa Agricultural Bio Fibers (IABF) were central to the first large scale harvest of corn stover sponsored by the DOE in Harlan, IA from 1997-99. The producers and contractors around Harlan have baled in excess of 50,000 tons of corn stover. The team’s involvement in that project and their subsequent on-the-ground trial and error experiences during the last 11 years have enabled the IABF team to develop, refine and demonstrate a prototype for a sustainable, efficient, large scale HST system. (Glassner, Hettenhaus & Schechinger, 1998).

Central to this applied research is a focus on the critical processes necessary to enhance the value of the corn stover and the products that can be produced from it. The IABF team has demonstrated in a working system that corn stover feedstock development and bio-fuels development can be cost effective, sustainable, and can be commercialized in a variety of settings. The HST model can be replicated and transported to other agricultural communities where there is sufficient crop residue.

Keywords: Bio-fiber, Feedstock, Production, Sustainability Model

Poster #18

Biofuels Research Program at Tennessee State University

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The biofuels research program in the Department of Agricultural Sciences at Tennessee State University (TSU) is dedicated to identifying crops, crop cultivars, crop management practices, and processing technologies that enhance sustainable biofuel production in Tennessee as well as the U.S. Initiated in 2008, biofuels research has focused on microorganisms that have the potential to produce cellulase and xylanase enzymes; enzymes capable of converting herbaceous biomass into ethanol. Microorganisms that produce such enzymes are being isolated from goat ruminal fluid and identified. Recombinant enzymes of cellulase and xylanase will be constructed and assessed for hydrolytic activity. Those with the greatest activity will be tested on different biofuel feedstocks. With the expansion of the number of faculty members committed to biofuels research, new projects are also being developed that center around plant breeding, agronomy, and the environmental effects of bioenergy crop production. Plant breeding projects will focus on the genetic improvement of Camelina (Camelina sativa L.) stress tolerance and productivity for biodiesel production and Miscanthus species for bioethanol production. Environmental and ecosystem-level research will focus on an assessment of soil carbon sequestration potential and greenhouse gas emissions of established herbaceous and woody biomass plantations for comparison with native/secondary pastures and forests in middle Tennessee. Agronomic research will focus on the optimum level of mineral nitrogen and organic amendments required to produce the greatest quality and quantity of switchgrass from soils in

middle Tennessee. The biofuels program in the Department of Agricultural Sciences at TSU is contributing important research findings to the biofuels initiative and is working toward becoming a significant player in sustainable bioenergy production.
Keywords: cellulase, xylanase, carbon sequestration, switchgrass, camelina, miscanthus

Poster #19

Biofuel Potential of Cellulosic Double Crops across the U.S. Corn-Soybean Belt

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Efforts by researchers and policy makers to reduce U.S. dependence on imported oil include investigation of plant biomass- derived biofuels, which raises concern over fuel – food competition. One solution that addresses the concern is to raise cellulosic double crops on the land base between summer crops. To date, winter rye has been inserted successfully into corn – soybean rotations to provide ecosystem benefits. This study was conducted to estimate the harvestable biomass from a winter rye cover crop on lands supporting corn and soybean crops, a practice that has potential to provide both ecosystem and economic benefits. We identified corn and soybean acreage in the U.S. by county using USDA NASS acreages and excluded irrigated land and acreage already supporting a winter small grain crop. We selected 30 locations within the identified region and calculated the winter rye biomass potential with RyeGro, a soil-plant-atmosphere simulation model developed for this purpose. Generated weather inputs for the 30 locations were used; fall and spring planting and harvest dates were derived from USDA state-based data. Average RyeGro biomass yields for a 23-year period were used to develop a regression model based on temperature and precipitation. The regression model was then used to determine rye biomass potential in each county. The spatial analysis of crop land indicated that 18.4 million acres in continuous corn rotation and 78.2 million acres in a corn-soybean rotation are suitable for producing winter rye. The modeling results project that from 194 to 224 million Mg (214 to 247 million ton) of rye biomass, with an energy content of 3400 to 3900 PJ (3.2 to 3.7 quads), can be harvested from this land base when the rye is harvested seven to two days prior to spring crop planting, respectively. The average RyeGro biomass yield for the 30 locations for six planting-harvest date scenarios was 6.0 Mg/ha (2.7 ton/ac). Although additional analysis needs to be performed on the impacts of widespread use of winter rye as a cellulosic double crop, the current study demonstrates the sizable potential for this strategy to produce cellulosic biofuel without redirecting the primary food crop to fuel.
Keywords: cellulosic double crop, biofuel, winter cover crop

