TECHNICAL REVIEWERS' RATING SUMMARY

BM006-A

Evaluation of Perennial Herbaceous Biomass Crops in North Dakota for Production of Ethanol and other Value-Added Products and for Use in Coal Plant Co-Firing

Natural Resources Trust, Great River Energy, ND Farmer's Union,
ND Game and Fish Department, Natural Resources Conservation Services
Principal Investigators: Keith Trego
Request for $280,000; Total Project Costs $420,000

		Technical Reviewer			
		3A	3B	3C	Average
Rating Category	Weighting Factor	Rating			Weighted Score
1. Objectives	9	3	5	3	33.00
2. Achievability	9	5	4	3	36.00
3. Methodology	7	3	5	3	25.67
4. Contribution	7	4	5	3	28.00
5. Awareness	5	3	5	3	18.33
6. Background	5	3	4	2	15.00
7. Project Management	2	3	3	3	6.00
8. Equipment Purchase	2	5	5	5	10.00
9. Facilities	2	4	4	3	7.33
10. Budget	2	4	5	2	7.33
Average Weighted Score		183	230	147	**186.67**
Maximum Weighted Score					**250.00**

OVERALL RECOMMENDATION

FUND	x	x	
FUNDING MAY BE CONSIDERED			x
DO NOT FUND			

BM006-A
Evaluation of Perennial Herbaceous Biomass Crops in North Dakota
For Production of Ethanol and other Value-Added Products
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1. The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Renewable Energy Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer 3A (Rating: 3)
To fulfill the goals of NDIC in depth knowledge of the production of biomass on ND soils is essential. The commission can not move forward in an objective fashion without full knowledge of the production fundamentals of feedstock species grown on ND soils and within the parameters of the ND climate. This proposal is clearly aimed at providing supportive information to NDIC goal and objectives.

Reviewer 3B (Rating: 5)
The goals look very similar. This information is needed to determine feasibility.

Reviewer 3C (Rating:3)
I believe this proposal does meet and satisfy many of the objectives related to the REC goals. The information collected, if successful, would provide valuable information to agricultural producers in the state. Sound management guidelines for the production of dedicated energy crops are critical to the establishment of the industry. This proposal meets at least 4 of 8 grant priority guidelines provided to the reviewer. My only concern related to meeting the REC objectives is the timeline of the proposal. The timeline here is very long and I wonder if the state can wait until 2015 for a complete report. The industry is moving quickly and the collection of information must move similarly.

The biomass plots were established in 2006 with the first biomass harvest conducted in 2007 and the second harvest in 2008. North Dakota State University has published and widely distributed results obtained to date on biomass yields and related data. The ten-year time frame for the study was determined based on the need to capture climatic variability and the potential influence on biomass yields and chemical composition; allow for variation in harvest frequency of the various biomass plot seed mixes; and detect changes in soil quality and carbon sequestration. Overall, the study length increases the scientific rigor of the study and provides potential biomass users with better data.

2. With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or

5 – certainly achievable.

Reviewer 3A (Rating: 5)
Given the knowledge base currently established by ND Natural Resources Trust starting in 2006 and the intention to integrate this work into the future proposal the objectives are certainly achievable.

Reviewer 3B (Rating: 4)
Looks realistic for the next 3 years. I would be interested to see a cost projection for the final 4 years of their 10 year project, and where that funding is anticipated to come from.

Current budget: The current grant will fund years 2009-2011. The final four years of the study will include funding for biomass plots maintenance, harvest, chemical analysis and soil data collection and analysis. The soil chemical data collection and analysis will cost approximately $40,000. The biomass plots maintenance, harvest, and chemical data collection and analysis will cost an average of $100,000 per year. The funding for the final four years of the project will be contributed by existing project partners and any new grant sources that are available.

Reviewer 3C (Rating: 3)
As noted earlier, the long timeline is a concern. I understand why the proposal authors have set the timeline the way they have, but rather than collecting soil and chemical information every 3 or 5 years, why not every year for three years initially to produce some recommendations in the short-term. A long-term study would be great, but again, can we wait until 2015 to get results.

Response provided by project partner Dr. Mark Liebig, USDA, Agricultural Research Service, Mandan, ND, as follows:

The amount of time necessary to detect changes in soil properties is largely a function of organic matter inputs to the soil, which in turn, are largely dependent on climatic and edaphic factors dictating production potential. Within the northern Great Plains, the production potential of most agroecosystems is such that management factors often have subtle effects on soil properties within an annual timescale, and can take years or even decades before an effect of management is discernable. Consequently, long-term research sites are essential for estimating management impacts on soil properties, particularly soil organic carbon.

