

NCERA 059 Soil Organic Matter: Formation, Function, and Management Annual Meeting

University of Wisconsin

Madison, Wisconsin

August 17-19, 2009

Chair:

Teri Balsler
University of Wisconsin – Madison

Chair-elect:

Richard Dick
The Ohio State University

Secretary:

Ann-Marie Fortuna
Washington State University

Administrative Advisor:

Gerald Miller
Iowa State University

Members in Attendance:

Teri Balsler, WI
Larry Cihacek, ND
Rhae Drijber, NE
Ann-Marie Fortuna, WA

William Horwath, CA
Dan Olk, USDA-ARS
Charles Rice, KS

Members Absent:

Deborah Allan, MN
Douglas Archibald, PA
Cynthia Cambardella, USDA-ARS
Richard Dick, OH
John Grove, KY
Jane Johnson, USDA-ARS
Peter Motavalli, MO
Kristine Nichols, USDA-ARS
Rebecca Phillips, ND

Sieglinde Snapp, MI
Alexandra Stone, OR
Dan Sullivan, OR
Robert Tate, NJ
Ron Turco, IN
Michelle Wander, IL
Raymond Weil, MD
Sharon Lachnicht Weyers, USDA-ARS

Advisors:

Gerald Miller, IA, Administrative Advisor,
present

Guests:

Nicola Lorenz, OH; representing Richard Dick
Matt Ruark, WI

1. The new 5 year plan for the committee is due in November 2010.
2. The minutes from the June 2008 Meeting were discussed and approved by a show of hands.
3. Carbon Cycling & Biosequestration Integrating Biology & Climate through Systems Science March 2008 Workshop was discussed.
4. Report form Jerry Miller

- a. Election, chain of succession: Current and former executive committee members as of August 2009

Ann-Marie Fortuna - secretary
Richard Dick - chair-elect
Teri Balser - chair
Alex Stone - chair, FY08
Doug Archibald – chair, FY07
Deb Allen – chair, FY06
Sieg Snapp – chair, FY05
Serita Frey – chair, FY04

- b. Turn in state reports. Send to Ann-Marie Fortuna. Ann-Marie will compile the state reports and meeting notes and forward them to Jerry. Due in 60 days after meeting.
- c. Email via NMISS or get excel file from Teri with emails of work group. Check list-serve email for NCERA-059 to verify who is participating.
- d. Chair. Incoming chair is begins with the fiscal year September 30th, 2009. Richard Dick is the incoming Ann-Marie Fortuna is the chair elect. Will elect new secretary today
- e. Midterm review last year. NCERA-059 was approved for continuation. Letter received April 9th was circulated on the list-serve.
- f. Next year we will write a new proposal during the 2010 meeting in Ohio. The report is due November 15, 2010. This year (2009) is the 3rd year. Next year is the 4th year and a new report will be needed prior to year 5. NCERA-059 will meet in June, July or August. The new report needs to be on the agenda for FY 2010.
- g. Action item: If committee plans to meet in Pittsburgh coordinate with Schlesinger at ASA.
- h. Funding. The NIFA budget was passed by the president and House of Representatives. The budget was passed in the Senate but was not finalized.
- i. Cheap food policy and perception that food is cheap resulted in USDA getting no money from stimulus package (see slides Iowa State University). Odesta was hired to lobby east coast media about the problem of funding (see slides).
- j. National Institute of Food & Agriculture (NIFA) head Raj Shaq has emphasized the following areas of research: bioenergy (feedstocks & conversion), climate change (mitigation and control of global warming), nutrition, health and nutrition (consumption), food safety and food security and world hunger.

5. Committee accomplishments

- a. What are we accomplishing and what impacts have we had as a committee. Question asked by NCAC department chairs, what have you done? Do not include impacts that have not occurred i.e. Pittsburgh, PA ASA, CSA, SSSA Meetings 2009.

- b. Chuck Rice. Let's go back to our committee objectives and see what we can accomplish and have accomplished. Because committees like NCERA-059 are unfunded our participation is somewhat limited. Particularly participation of young faculty.
- c. Will Horwath USDA representatives get no credit or money for participating in NCERA-059. Also asks how the regional designation of a committee comes into play. Example, NCERA-059 is in the North Central region. Larry responds that there has to be a region administrating the committee.

6. State Reports

a. Larry Cihacek

Project focused on C sequestration in grasslands. He trained 2 MS and 1 PhD student. Large data set and output. Handouts provided of data to committee. Hard to make a comparison between range lands and agronomic sites. Rangelands are usually poor land, shallow rocky. Did not see a lot of C sequestration. The region is cool and moist. Rangelands were compared to high input crop land (large biomass returned).

NC1017 C sequestration & distribution of soils in eroded landscapes ends September 30,2009. New project NC1187 begins on October 1. Title: impacts of crop residue removal of biofuels on soil.

Symposium: SSSA S6 primary symposium is joint with NCERA59 & NC1017.
Symposium Title: Soil C and greenhouse dynamics in Agricultural lands.

7. Accomplishments 2009:

- a. The minutes from the June 2008 Meeting were discussed and approved by a show of hands.
- b. The NCERA-059 committee met in Kansas in June of 2008
- c. Discussion of joint efforts
- d. Last year's accomplishments were discussed
- e. Benchmarks of soil quality was an accomplishment.