Poster #20

Penn Center Germplasm Switchgrass for Coastal Carolina

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The USDA-Natural Resources Conservation Service (NRCS) Jimmy Carter Plant Materials Center (PMC) located in Americus, Georgia is involved in several studies evaluating native warm season grasses for soil conservation, forage, and wildlife habitat improvement.
The Jimmy Carter PMC, in cooperation with the NRCS in South Carolina, and Mepkin Abbey in Moncks Corner South Carolina, is in the process of increasing a local South Carolina switchgrass (Panicum virgatum) for soil conservation and stabilization.
In February 2008 the Jimmy Carter PMC and Mepkin Abbey took vegetative material of switchgrass from Beaufort County, South Carolina near the Penn Center.
Keywords: local ecotypes, biofuels production, diversity

Poster #21
Twenty-year Biomass Yields for Eight Switchgrass Cultivars in Alabama
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Short-term research on switchgrass (Panicum virgatum) has shown that it has substantial potential as a cellulosic biomass crop. Long-term experiments are needed to determine stand longevity and yield response to factors such as rainfall, which have critical economic implications. However, no information has been published on long-term yields of different cultivars of switchgrass. Consequently, data from a replicated small-plot experiment which included eight switchgrass varieties that were planted during spring of 1988 in south central Alabama were analyzed, and are presented in this study. Cultivars included two lowland types of switchgrass, 'Alamo' and 'Kanlow', and six upland types, 'Cave-in-Rock', 'Blackwell', 'Summer', 'Trailblazer', 'Pathfinder', and "Kansas Native'. Plots were fertilized at a moderate level, and were harvested twice a year in mid-summer and again in fall, from 1999 to 2009, providing a unique long-term dataset. Alamo provided the highest average yield (10.4 dry tons/acre/year), followed by Kanlow (8.3 tons/acre/year) and Cave-in-Rock (6.5 tons/acre/year). Multiple regression analysis indicated that yield of upland varieties increased with age and rainfall, but yield of lowland varieties was not affected by these variables. In 2007 Alabama experienced the worst drought in over a hundred years. Most traditional row crops such as corn, cotton and soybeans did not provide sufficient yields to justify the cost of harvesting, but the drought had a relatively small effect on switchgrass yield. We conclude that; 1) Alamo is the most suitable cultivar of switchgrass for the Southeastern USA; 2) switchgrass is extremely tolerant of drought; and 3) stands of switchgrass can be expected to remain productive for over 20 years if they are properly managed for cellulosic biomass production.
Keywords: Twenty years biomass yield, switchgrass, cultivars

Poster #22
Assessing Production and Ecosystem Function for Grain and Bioenergy Feedstock Crops Across Variable Soil Landscapes
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Some soils in the U.S. Midwest region have been especially negatively impacted by grain cropping. The result has been lost productivity and diminished resiliency for ecosystem function. Of note are the degraded soils of the Midwest classed as "claypan soils." These soils are disproportionate sources of non-point pollution and soil quality degradation when grain cropped. Alternative production systems are needed for long-term productivity and environmental sustainability. The objective of this research is to simultaneously evaluate grain and feedstock bioenergy production and ecosystem services across variable soil landscapes. Three studies are being conducted to achieve this objective: 1. SPARC (Soil Productivity Assessment for Renewable Energy and Conservation). Decisions about where on claypan landscapes grain or switchgrass production systems can be placed to minimize production and economic risk are of particular importance. This study initiated in 2009 allows for contrasting renewable energy options of grain crops and switchgrass under variable topsoil depth. Research at this site also contrasts the N management issues with switchgrass under variable topsoil depth. 2. Large-Plot Cropping System Evaluation. 30 individual plots in a 30-acre research site have been managed over a 20 year period comparing conventional and innovative grain cropping systems. The site is unusual since each experimental unit traverses a landscape of soil types (summit, backslope, and footslope positions). Now, some of these plots are being converted to bioenergy cropping systems. Side-by-side grain and biofuel (switchgrass and short-rotation woody biofuel) production systems will be assessed for productivity and water quality. 3. Soil Productivity Assessment from Yield Maps. Over 100,000 acre-years of yield map data have been obtained from over 30 producers in the Missouri claypan region. This multi-temporal and spatial replication of crop yield monitor data is being used to empirically quantify production risks due to soil and landscape factors. Our approach is to collect yield data, collect soil and landscape data (continuous and full coverage), merge these two data sets, then model yield and yield variance with data mining techniques. Soils with both high yield variance and low yield mean will be evaluated further for perennial bioenergy feedstocks.