The five-year time-step selected for soil sampling acknowledges the slow rate of change in soil properties in the region. Sampling on a more frequent basis – while tempting – increases the likelihood of not detecting a treatment effect, resulting in an inefficient use of limited resources.

The decision to sample on a five-year time-step is supported by recently published research from the Agricultural Research Service at Mandan, ND (Liebig et al., 2008). A five-year sampling sequence was used in an on-farm study across three states (NE, SD, ND) to investigate switchgrass production effects on soil organic carbon. Of the ten sites sampled, a statistically significant change in soil organic carbon was detected in only four sites within the surface 30 cm depth. Three sites were sampled to 120 cm, yet only one site exhibited a significant change in soil organic carbon over a five year period.

Liebig, M.A., M.R. Schmer, K.P. Vogel, and R. Mitchell. 2008. Soil carbon storage by switchgrass grown for bioenergy. Bioenerg. Res. 1: 215-222.

Overall, the project goals are achievable within the timeline and budget. The list of supporting partners is very good and should provide coverage of the management of the project and tasks well.

3. The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer 3A (Rating: 3)
Methodology makes no reference to Phosphorous Analysis of biomass. Given the low level of this nutrient in ND soils generally offtake of phosphate should be quantified. In addition all major and minor elements necessary for plant growth should be analyzed in the biomass harvested and soils over time.

Gathering data on phosphorous levels in soils as well as all major and minor soil elements is typically part of a soil fertility study. The purpose of this project is not to conduct a soil fertility study; this topic has been thoroughly studied in North Dakota and in the Northern Great Plains, therefore we did not see a need to duplicate these studies.

Reviewer 3B (Rating: 5)
Methodology looks very good. Distribution of plots across the state should give a good reference to soil type and moisture conditions. Grass varieties were very well chosen. Plot size and replication looks good. Harvest schedule looks right.

Reviewer 3C (Rating: 3)
The title of this proposal includes the word "for the production of ethanol." Yet beyond growing biomass, I do not see any analysis related to producing ethanol. The proposal primarily focuses on biopower (cofiring) which is equally important. If ethanol were a focus, some of the chemical analysis should include sugar content, lignin structures, and other key characteristics. My recommendation would be to focus on producing biomass and on cofiring. The proposal contains no analysis related to ethanol production whatsoever.

The proposal (Pages 10-11) addresses why this project is needed, as follows, "Based on a 1999 study of biomass feedstock availability in the United States, North Dakota ranks first in potential energy crops, such as switchgrass and other prairie grasses. Despite this potential, the suitability of North Dakota for production of bioenergy crops has yet to be thoroughly assessed. In addition to ethanol, many other useful and potentially more profitable products can be produced from prairie grasses. Prior to building a conversion plant or bio-refinery, data is needed on appropriate grass species, harvest methods, chemical composition of harvested biomass, and practices to maintain productive perennial biomass stands."

Additionally, as the letter from North Dakota State University indicates, as part of this project, Dr. Quingwu Xue is conducting an analysis of the biomass to determine the cellulose and hemi-cellulose content. This information should be beneficial to better understanding the potential of biomass from the plots for ethanol production.

More specific information is attached on soil quality parameters and biomass chemical properties that will be analyzed.

The methodology of the project is sound, though more detail would be beneficial. The information with regards to plots, sampling, etc is all fine. I do have a couple of comments regarding some specific methods. The authors state that all plots will have 20 lbs of nitrogen applied each spring per ton of biomass produced. It would be nice to know where this number (what reference) comes from. This varies from region to region so knowing where the number comes from is important (in some regions this would be considered a very high level of fertilization. Also, what about potassium and phosphorous? Typically, these are applied also, especially on marginal soils.

North Dakota State University has indicated that the 20 lbs of nitrogen is based on their experience and that nitrogen is generally more limiting than potassium and phosphorous.

In regards to the chemical analysis, the authors state that samples will be "stored in sealed plastic or glass containers until chemical analyses are performed." How will they be stored? Materials of this type typically MUST be frozen if analysis is not conducted shortly after collection. Long term storage of samples (not frozen) can lead to some skewed results due to changes in the plant material during storage.

