Biobased Industry Center Grants Program

Project Title: Evaluation of Corn Stover Management Strategies for Bioenergy Use and Potential Effect on Soil Quality and Greenhouse Gas Emissions

Project Leadership

<table>
<thead>
<tr>
<th>Name (PI/Co-PI)</th>
<th>Department</th>
<th>Phone No.</th>
<th>E-mail</th>
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<tbody>
<tr>
<td>Dr. Mahdi Al-Kaisi (PI)</td>
<td>Associate Professor, Soil and Water Management, Agronomy</td>
<td>515-294-8304</td>
<td><a href="mailto:malkaisi@iastate.edu">malkaisi@iastate.edu</a></td>
</tr>
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<td>Dr. Tim Parkin (Co-PI)</td>
<td>Microbiologist, Soil, Water, and Air Resources, USDA-ARS</td>
<td>515-294-6888</td>
<td><a href="mailto:tim.parkin@ars.usda.gov">tim.parkin@ars.usda.gov</a></td>
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<td>Jose Guzman (Co-PI)</td>
<td>Research Assistant, Agronomy</td>
<td>515-294-2054</td>
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Research Priority Addressed by this Project
Environmental Impacts of Biobased Industries and their implications for Regulatory and Economic Incentives.

Objectives
The main goal of this project is to establish field and laboratory studies to determine the short-term and long-term impacts of varying corn stover removal, N fertilization, and tillage systems on soil, air, and water resources. The project has five main objectives which include:
2. Soil C and N sequestration potential in varying stover and N fertilization management practices.
3. Evaluation of varying stover and N fertilization management practices on soil physical properties.
4. Quantification of greenhouse gases (GHG) being emitted under varying stover and N fertilization management practices.
5. Provide training and educational material on the productivity and profitability of stover removal in a sustainable agroecosystem.

Approach

Objective 1: Iowa farmers need to know how the removal of crop stover for cellulosic ethanol production will affect their yields and soil quality before they can confidently remove some of it. Soil measurements will be conducted every August which include soil C, N, P, K, and bulk density. After every harvest, crop measurements include harvested corn for grain yield, and N, P, and K uptake. Findings from field studies include N, P, K uptake and nutrient cycling for use in adjusting fertilization requirements for farmers, which is currently not available.

Objective 2: Soil measurements include changes in soil C, N, bulk density, and aggregate distributions. In addition, budgets are being evaluated to determine whether different stover removal practices are a sink or source of C and N. Emphasis will be taken to determine if any management practices such as switching to no-till, can be used to minimize, if not, increase C sequestration even when stover is removed in Iowa.
**Objective 3:** In addition to soil measurement taken from objectives 1 and 2, water infiltrations rates into the soil and soil compaction will also be investigated. These measurements will evaluate how varying rates of stover removal and N fertilization will impact soil hydraulic properties and soil erosion as a result of potential surface cover and soil quality changes.

**Objective 4:** Agriculture contributes a large proportion of GHG emissions, but by definition is a practice we have some control over. As such, many methods aimed to mitigate GHG emissions have been proposed and investigated, including: changes in fertilizer regimes, and tillage while still increasing crop yields. The focus of this study is to quantify N₂O and CH₄ emissions and net CO₂ efflux under different stover and N fertilization managements in Iowa.

**Objective 5:** Financial planning tools such as the Ag Decision Maker from ISU and others will be used to determine input costs such as number of trips in the field, fuel, machinery, tillage, and fertilization management to examine profitability of removing crop residue for bioethanol production. Annual field days, training workshops, and other educational events will be held for producers and agriculture professionals.

**Work plan and Schedule**
Short-term and ongoing long-term field studies will be sought out for in a poorly-drained soil at the ISU Agronomy Research Farm west of Ames, IA, and a well-drained soil at the Armstrong Research Farm southwest of Atlantic, IA in continuous corn. The main treatment is tillage practice (no-till and chisel plow), which will be split into three different stover removal rates (0, 50, and 100%) which will then be further split into six N fertilization rate treatments varying from 0 to 250 lb N/acre. Soil measurements will be conducted every August/September which includes soil C, N, P, K, aggregate distributions and bulk density. Additionally, soil temperature will be monitored on an hourly basis as well as daily soil moisture. Weekly CO₂, N₂O and CH₄ gas measurements will also be taken. After every harvest, crop measurements include harvested grain yield, N, P, and K uptake, above-ground biomass, and root biomass.

**Budget** (indirect not allowed)

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<thead>
<tr>
<th>CATEGORY</th>
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<tr>
<td>Salaries/Graduate Research Assistant</td>
<td>19,044</td>
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<tr>
<td>Benefits at 13.2%</td>
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<tr>
<td><strong>Sub-total</strong></td>
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<td>Students/Hourly</td>
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<td>Benefits at 4.6%</td>
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<td>Tuition</td>
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<td><strong>Sub-total</strong></td>
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<td>Equipment</td>
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<tr>
<td>Supplies &amp; Services</td>
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<tr>
<td>Travel</td>
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</tr>
<tr>
<td>Publication</td>
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<td>Miscellaneous*</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>49,690</strong></td>
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*Includes telecomm, computer use, print/copy, honoraria, services/user fees, postage, etc.
CURRICULUM VITA

Mahdi M. Al-Kaisi, Ph.D.