Keywords: soil productivity, claypan soils, water quality, landscape targeting

Poster #23

Managing Nutrients for Sustainable Bio-energy Feedstock Production

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Both corn (Zea mays L.) grain and stover are being evaluated as feedstock sources for bio-energy production. To meet current and future demands, the short- and long-term effects of grain and stover removal on soil nutrient cycling, physical properties, and biological activity must be understood. Our goal in this study is to

increase corn grain and stover yield by optimizing positional and temporal nutrient availability with N-P-K-S fertilizers. Field plots were established on the Clarion-Nicollet-Webster soil association in central Iowa in the fall of 2007. Corn was grown with a variety of management systems, including 76-cm row spacing with standard fertility management and a twin-row, high-population (108K plants ha-1) treatment with increased fertilizer additions. In 2008, first-year corn grain yields for conventional and twin-row management averaged 10.7 Mg ha-1 and 11.5 Mg ha-1, respectively. Dry stover yields averaged 5.6, 6.5, 6.3, and 6.9 Mg ha-1 for a high (just below ear shank) and low (~10-cm stubble) cuts for the two planting configurations, respectively. In 2009, neither management system (including planting configuration, plant population, and fertilization rate) nor tillage (chisel versus no-till) affected corn grain yield; however, grain yields were lower, averaging 8.9 Mg ha-1, in plots where corn stover was not harvested in 2008. We attribute this response to the total amount of fertilizer, particularly N, which was applied to the non-removal plots. The amount (160+75+60+20 N+P+K+S, respectively) was based on previous studies. Even though early-season N supply was adequate based on V6 tissue tests, the lower N rate (coupled with increased immobilization during residue decomposition and less mid-season mineralization) negatively affected final corn grain yield. These results suggest that good nutrient management for systems producing both grain and residue feedstock is essential, and that it will differ from grain-only systems.
Keywords: corn, nutrient management

Poster #24

Site-specific assessments of corn stover removal thresholds and environmental impacts in the Upper Mississippi River Basin

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The emerging lignocellulosic biofuel industry could be sustained by the use of current crop residues. Corn stover, because of its abundance, easy accessibility and high cellulose content in the U.S. Corn Belt, is a prime lignocellulosic feedstock candidate. Of concern, however, is the uncertainty associated with its indiscriminate removal on crop productivity, environmental integrity and sustainability of agro-ecosystems. Current available data do not provide practical guidelines to overcome the uncertainties for implementation. We examined the effects of corn stover removals (0%, 40%, 60% and 80%) on corn grain and stover yields, Soil Organic Carbon (SOC) sequestration, sediment and nutrient (N&P) losses across two land types (highly erodible - HEL and non-highly erodible – non-HEL), three soil textural classes (Clayey, Loamy and Sandy) and two management practices; the *Baseline* - reflecting management practices reported in the CEAP national cropland assessment survey database (USDA NRCS, 2010) and the *Enhanced Conservation Treatment* – (ECT) reflecting management practices needed to mitigate sediment,

nutrient, and SOC losses. The findings were obtained from APEX[1] model-generated data derived from input databases built for the CEAP Cropland Assessment project (USDA-NRCS, 2010) to determine the impacts of corn stover removal from 3703 farm fields within the Upper Mississippi River Basin. For evaluation purposes, stover removal thresholds were based on five criteria; SOC change > 0, N in surface runoff < 8.4, N in sub-surface runoff < 14.0, total P losses < 2.24 kg/ha/yr and Sediment loss < 2.24 Mg/ha/yr (USDA-NRCS, 2010). For the *Baseline practices*, and for sites satisfying the above criteria, stover removal rates of 40, 60 and 80% yielded 3.2, 4.8 and 6.4 Mg/ha/yr of stover. Averaged across stover removal rates, Clayey, Loamy and Sandy soils, yielded 4.5, 4.8 and 4.6 Mg/ha/yr, while HEL and non-HEL, yielded 3.0 and 3.1 Mg/ha/yr. *Enhanced Conservation Treatment* management increased stover yields with the three rates of stover removal, yielding 3.4, 5.0 and 6.6 Mg/ha/yr; while HEL and non-HEL yielded 3.7 and 3.8 Mg/ha/yr. Clayey, Loamy and Sandy soils averaged 4.7, 5.0 and 4.6 Mg/ha/yr. Overall, increasing stover removal rates decreased grain and stover yields while sediment, N&P and SOC losses increased.