According to North Dakota State University, the standard protocol for forage samples is to oven dry the sample, grind through a 1mm screen and then store the sample in an air tight plastic bag. North Dakota State University has previously collected and stored samples using this technique with no degradation problems.

Also, the proposal authors never give any detail related to wildlife and conservation. They mention a few times and even note it as one of the tasks in the management plan. No methodology is provided though. This either needs to be added as an objective with methodology or dropped from the proposal.

The North Dakota Natural Resources Trust has conducted a literature review and prepared preliminary Best Management Practices for Biomass Production, Harvest, and Management with the primary focus on wildlife and conservation in North Dakota. The science is still evolving on best management practices for wildlife and conservation; therefore, as part of this project, we propose to update the BMP's as additional information is published. For example, an important effort that should be considered is the Council on Sustainable Biomass Production (CSBP) program. The CSBP has prepared a Draft certification system designed as a mechanism by which consumers can ensure that the biofuels or electricity they purchase comes from sustainable producers.

Again, a concern is the fact that soil will only be sampled in year 0, 5 and 10. I agree a long-term study is ideal and provides good information. However, is the REC goal to provide good information in a shorter period of time? Ten years seems like a long time for the State to wait for this information. Again, it seems to me that to get information to benefit ND farmers in the short-term, samples should be taken in shorter intervals, shortening the whole project. The industry is moving quickly and I don't know if we have ten years to wait. Most DOE grants now are no longer than 5 years.

Please refer to replies to Technical Reviewer comments on Rating Category 2, Achievability.

4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Renewable Energy Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer 3A (Rating: 4)
Process Design relies heavily on integration of quantifiable parameters such as throughput, chemical composition data and nature of biomass species. To obtain this information for a specific feedstock supply region requires research to be conducted in this region on crop species with biomass potential.

Reviewer 3B (Rating: 5)
This work should produce the information needed to determine most productive species for biomass production.

Reviewer 3C (Rating: 3)
The information gained will be extremely beneficial to the REC goals through the establishment of a sustainable biomass industry and biopower industry.

5. The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 3A (Rating: 3)
The proposal can be regarded as a realistic and commercially compatible effort to further the ND biomass industry answering both the requirement of primary producers and end user facilities with regard to production fundamentals at given species.

Reviewer 3B (Rating: 5)
Well referenced

Reviewer 3C (Rating: 3)
The authors have cited some of the leaders in this field, so I do feel they have a good understanding of the current research activity.

6. The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 3A (Rating: 3)
N/A – Limited information is given on the background of the Principle Investigator.

Keith Trego is Executive Director for the North Dakota Natural Resources Trust (resume attached) and Karen Kreil is the staff contact for the project. The Trust is the overall project coordinator. Dr. Paul Nyren, Director/Range Scientist for the North Dakota State University Central Grasslands Research Extension Center is the lead scientist on several aspects of the project (see next reply) and a copy of his vitae is attached. Dr. Mike Liebig and Dr. Kris Nichols, USDA Agricultural Research Service, Mandan, ND, collected and analyzed the baseline soil samples and would collect and analyze soil samples in 2010 and 2015 for comparison. Vitae for Dr. Liebig and Dr. Nichols are attached.

Reviewer 3B (Rating: 4)
The Trust appears to have a good understanding and background in regards to the agronomics of the plant aspect. I appreciate Great River Energy's interest and commitment to the project. Their interest makes this project possible as the consumer/distributer.

Reviewer 3C (Rating: 2)
I believe the investigators' backgrounds with native grasses, riparian areas, and conservation is good. I think that the experiences they have had with the establishment of grasses is also good. With the right people at NDSU doing sampling and analysis, the project stands an excellent chance of being very successful. I am unable to determine, other than the energy company partner, if any investigators have experience in managing grasses for bioenergy, a very different management technique than for wildlife.

We are not aware of any entity in North Dakota that has experience in managing grasses for bioenergy which is one of the reasons this study was initiated. Dr. Paul Nyren, Director/Range Scientist for the North Dakota State University Central Grasslands Research Extension Center is the lead scientist on several aspects of the study including biomass plots establishment, maintenance, and harvest; analysis of the chemical composition of harvested biomass; coordination with four other Research Extension Centers on biomass plots study; and communication with agricultural producers, end users, and others on study results. Dr. Nyren has the requisite background for the effort and a copy of his vitae is attached.