Education
Ph.D., Soil Physics/Water Management, North Dakota State University, 1986.
M.S., Soil Physics/Salinity, North Dakota State University, 1982.
B.S., Soil Science, University of Baghdad, 1974.

Experience
2006-present, Associate Professor, Department of Agronomy, Iowa State University
2000-2006, Assistant Professor, Department of Agronomy, Iowa State University
1991-2000, Extension Water Quality Specialist, Colorado State University
1998-1999, Research Associate, Department of Soil Science, North Dakota State University
1986-1987, Assistant professor, Department of Soil Science, University of Baghdad, Iraq
1980-1986, Graduate Student, North Dakota State University
1977-1980, Soil Instructor, Institute of Agriculture Technology, Baghdad, Iraq

Research Interest
Research interest focuses on the effect of cropping systems, tillage systems, crop residue management, and nitrogen fertilization on soil water conservation, crop water use, soil quality, soil carbon dynamics, and greenhouse gas emission. Also, research interests include the interaction effects of agricultural practices and environmental factors (i.e., climate change) on agriculture system sustainability and productivity.

Publications
Selected Refereed Journal Articles:
Guzman, J. and M. Al-Kaisi. 2010. Reconstructed prairies age and landscape position effect on selected soil properties in south central Iowa. Soil and Water Cons. J. (Accepted).
Curriculum Vitae
Timothy B. Parkin

Education:
1978  M.S.  University of Wisconsin, Madison, M.S., Major: Bacteriology.

Employment History:
1980-1983  Research Associate, Michigan State University, East Lansing, MI (Joint appointment in the department of Crop and Soil Sciences and the department of Microbiology and Public Health)
1983-1990  Research Microbiologist, Soil Nitrogen and Environmental Chemistry Laboratory, USDA-ARS, Beltsville, MD.
1990-2002  Research Microbiologist, National Soil Tilth Laboratory, USDA-ARS, Ames, IA.
2002-2009  Research Leader, Air Quality of Agricultural Systems Research Unit, NSTL, USDA-ARS, Ames, IA.
2009-Present  Research Microbiologist, National Laboratory for Agriculture and the Environment, U.S. Department of Agriculture-ARS, Ames, IA

Honors and Awards
National Institute of Health predoctoral fellowship award 1979 and 1980;
ISI Highly Cited Researcher, 2002

Professional Societies
Agronomy Society of America
Soil Science Society of America

Research Interests
Research interests include the microbial ecology of terrestrial systems in relation to C and N cycling processes, greenhouse gas production and emissions, assessment of spatial and temporal variability associated with naturally occurring microbial processes, and novel statistical approaches as applied to the study of microbial ecology.

Peer Reviewed selected Publications
JOSE GUZMAN  
Tel: 515-294-2054, jguzman@iastate.edu

EDUCATION
2009-current  Iowa State University; Graduate Research Assistant (PhD), Agronomy Dept.
2006-2008  Iowa State University; M.S. in Agronomy; Soil Science
2003–2005  Kansas State University; B.S. in Agronomy; Plant Science and Biotechnology & Natural Resources & Environmental Sciences

RECENT ACADEMIC AND RESEARCH EXPERIENCE
2006-Current  ISU Soil Management & Environment Extension; Ames, IA  
Soil Management and Environment Research Assistant
- Field & Lab technician; responsible for operation of several significant analysis instrumentation & development of new field and lab soil related procedures.
- PhD work on the interaction effects of corn residue removal, nitrogen fertilization, & tillage practices on continuous corn production, greenhouse gas emissions, soil C dynamics, and nutrients cycling.
- Master’s work on landscape position, time, and management practices impacts on soil carbon sequestration in reconstructed tall-grass prairies and cropland.

2004–2006  Kansas State University Soil & Cropping Systems Lab; Manhattan, KS  
McNair Scholar/Honors Project
- Working with Citizen Science Program promoting soil and water testing for local farmers and community members to enhanced natural resource stewardship.
- Honors project-correlation between commercially available soil test kits and certified soil laboratory procedures.

RECENT PUBLICATIONS IN REFERRED JOURNALS

Guzman, J. M. Al-Kaisi. 2010. Landscape position and age of reconstructed prairies system effect on soil organic carbon sequestration rate and aggregate associated carbon. Journal of Soil and Water Conservation (65) 9-21

Guzman, J. M. Al-Kaisi. 2010. Effects of landscape position and age of reconstructed prairie on infiltration rate and selected soil properties in South Central Iowa. Journal of Soil and Water Conservation (accepted)

Guzman, J., C. Godsey, G. Pierzynski, D. Whitney, R. Lamond. 2006. Effects of tillage and nitrogen management on soil physical and chemical properties after 23 years of continuous sorghum. Soil and Tillage Research (91) 199-206