Keywords: stover removal, highly erodible, environmental integrity

Poster #25

Fall Armyworm Resistance in Sweet Sorghum

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Sweet sorghum [Sorghum bicolor (L.) Moench] is one of the favorable biofuel feedstocks for ethanol production. Fall armyworm [Spodoptera frugiperda (JE Smith) (Lepidoptera: Noctuidae)] is one of the most serious foliar-feeding insect pests in sorghum production in the southeastern US states. Severe whorl injury of fall armyworms results in significant reduction of sweet sorghum biomass accumulation. Breeding for fall armyworm-resistant sweet sorghum hybrids with high yield potential is one of the long-term goals of our research team. In the present study, 116 sweet sorghum inbred lines were evaluated for fall armyworm resistance with natural fall armyworm infestations. The experiment utilized a randomized complete block design with two replications of double-row plots. The experiment was repeated with two planting dates in 2009. Fall armyworm injury was assessed using a visual rating scale (1-9; 1 = no injury, and 9 = complete defoliation) on each row of the experimantal plots. We identified 11 entries (i.e., entries 1, 2, 6, 10, 11, 15, 20, 24, 25, 27, and 29) with the lowest fall armyworm injury ratings (< 3.25), and four entries (i.e., entries 3, 4, 18, and 22) with the highest ratings (> 4.0). The rest of the 101 entries showed moderate resistance to fall armyworm feeding. The identification of the four fall armyworm-resistant sweet sorghum inbred lines is important to develop new sweet sorghum hybrids with fall armyworm resistance, and in turn, to reduce the cost of insecticide applications, and improve the long-term sustainability of sweet sorghum production in our region.

Keywords: germplasm screening, insect resistance

Poster #26
What Would It Take for the US South Simultaneously to Meet Renewable Electricity and Greenhouse Gas Mandates and be a Major Producer of Biofuel?

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We have analyzed the implications of simultaneously meeting mandates for renewable electricity, for reducing greenhouse gas emissions, and for production of biofuel in the southeast. The analysis includes 11 states from Texas and Oklahoma to Tennessee and North Carolina.

Using estimates of switchgrass and miscanthus yields as a function of location, and Forest Service data on forest biomass, coupled with county-level data on agricultural production and crop returns, we have developed supply curves for production of miscanthus, switchgrass and forest biomass in the southeast. Using GIS-based analysis, we have modeled where switchgrass and miscanthus might be grown, as a function of feedstock price, as well as the total feedstock produced, and we have modeled which crops are displaced on an county-by-county basis. Displaced crop production includes soybeans, corn, and winter wheat, and there is potential for increased use of nitrogen fertilizers and other agricultural inputs particularly when switchgrass or miscanthus displace soy. Corn and cotton are first displaced in southern Alabama; rice is first displaced in southern Louisiana; soy is first displaced in Louisiana and Mississippi; peanuts are first displaced in the Florida panhandle and eastern North Carolina, and wheat is first displaced in the Florida panhandle.

We have evaluated the potential for renewable energy generation including biomass cofiring, dedicated biomass electricity generation, combined heat and power in both industrial and commercial building settings, wind, and solar photovoltaics. For most of the southeast, biomass-derived electricity is the lowest cost near-term option for renewable electricity. We have modeled future electricity production using both the US DOE MARKAL model and through development of a non-linear mixed integer programming model with a case study of the state of Georgia. We have shown that the biomass consumed in meeting a renewable electricity standard and/or greenhouse gas emissions constraints depends on the formulation of the renewable electricity policy structure and the implementation of electricity efficiency measures.

Meeting electricity, greenhouse gas and biofuel goals has the potential to provide higher returns to farmers and forest owners, without large increases in electricity prices. Achieving these goals requires improved feedstock productivity, and increased energy efficiency.

Keywords: renewable electricity standard, greenhouse gas reductions, southeast, switchgrass, miscanthus, forest biomass

Poster #27

Determining Climate, Weather, and Soil Impact on Bioenergy Production Sustainability, An Example from the Southeastern USA