One major note about investigators: At no point in the proposal is the group at NDSU introduced. We do not know who the lead at the University is and there is no letter of support from the institution.

A letter of support from North Dakota State University is attached.

7. The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and

subcontractors, if any, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer 3A (Rating: 3)
The proposal is strengthened by the diversity of stakeholders involved. This will ensure proactive cooperation and communication, to complete the project between all parties. The proposal is mainly comprised of routine analytical procedures.

Reviewer 3B (Rating: 3)
Milestone chart, schedule for activities, and financial plan look good for the next 3 years. This will be a very big project and I hope the Trust is up to the communication challenge. Coordination of this many partners and managing contractors will be a big job. I would like to know more about how they plan to manage the project. Communication will be the key factor in whether this succeeds. Would like to see at least biannual meetings scheduled.

The North Dakota Natural Resources Trust is confident we are up to the task because of our overall experience as well as our specific experience in coordinating and administering grants for the first three years of the project. Communication and coordination on the study and the results generated have been and will continue to be important aspects of the project and biannual meetings is a suggestion we will discuss with project partners.

Reviewer 3C (Rating: 3)
Overall, the management and financial plans look sound.

8. The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 3A (Rating:5)
The intention to use equipment and facilities currently existing in the state is a key advantage to this proposal.

Reviewer 3B (Rating: 5)
No equipment stated.

Reviewer 3C (Rating: 5)
This proposal does not seem to include any equipment purchase, though there is no budget detail for the NDSU part. Chemical analysis of the biomass samples is expensive but I have no way to tell what the budget is for.

The budget does not include any equipment purchases. The NDSU budget includes staff time for biomass plot maintenance, harvest, storage preparation, and chemical composition analysis and is based on costs of these activities during the first three years of the project.

9. The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 3A (Rating: 4)
Excellent work has been conducted and published from these facilities historically and one should have no reason to expect otherwise with regard to this proposal.

Reviewer 3B (Rating: 4)
Facilities appear very good. No information on harvesters.
North Dakota State University will use a self propelled harvestor which harvests and weighs a 1 meter wide sample of the 30 foot plot. A photograph of the harvestor is attached.

Reviewer 3C (Rating: 3)
I certainly think the fields where the experimental plantings are located are adequate, but no detail is provided related to chemical analysis at NDSU and thus no good determination can be made.

10. The proposed budget "value"[1] relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value. (See below)

Reviewer 3A (Rating: 4)
For the value of the proposed information to be generated as a result of this proposal it represents excellent value for each dollar spent.

Reviewer 3B (Rating: 5)
The groundwork has been laid, plots established, and a very good selection of partners signed on.

Reviewer 3C (Rating: 2)
With the amount of cost share provided and the leveraging of other grants received by the Trust, the value is average.

This project does not meet the 50% cost match. The proposal requests $280,000 of a total budget of $420,000. The request is more than 50% of the total. Thus, the value is low.

The Biomass Incentive and Research Program does not require a 50% cost match. The North Dakota Department of Commerce determined the project is eligible.

[1] "Value" – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar.

10a. Financial commitment from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Higher priority is to be

given if the application has private industry investment equal to or at least 50% or more of total cost.

The minimum 50% cash match is demonstrated.

Section C. Overall Comments and Recommendations:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 3A ***(Fund)***
This project proposal is aimed at elucidating the fundamentals of targeted commercial biomass production in North Dakota. Information on adaptability of crop species, chemical composition, yields, impact on soil properties and environmental and wildlife implications will be generated. This information will be a valuable resource for both primary producers (farmers/landowners) of biomass crops and for potential processors/end users and for the general public.

If there is a weakness in the project it would be lack of reference to showcasing this work annually to farmers/growers to help "sow the seeds" of innovation amongst entrepreneurial farmers. Development of semi-commercial areas at promising crop species with some of these growers in the interim period would also be worthy of consideration.

As the North Dakota State University support letter indicates, NDSU has showcased this project in a number of ways including hosting biannual meetings for area agricultural producers; publishing articles in their annual reports which are distributed to 25,000 constituents throughout central North Dakota; and publishing the annual reports on their website. Both NDSU and the Natural Resources Trust have given presentations on the study at a number of different conferences and has been interviewed about the project by television and radio stations throughout central North Dakota and articles have been published in magazines such as the North Dakota Water magazine published by the North Dakota Water Education Foundation.

I recommend this proposal receives funding.

Reviewer 3B ***(Fund)***
Very interesting project. The information to be gained from this study could be invaluable to the state of ND. I believe their standards for success of the project is right on. However, I would like to know when and how the information generated will be available to producers (through extension, industry, etc.). I would also like to note that there may be problems with the CRP mixture. Weed pressures in some of these areas is intense and control may make it necessary to eliminate established legumes. But overall, a very good proposal and I would recommend funding.

Reviewer 3C ***(Funding May Be Considered)***
Overall, the proposal is a good idea and would provide good information.

Three key points stick out though:

1) No information or letter of support from NDSU. Practically all of the proposal budget is going to NDSU and a letter of support and facility information should be required.
2) Timeline is too long in my opinion to provide needed value to the state
3) Cost share/match does not meet the guideline (50%) provided in the reviewer's document.

Chemical Analysis of Biomass and Soil	NRCS CIG Biomass Plots Study[1]	REC Proposal[2]
Biomass Parameters	X	X
• Weight (dry)	X	X
• Moisture	X	X
• Nitrogen	X	X
• Potassium	X	X
• Carbon	X	X
• Ash	X	X
• Neutral and Acid Detergent Fiber (For Cellulose, Hemicellulose, and Lignin information)	X	X
• BTU		X
• Silica		X
• Alkalinity		X
Soil Parameters		
• Electrical Conductivity	X	X
• Soil pH	X	X
• Total carbon and nitrogen	X	X
• Soil inorganic carbon	X	X
• Particulate organic matter	X	X
• Extractable Nitrate and Phosphorus	X	X
• Glomalin	X	X
• Gravimetric water (pre-drying)	X	X
• Soil Bulk Density	X	X

[1] Natural Resources Conservation Service Conservation Innovation Grant funding.
[2] Renewable Energy Council Grant funding. Additional chemical analyses indicated in yellow.

Paul E. Nyren, Director/Range Scientist
Central Grasslands Research Extension Center

Education:

M.S., Range Ecology, 1975.

B.S., Washington State University, Range Management, 1973.

Research Interests:

As director of the CGREC, Paul is engaged in every aspect of research and administration. He is a strong advocate of new and innovative technologies to restore and improve grassland communities. Paul was one of the first range scientists at NDSU to use GIS to monitor rangeland condition and production. In addition, he is involved with a wide variety of research projects including grazing systems which examine several levels of grazing intensity, CRP research, wildlife management, soil quality and runoff, range equipment research, range plant ecology, economic comparison studies of cropping versus grazing, etc. Established a model ranch enterprise on the CGREC to demonstrate best management practices (BMPs) in the areas of grazing management and resource monitoring, livestock management and nutrition, and forage production which provides a reference for maximizing economic returns through a system of whole farm management for producers in the Northern Great Plains. The program provides an economic analysis of livestock management "from birth to plate." Paul is project leader for a new research study which began in 2006 to evaluate perennial biomass energy crops in North Dakota. This 10-year study was initiated to: 1. Evaluate the agronomic practices necessary to maximize the production of various grass and legume crops for biomass production. 2. Determine the effect of perennial biomass energy crops on carbon sequestering and other soil physical properties. 3.Provide an economic analysis of the production costs. Developed an International Scholars Program at Central Grasslands REC in cooperation with the Chinese Academy of Science Institute of Botany in Beijing, China and the Northwest Institute of Plateau Biology in Tibet. This program began in 2004 and will continue to 2011. This agreement permits Chinese scientists and their students to conduct research at CGREC near Streeter, North Dakota. This plan, named the Visiting Scholars Program, allows for an exchange of scientific inquiry. Since 2004, graduate-level students from China have studied various aspects of the mixed-grass prairie at CGREC. Using the Center's extensive database of weather, vegetation, and soil information, along with livestock and rangeland management data collected over many years, these students are able to conduct a variety of studies and contribute to the understanding of the area's ecology. Paul gave a paper on the production of perennial forages for biofuels at the Biomass ‘08 Technical Workshop in Grand Forks, ND. He has served on two regional Sun Grant review panels in 2009. He has authored or co-authored 30 research publications covering areas such as grazing systems, range ecology, complementary grazing, interseeding, range fertilization, alfalfa management, and equipment design.