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Climate, weather, and soil variability impact the yield and yield stability of bioenergy feedstock production. This variability will also impact the net energy value (NEV), i.e. the output energy of the produced biofuel after all non-renewable energy inputs in the production have been accounted for. Also the potential to reduce greenhouse gas emissions will be impacted by climate, weather and soil variability. To increase the sustainability of bioenergy production systems, more knowledge about how this variability impact biofuel feedstock production is crucial. The goal of this project was to determine the impact of climate, weather, and soil factors on key factors for sustainability of bioenergy production systems: namely the feedstock yield variability, the NEV and the potential to reduce greenhouse gas emissions. We applied a novel approach linking dynamic crop simulation models to life cycle analyses of bioenergy production chains. Both traditional biofuel feedstocks such as corn and wheat grain for ethanol as well as second generation feedstocks such as wheat straw and switchgrass for cellulosic ethanol were studied. Bioenergy feedstock yield as a function of weather, soil and management practices which represented the southeastern USA were determined with the crop simulation models CSM-CERES-Maize and CSM-CERES-Wheat respectively for the first two crops and the ALMANAC model for switchgrass. In a second step the simulated yield outputs were linked to calculations of the NEV and the greenhouse gas reduction from the biofuel production chains by taking into account the entire production chains including farming, transportation and biofuel processing. We identified a significant impact of temporal and spatial climate variability as well as spatial soil variability on biofuel feedstock yield, NEV and greenhouse gas emissions. These results emphasize the potential use of dynamic crop simulation models in combination with life cycle analyses to identify regions with climate and soil conditions, as well as management practices which favors a sustainable and stable bioenergy production. This approach could also be applied to determine bioenergy production sustainability in other regions within the USA and in other regions of the world.

Keywords: climate variability, crop modeling, LCA, weather variability

Poster #28

Ethanol Production Yield of Five Warm-Season Perennial Forage Grasses

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Developing a favorable biomass supply for conversion to biofuels will require high production and conversion efficiency. In this work, five warm-season perennial grass species were evaluated for their potential as bioenergy crops within the southeastern USA. The plant materials were part of a field study that compared grass hay crops for manure-nutrient management in a swine effluent spray field near Crawford, MS. Adapted varieties of bermudagrass, eastern gamagrass, indiangrass, johnsongrass, and switchgrass were transplanted to the field in July 1999. An initial assessment of feedstock conversion to ethanol was based on the aboveground biomass harvested in August 2001, following six weeks of regrowth. Total carbohydrates and enzyme digestion assays were determined in the laboratory. Initial results indicated indiangrass and switchgrass had the highest average (n=4) yield of glucose and xylose in grams monosaccharide per kg dry biomass. Due to species difference in biomass production and carbohydrate-to-ethanol conversion efficiency, potential ethanol yield ranged from 4368 liters per hectare in bermudagrass to 1767 liters per hectare in indiangrass. Because the harvest in August indicated relatively high ethanol yield in ‘Coastal’ bermudagrass (1248 l/ha) and ‘Alamo’ switchgrass (929 l/ha), their season-long production yields were estimated based on laboratory assays of forage samples from four harvest dates in summer 2001. Results should influence the selection of these forage crops as bioenergy feedstocks for the Southeast, where familiarity with these grasses, their documented responses to manure fertilizer, and an abundance of manure enable conversion of animal wastes into energy, thus addressing two regional problems.

Poster #29

Native Legumes for Advanced Biofuel Production

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Agriculture is a major user of energy with direct consumption through tractors and other farm equipment and indirect consumption through production inputs including fertilizer, seed and chemicals. With development of advanced biofuels, agriculture has the potential to become an increasingly important source of renewable energy that could not only reduce farm expenses but also provide significant economic opportunities for farmers and ranchers. The objective of this study is to evaluate herbaceous and semi-woody legume germplasm as feedstock for biodiesel production under crop rotation and pasture systems in Texas. Initial efforts have focused on securing native legume germplasm collections of Illinois bundleflower (Desmanthus illinoiensis), siratro (Macroptillium atropurpureus), prairie acacia (Acacia angustissima) and upright bundleflower (Desmanthus bicornutus). Subsequent screening for herbage yield, seed production, harvestability, conversion efficiency (biodiesel potential), nitrogen fixation, stress hardiness and survival are planned. Leguminous species are being emphasized because they have the potential to provide quality pasture and hay production as well as biodiesel seed yields. Data from this study will also provide information on the benefits of incorporating legumes in crop rotation systems including nitrogen fixation, forage and hay yield, seed yield, and biodiesel or other biofuel yield. Developing these species could help minimize the "Food vs. Fuel" debate because of their ability to be

grown on over 500 million acres of hay and pastureland in the U.S., but doing so must also account for the forage currently provided to ruminants by those lands.
Keywords: native perennial plants, native legumes

Poster #30
Producing Sorghum Cellulosic Feedstock for Advanced Biofuels Production and its Impact on Soil Physical Properties