Recent Honors and Awards:

2001, SRM Fellow Award, Society for Range Management, Exceptional contributions to the art and science of Range Management

1999, Outstanding Achievement Award, Northern Great Plains Section of the Society for Range Management, Range Management

Recent Publications:

Z. Zhanga,c,d,, S.-P. Wangb,, P. Nyren, G.-M. Jianga (2006) Morphological and

reproductive response of Caragana microphylla to different stocking rates, *Journal of Arid Environments*, 67 (2006), 671-677

Y. Z. Gao, S. P. Wang, X. G. Han, B. D. Patton, P. E. Nyren (2005) Competition Between Artemisia frigida and Cleistogenes squarrosa Under Different Clipping Intensities in Replacement Series Mixtures At Different Nitrogen Levels, *Grass and Forage Science*, 60, 119-127

S. P. Wang, Y. F. Wang, Z. Z. Chen, B. Patton, P. Nyren (2005) Effect of stocking rates on plant morphology in the Inner Mongolia steppe of China, *XX International Grassland Congress*, 533

P. Wang, Y. F. Wang, Z. Z. Chen, B. Patton, P. Nyren (2005) Effect of stocking rates on plant morphology in the Inner Mongolia steppe of China, *XX International Grassland Congress*, Dublin, Ireland, 533 pages

Patton, B. D. and P. Nyren, Effect of Grazing Intensity on Soil Water and Rangeland Productivity in Southcentral North Dakota, *Proc. of AWRA Special Conference Rangeland Management and Water Resources Assoc*, TPS-98-1, 219-228, 1998

Biondini, Mario E., Bob D. Patton, and Paul E. Nyren, Grazing Intensity and Ecosystem Processes in a Northern Mixed Prairie, *J. Ecological Applications.*, 8(2), 469-479, 1997

Gilley, J.E., B.D. Patton, P.E. Nyren, and J.R. Simanton., Grazing and Haying Effects on Runoff and Erosion from a Former Conservation Reserve Program Site, *Applied Engineering in Agriculture.*, 12(6), 681-684, 1996

CURRICULUM VITAE

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EDUCATION

1998	Ph.D., Agronomy	University of Nebraska
1992	M.S., Agronomy	University of Nebraska
1990	B.A., Biology-MCD	University of Colorado

PROFESSIONAL AND ACADEMIC APPOINTMENTS

2003 – present	Adjunct Professor, Department of Soil Science, North Dakota State University.
1999 – present	Research Soil Scientist, USDA-ARS-NGPRL, Mandan, ND.
1998 – 1999	Postdoctoral Research Associate, USDA-ARS-SWCRU, Lincoln, NE.

SELECTED PROFESSIONAL ADVISORY/CONSULTATION ACTIVITIES (last 3 years)

2008 – present	Served as expert advisor for *agri benchmark* (Johann Heinrich von Thünen-Institut, Braunschweig, Germany) in the development of a greenhouse gas accounting system for prevalent cropping systems in 13 countries. Provided advice and counsel for one M.S. student assigned to the project (Sumadhur Shakya, 2009).
2007 – present	Served on ASA-CSSA-SSSA Greenhouse Gas Working Group.
2006 – present	Served as a member of the Chicago Climate Exchange Soil Carbon Technical Advisory Committee.

OFFICES AND COMMITTEE ASSIGNMENTS IN SCIENTIFIC SOCIETIES

2010	Chair-Elect. SSSA Division S-6.
2002 – 2004	Member. SSSA, S490 Francis and Evelyn Clark Soil Biology Scholarship Committee.
2002 – 2003	Member. SSSA, S475 Emil Truog Soil Science Committee.
2001 – 2003	Council Representative. Soil and Water Conservation Society, North Dakota Chapter.

EDITORIAL RESPONSIBILITIES FOR PEER-REVIEWED JOURNALS

2003 – present	Associate Editor. Renewable Agriculture and Food Systems.
2006 – 2008	Technical Editor. Forages and Grazinglands.

AWARDS/RECOGNITION

2008	Soil and Water Conservation Society, Conservation Research Award.
2007	USDA-ARS-NPA, Early Career Scientist of the Year.
2007	Soil and Water Conservation Society (North Dakota Chapter), Professional Award.
2004	ASA-CSSA-SSSA Editor's Citation for Excellence in Manuscript Review, *Journal of Environmental Quality*.
2004	Soil Science Society of America, S-6 Young Scholar Award.
1998	Soil and Water Conservation Society, Kenneth E. Grant Research Scholarship.
1991	University of Nebraska, Widaman Trust Distinguished Graduate Assistant Award.

PEER-REVIEWED PUBLICATIONS (last 3 years)

Liebig, M.A., D.L. Tanaka, and J.R. Gross. Fallow effects on soil carbon and greenhouse gas flux in central North Dakota. Soil Sci. Soc. Am. J. (accepted, 3/3/09).

Liebig, M.A., S.L. Kronberg, and J.R. Gross. 2008. Effects of normal and altered cattle urine on short-term greenhouse gas flux from mixed-grass prairie in the northern Great Plains. Agric. Ecosys. Environ. 125:57-64.

Liebig, M.A., D.J. Wikenheiser, and K.A. Nichols. 2008. Opportunities to utilize the USDA-ARS Northern Great Plains Research Laboratory soil sample archive. Soil Sci. Soc. Am. J. 72:975-977.

Liebig, M.A., M.R. Schmer, K.P. Vogel, and R. Mitchell. 2008. Soil carbon storage by switchgrass grown for bioenergy. Bioenerg. Res. 1: 215-222.

Liebig, M.A., J.R. Hendrickson, J.D. Berdahl, and J.F. Karn. 2008. Soil resistance under grazed intermediate wheatgrass. Can. J. Soil Sci. 88:833-836.

Hendrickson, J.R., M.A. Liebig, and J.D. Berdahl. 2008. Responses of Medicago sativa and M. falcate type alfalfas to different defoliation times and grass competition. Can. J. Plant Sci. 88:61-69.

Hendrickson, J.R., M.A. Liebig, and G.F. Sassenrath. 2008. Environment and integrated agricultural systems. Renew. Agric. Food Sys. 23(4): 304-313.

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Frank, A.B., M.A. Liebig, and D.L. Tanaka. 2006. Management effects on soil CO_2 efflux in northern semiarid grassland and cropland. Soil Tillage Res. 89:78-85.

Franzluebbers, A.J., R.F. Follett, J.M.F. Johnson, M.A. Liebig, E.G. Gregorich, T.B. Parkin, J.L. Smith, S.J. Del Grosso, M.D. Jawson, and D.A. Martens. . 2006. Agricultural exhaust: A reason to invest in soil. J. Soil Water Conserv. 61(3): 98-101.

Kristine A. Nichols

Education

B.A. 1995 University of Minnesota, Plant Biology/Genetics and Cell Biology
M.S. 1999 West Virginia University, Environmental Microbiology
Ph.D. 2003 University of Maryland, Soil Science

Professional Experience

Senior Laboratory Technician – Department of Plant Biology, University of Minnesota (1995-1996): Using arbuscular mycorrhizal fungi (AMF) in roadside reclamation by culturing native isolates in the laboratory and re-introducing them to disturbed sites.

Instructor – ICOM I (International Conference on Mycorrhizae), (1996): Assisted in the preparation of an instruction manual, mycorrhizal spore samples and laboratory chemicals and supplies for a workshop entitled 'Classification & Identification of Arbuscular Mycorrhizal Fungi'. Provided support for workshop participants and taught a section on *Gigaspora* spp.

Graduate Research and Teaching Assistant – Plant Pathology and Environmental Microbiology Department, West Virginia University (1996-1998): Used a series of growth room, axenic pot culture experiments to examine iron influences on the accumulation of glomalin. Examined spore characteristics used for taxonomy of AMF.

Research Associate – Center for Agricultural Biotechnology, University of Maryland (1999-2000): Compared glomalin to other types of soil organic matter, such as humic substances and particulate organic matter, and correlating with aggregate stability and soil edaphic factors.

Biological Science Laboratory Technician – USDA-ARS-Sustainable Agricultural Systems Laboratory, (2000-2003): Studied glomalin in native and agricultural ecosystems and axenic pot cultures, using immunological assays (i.e. ELISA, Western blots, immuno-fluorescence, and immuno-dot blot), colorimetric assays, elemental analysis, NMR, SDS-PAGE, AA and GC-MS.

Soil Microbiologist – USDA-ARS-Northern Great Plains Research Laboratory, (2003-present): Study of glomalin and soil aggregate stabilization in the soils of the northern Great Plains region. Evaluate native prairie grasses for potential biofuel production and soil carbon storage.