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According Energy Policy Act of 2005, the U.S. must produce 21 billion gallons of advanced biofuels in 2022. Cellulosic material is considered a renewable and environmental improved alternative source for energy production. Sorghum (Sorghum bicolor L.) is considered a high cellulosic biomass productive plant with low Nitrogen inputs. Thus, sorghum can be produced in rotation with other common cash crops. However, soil physical impacts caused by removing cellulosic biomass on soils must not be ignored. Therefore, the objectives of this study were to evaluate sorghum and corn cellulosic biomass production (quantity/quality), and to monitor soil physical properties, such as bulk density (Bd) and cone index (CI) when producing and removing sorghum/corm biomass. The types of sorghum evaluated were: grain sorghum - NK300 (GS), high biomass forage sorghum - SS 506 (FS), and photoperiod sensitive forage sorghum - 1990 (PS). These 3 different varieties and a forage corn (Zea mays L.) - Pioneer 31G65 were grown in 2008 and 2009 under irrigated and non-irrigated treatments, and under two different tillage systems: conventional and conservation tillage. Results after two years of cropping showed that irrigation and conventional tillage resulted in high aboveground biomass production (ADM). PS was considered the best tested variety in order to produce ADM which produced 26.04 and 30.13 Mg/ha at 18 and 24 weeks after planting. Biomas quality parameters, such as holocellulose, lignin and ash content showed low differences among varieties, and they were considered minor. Additionally, soil consolidation was observed after two years of cropping. Bd values increased at all depths, but those values were always lower than threshold for soil compaction. PS showed significant lower Bd than corn in superficial layers (0.05 - 0.20 m). Conventional plots had higher Bd in some evaluated layers. Cone Index (CI) values also showed improved soil conditions at in-row positions for conservation plots, with restrictive layers being found at depths of 0.15 m for conventional plots. Therefore, conservation tillage and photoperiod sensitive sorghum (1990) - PS were considered the best alternatives to produce cellulosic feedstock biomass and to diminish soil physical impacts.
Keywords: cone index, bulk density, lignin, holocellulose, ash

Poster #31

Comparison of five sorghum cultivars for biomass and ethanol production

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An experiment was conducted during 2008 and 2009 to study the effect of planting date on biomass yield and ethanol production from sweet sorghum and fiber sorghum cultivars (Biocolor (L.) Moench). Cultivars tested were Sweet Drip, Hikane II, SS405, SS506, and M81-E and the planting dates were May and June for 2008 and April and June for 2009. Cultivars were fertilized with 100 lb nitrogen per acre and harvested at 120 days. Cultivar biomass and bagasse yields did not differ among planting dates within years however, year one produced higher biomass yields when compared to year two. Sweet Drip and Hikane II biomass yields were lower (8.65 and 7.65 Mg/ha, respectively) than SS405, SS506 and M81-E (17.11, 19.52, and 18.36 Mg/ha, respectively). Juice production differed among planting dates within years (year one planting date one 1980.66 L/ha and year two planting date two 1132.86 L/ha) with Hikane II producing the least amount of juice (680.29 L/ha) and M81-E producing the highest (1881.97 L/ha) within both years. Calculated ethanol values were highest for M81-E (130.15 L/ha) and lowest for Hikane II (38.42 L/ha). Early planting dates among years produced higher amounts of ethanol for Hikane II, Sweet Drip, SS405, and SS506 cultivars; however M81-E did not differ among planting dates. Year one produced higher amounts of ethanol (94.12 L/ha) compared to year two (63.19 L/ha). Lower yields of biomass, bagasse, juice, and ethanol amounts for year two may be the result of higher than average rainfall during the initial growing period.

Keywords: Sorghum,cultivars,biomass, alcohol

Poster #32

Biofuels Production Options and Potentials in the Southeast

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We present preliminary data that highlight potential biomass production issues including: candidate feed stocks for the southeastern region, sustainable biomass yield potentials, input requirements and low input production options, potential land use change impacts resulting from targeted siting of biofuel conversion plants, and the potential to use conservation set-aside areas as biofuel feed stock production lands. Our early results raise as many questions as they suggest answers, and highlight the need for increased communication between producers, policy makers, researchers, technology deliverers, private industry, and conservation groups. Early data suggest that while perennial grasses grow in uplands may offer the opportunity for high biomass production, they may also be responsive to N fertilization and that yield without fertilization may decline in subsequent years. Perennial grasses may yield well in the riparian zone, and could possibly fill the grass component of a three zone riparian buffer conservation system. We use a geographic information systems approach to assess the yield potential surrounding

11 GA Coastal Plain cities with and without conversion of current agricultural land exclusively to biofuels production.
Keywords: Elephant Grass, Winter Cover, Marginal Lands

Poster #33
A Spatial Decision Support Tool to Evaluate the Environmental Impacts of Biofeedstocks

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The objectives of this work were to create and apply decision support tools to quantify the long-term losses in runoff, percolation, erosion, nitrate-nitrogen, total phosphorus and pesticides attributed to multiple levels of corn-stover removal. A field-scale modeling framework, which utilized the GLEAMS-NAPRA model and RUSLE 2.0, was created and applied within Indiana to evaluate water quality impacts associated with three corn-stover removal rates (38%, 52.5% and 70%) with conventional tillage and no-till management options. GLEAMS and other water quality models do not readily represent residue removal effects on water quality and had to be modified to simulate changes in the above ground biomass following the main crop harvest. The modified GLEAMS is being incorporated into the web-based agricultural risk assessment tool, NAPRA (National Agricultural Pesticide Risk Assessment tool), to aid stakeholders in assessing pesticide, nutrient, erosion and hydrology based management decisions at field- and watershed-levels. This integrated web-based Spatial Decision Support tool can be used to identify sustainable feedstock production practices.
Based on our initial study, the results show that management decisions such as tillage and nutrient application methods will be critical to corn stover removal options. With no-till practices, the model results suggest that removing corn- stover at the rates 38%, 52.5% and 70% would result in statistically significant higher annual erosion losses ($p<0.05$) when compared with no residue removal management. On soils with 4% or less slopes, a 70% residue removal rate with no-till practices would result in slightly lower erosion losses, when compared with conventional tillage involving no residue removal. No-till systems produced higher total phosphorus losses when commercial fertilizer was surface applied as opposed to the incorporation method practiced with conventional tillage. Nonetheless, levels of leached nitrate-N from no-till systems were significantly lower than losses from conventional tillage, partly due to higher denitrification processes. The results point to a need for ongoing research to make large-scale cellulosic biofuel production economically viable and competitive while protecting regional natural resources.
Keywords: water quality, residue removal, decision support tool, nitrates, total phosphorus, erosion, pesticides

Technology Demonstrations

Accelerate HST Innovation with Group Decision Support Tools

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Innovative solutions are needed to address America's energy requirements and reduce the world's carbon footprint problem without creating other environmental challenges. Iowa Agricultural Bio-Fibers (IABF) is an innovative company in Harlan Iowa that has established prototype processes for Harvesting, Storing, and Transportation (HST) of corn stover. The IABF processes have proven to be sustainable on a local level from environmental, economic, and social perspectives. One of the biggest challenges IABF faces is how to scale its proven HST processes for corn stover production for widespread deployment. For example the production of corn stover on a local basis will require significant modification to be sustainable on a county-wide, watershed-level or state-wide basis. The session will describe how IABF is using a Group Decision Support Tool (GDSS) tool called ThinkTank to help plan projects with partners and farmers to meet the scaling challenges. ThinkTank is a server-based on-line collaboration tool that can cut meeting time while improving the quality of information gathered from partners and farmers. Participants come together in a ThinkTank session to contribute ideas anonymously and simultaneously using PCs with an Instant Messenger like browser interface. And once ideas are captured and classified participants can vote on them and move quickly to action steps. The tool can also be used to train partners and farmers, conduct briefings on new products and capture ongoing feedback.

The IABF team has extensive experience with current group conferencing and GDSS support tools that stimulate and capture ideas from diverse participants and quickly build group consensus. The GDSS tools are based on Six Sigma Lean principles and other communications research done to maximize the quality of group inputs, build consensus and move to action.

During the conference presentation IABF will demonstrate how you can use ThinkTank for HST planning and training. Conference participants will experience a collaborative GDSS session and understand how a GDSS can accelerate innovation in the field of Sustainable Feedstocks for Advanced Biofuels.

Keywords: Innovation, Interactive, Decision Support Tools

Getting it Right The First Time – Simple Approaches to Planting Native Warm Season Species in South Carolina.