Honors and Awards

Eloise Pittman Scholarship for Excellence in Plant Biology. University of Minnesota, 1994.
President's Leadership and Service Award. University of Minnesota, 1995.

Selected Publications (last five years)

Pikul Jr., J.L., G. Chilom, J. Rice, A. Eynard, T. Schumacher, K. Nichols, J. M. F. Johnson, S. Wright, T. Caesar, M. Ellsbury. 2009. Soil aggregate stability and components of organic matter affected by tillage. Soil Sci. Am. J. 73: 197-206.

Liebig, M.A., D.W. Wikenheiser, K.A. Nichols. 2008. Soil sample archive at the USDA-ARS Northern Great Plains Research Laboratory. Soil Sci. Am. J. 72: 975-977.

Nichols, K.A. 2008. Indirect contributions of AM fungi and soil aggregation to plant growth and protection. In: *Mycorrhizae: Sustainable Agriculture and Forestry.* Z.A. Siddiqui, M. S. Akhtar, and K. Futai (eds.). Springer, Netherlands. 177-194.

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Wright, S.F., K.A. Nichols, and W.F. Schmidt. 2006. Comparison of efficacy of three extractants to solubilize glomalin on hyphae and in soil. Chemosphere. 64 (7): 1219-1224.

Nichols, K.A. and S.F. Wright. 2005. Comparison of Glomalin and Humic Acid in Eight Native U.S. Soils. Soil Sci. 170 (12): 985-997.

Lovelock, C.E., S.F. Wright, and K.A. Nichols. 2004. Using glomalin as an indicator for arbuscular mycorrhizal hyphal growth: an example from a tropical rainforest soil. Soil Biol. Biochem. 36: 1009-1012.

Gonzalez-Chavez M.C., R. Carillo-Gonzalez, S.F. Wright, and K.A. Nichols. 2004. The role of glomalin, a protein produced by arbuscular mycorrhizal fungi, in sequestering potentially toxic elements. Environ. Pollut. 130: 317-323.

Nichols, K.A. and S.F. Wright. 2004. Contributions of soil fungi to organic matter in agricultural soils. In: *Soil Organic Matter in Sustainable Agriculture.* F. Magdoff and R. Weil (Eds.). CRC Press. pp. 179-198.

Nichols, K.A., S.F. Wright, M.A. Liebig, and J.L. Pikul Jr. 2004. Functional significance of glomalin to soil fertility. In: Proc. of the Great Plains Soil Fertility Conference. March 2-3. Denver, CO. pp. 219-224.

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June 15, 2009

Karlene Fine, Executive director
North Dakota Industrial Commission
State Capitol - 14th Floor
60 East Boulevard Ave., Dept. 405
Bismarck, ND 58505-0840

Dear Ms. Fine:

I am writing in support of the North Dakota Natural Resources Trusts's project entitled "evaluation of perennial herbaceous biomass crops in North Dakota for production of ethanol and other value-added products and for use in coal plant co-firing".

North Dakota State University and the Central Grasslands Research Extension Center have pledged land, and facilities towards this project. Currently research plots have been established (2006) at the Research Extension Centers at Hettinger, Williston, Minot, Carrington and Central Grasslands. At Williston both dryland and irrigated plots have been seeded. In addition plots were established in the spring of 2009 at the Ducks Unlimited ranch North of Wing and at the USDA-ARS Northern Great Plains Field Laboratory in Mandan.

In 2008 the Central Grasslands Research Extension Center signed a memorandum of agreement with the USDA-ARS Laboratory in Mandan to share equipment and facilities in conducting this research project as well as future research. Dr. Quingwu Xue is a forage agronomist with North Dakota State University, officed a the USDA-ARS Mandan. Dr. Xue is conducting the forage analysis to determine the cellulose and hemi-cellulose

The Central Grasslands has included the plots at the Center on its field tours in June as well as a report at the January "Grass-n-Beef Research Review". In addition reports on the data analysis of all the plots is included in the 2007 and 2008 Central Grasslands Annual Report which is distributed to 25,000 constituents throughout central North Dakota. These report are also published on the Centers web page at http://www.ag.ndsu.nodak.edu/streeter/.

As the lead scientist from North Dakota State University on this project I have the responsibility for overseeing the planting, harvest, and data analysis for all sites.

Sincerely,

Paul E. Nyren
Director/Range Scientist