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Necessity has driven this low tech approach to planting native warm season species in South Carolina. The cost of equipment and fuel has made this concept a practical and economical approach to planting small fields or acreages for wildlife habitat or pasture and hayland plantings. In many cases though, 1 acre can be planted per hour with a hand planter. The equipment utilized ranges from what can be found on site such as a spin spreader, to what on hand materials such as pine saplings or a section of chain link fence to cover the seed. The end results have been more impressive than with modern drills designed to plant natives. Before the planting

can be done the proper herbicides must be selected and applied based on existing weed competition and those that will likely appear based on local conditions. The key to this approach is that time is taken to make adjustments to the seeding rate based on Pure Live Seed (PLS); this is the most misunderstood and often over looked step in planting native species. The next thing that must be grasped considering that the cost of the native seeds, which can be outrageous at times. Therefore, the method of measuring and flagging 1 acre plots of a field to be planted, calculate the PLS for each specie in the mix, make the necessary adjustments and add the amount of seed needed to plant that one acre, continue in this fashion until the whole field is planted. The spreaders can be calibrated and adjusted by laying black plastic on the ground and driving or walking over the area at the same pace or speed to be used when planting, while doing this broadcast the actual seed or seed mixture and count the number of seed per square ft. Start with the opening of the planter as small as possible so as not to spin all of your seed out in a few feet, adjust accordingly until the desired number of seed per square foot. There are guides available which provide details for many of the warm season grasses, forbs and legumes. These guidelines are being offered to those that are interested in planting native species but do not have access to the expensive equipment. But are driven to do there part by being stewards of the land, this may be achieved whether the planter is driving a yugo or a hummer.
Keywords: planting techniques, alternatives, cheap equipment,

Herbaceous Perennials: Placement, Benefits and Incorporation Challenges in Diversified Landscapes

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Herbaceous perennial feedstocks will fill numerous and critical roles in the bioenergy landscape. Our objective is to present the benefits and challenges of growing herbaceous perennials and provide regionally-specific scenarios for their use at the landscape scale. The primary herbaceous perennial feedstocks will vary by agro-ecoregion and will include switchgrass, Miscanthus, native polycultures, sugarcane, and energycane. In the near term, optimizing sustainable yield will drive the economic feasibility of herbaceous perennials. However, within agro-ecoregions, feedstock selection will be site-specific based on landscape position, potential ecosystem services, and producer-driven acceptance such as economics, familiarity, and committing land to long-term feedstock production. For example, in the central and northern Great Plains, managed switchgrass monocultures produce three times more dry matter and provide fewer establishment and management challenges than extensively managed native polycultures. Since yield is of paramount importance, native polycultures may be suited only to situations where ecosystem restoration and increased plant species diversity are primary objectives. In the Midwest, Miscanthus produces more biomass with fewer inputs than other herbaceous perennials. However, the cost of establishment and the time required to keep stands in production to offset the cost of establishment may limit producer acceptance on a large scale until non-invasive, seeded varieties can be developed.

In the Gulf Coast states, sugarcane has been produced for more than 200 years, so expanding production for bioenergy provides fewer barriers. The Southeast has the most diverse selection of herbaceous biomass crops which will be determined by local growing conditions, available harvest technology, and environmental considerations. Challenges in the Southeast include reluctance to adopt novel crops and the predominance of degraded soils on sites available for cultivation. Balancing biomass production, ecosystem services and producer acceptance will be major challenges for a diversified landscape in the new bioeconomy.
Keywords: switchgrass, Miscanthus, sugarcane, energycane, sustainability

Development of a Generalized Sustainable Agricultural Residue Assessment Tool

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Agricultural residues will play an important role in meeting national goals for biofuel and bioenergy production. However, it is also important to recognize and account for the critical contributions from those residues in maintaining soil and environmental health. Currently, six primary limiting factors have been identified that must be considered in making sustainable residue harvest decisions: 1) soil erosion, 2) soil organic matter, 3) management of plant nutrients, 4) soil compaction, 5) soil water and temperature, and 6) environmental degradation. For individual residue harvest scenarios, any of these factors can potentially be the most limiting in establishing sustainable residue removal practices. A consortium of researchers from multiple universities, USDA ARS, and DOE national laboratories has developed an analysis framework capable of multi-variant agricultural residue harvest assessment. The framework has been assembled by integrating peer-reviewed and accepted environmental process models addressing the limiting factors above. Work to date has focused on assessing soil erosion, soil organic matter, and plant nutrient impacts of residue removal decisions. The integrated modeling framework has been employed for multiple types of assessments and multiple end users. One key implementation has been performing nationwide sustainable agricultural residue analysis. In developing these assessments large datasets have been generated encompassing a significant range of potential residue collection scenarios. The framework development team has packaged this range of data and scenarios within a database structure that allows fast searching and data interpolation. A web-based map interface has been developed on top of that database to facilitate user-friendly investigation of a range of potential residue removal scenarios. Users are able to define a region of interest, typically a field or set of adjacent fields and then set a number of important criteria including crop rotation, tillage, and expected yield. Very quickly they receive sustainable residue removal limits in a graphic display within the map interface of this tool.