8. Accomplishments projected for 2010

- a. Accepted and organized a joint Symposium for SSSA meetings: S6 primary symposium joint NCERA-059 and NC1017 submission. Title of the Symposium: Soil C and greenhouse dynamics in Agricultural lands. This is an accomplishment for 2010.
- b. NCERA-059 committee agreed to cosponsor Dan Olk's symposium on humic amendments. Committee votes to approve by show of hands. Symposium was already approved by SSSA.

9. Meeting 2010

a. NCERA-059 committee can meet jointly with NCERA-03. NCERA-03 will meet at Ohio State June 14-18. This group will meet with NRCS reps and NC1187. Jerry suggests Richard Dick meet jointly with these groups at Ohio State. Chuck Rice also suggests meeting at the ISS meeting in 19th World Congress of Soil Science, Australia. NCERA-059 will sponsor symposium at both the SSSA and ISS Meetings.

10. Outcomes and Impacts

- a. Webinar Chuck Rice Carbon sequestration, Climate Change
- b. Webinar Poultry Livestock Management Site
- c. Chuck Rice briefing in front of Congress

11. Secretary election:

Ann-Marie Fortuna nominated Larry Cihacek for secretary, seconded by Will Horwath and Chuck Rice. Larry Cihacek, ND, was elected.

12. Future Interests of the committee to be incorporated into the 2010 renewal

- a. Scale, climate change as it relates to C N and microbial communities.
- b. Committee would like to meet mid year via acrobat meeting. Send info on acrobat meeting to the list serve.
- c. Report due 60 days following annual meeting.
- d. Objectives 4 and 5 of the NCERA-059 Committee need to be revamped
- e. Should the committee write a review article on management vs. science – which should be stressed why? Larry would like to write an article with NCERA-059 members that compares dissolved organic carbon from different locations using different methods of measurement.
- f. Objective 1. Review article management vs. the understanding of SOM Journal of Soil & Water Conservation Will Horwath and Chuck Rice will discuss at SSSA 2009 meeting.
- g. Dan Olk wants to conduct a joint study – a. across a range of soils, b.) soil C & temperature. Renewal can address longer term research needs. Dan is in charge of initiative.
- h. Objective 2. Eval./ identify indicators share and collect soils use standard methods (eg. Dissolved organic carbon by 3 methods) Potential poster for 2010 SSSA meeting, Larry Cihacek will lead.
- i. Objective 3 eXtension with NCERA3 webinar with IOP abstract for symposium. Due March 2010. Can we put together an online class? Talk about this possibility at SSSA Pittsburg. Outreach to classrooms K12/college. Chuck Rice talks about Soils Exhibit. In 2012, there will be an Omaha, NE soils exhibit, 2010 Minneapolis, MN.

2013 Santa Anna, CA. There will be demos special topics, talks interaction with kids. Classes interacting on line, as well. Symposium 2011 on organic?

Opportunities at the 2009 meeting to get involved, session A1 education outreach soils K-12, Paula Gail. Teri wants to have renewal objectives 2010 to add K12 as outreach. The committee can publish case studies that can be used to teach at the K12 or college level in future objective. Could the committee sponsor an education symposium in 2010?

- j. Larry Cihacek, Accomplishment for 2009. Terrestrial carbon 7 year USGS data set presented at CO2 reduction partnership annual meeting held at St Louis. Participants included scientists, practitioners, regulators, and industry. Presented 4 posters on carbon sequestration that meet objectives 3 and 4.
- k. Objective 4 co-sponsored symposia in 19th World Congress of Soil Science in Aberdeen: Rhea Drijber and Chuck Rice have several areas to address. Can we put posters in these sessions.
- l. Ann-Marie Fortuna needs to verify current member's info email phone cell, doodle poll for SSSA and 19th World Congress of Soil Science Meetings.
- m. We need to streamline our objectives for the workgroup prior to the renewal.
- n. Possible outcome for renewal research coordination networks proposal to NSF going into biology not geology. Fits objective 1. Also have incubator proposals. Full proposal due July 5, 2010. Teri will lead.

Accomplishments:

- Developed materials for K-12 teacher education and lesson plans for pre-college students as well as in-service training about these materials for Extension educators.
- Co-organized a special symposium for 2009 Soil Science of America annual meetings. Title: Linking soil enzyme activities to ecosystem functions. Includes 8 invited speakers.
- Developed models to describe the rate of C sequestration in grasslands across 5 states located in the prairie pothole region of the northern Great Plains area.
- Continued collaborative coordination with eOrganic working group.
- Met with colleagues located in China to develop an educational exchange focusing on the management of soil organic matter.
- Hosted a multi-state meeting of Extension educators and agricultural consultants from the north central region in August 2009. The meeting focused on farmer adoption of organic-N management.

Impacts:

- Examination of the transformation of microbial products during decomposition suggest that there may be a trend of slower initial decomposition of bacteria gram (+) and

possibly a long-term persistence or stabilization of fungi in soil. (see California state report)

- Studies to determine the effect of common agricultural management practices on dissolved organic carbon (DOC) from subsurface tile drains suggest that lagoon effluent application and fertilizer N rates do not affect long-term losses of DPC from tile drains.
- Models developed to assess the rate of carbon sequestration in grasslands assist public officials and land managers in establishing more accurate carbon credits for grassland soils.

Publications:

See listing of journal and non-refereed articles in individual state reports which are included in committee meeting minutes.

Officers for FY10:

Chair: Richard Dick
Chair-elect: Ann-Marie Fortuna
Secretary: Larry Cihacek
Past-chair: Teri Balsler

Submitted by:

Ann-Marie Fortuna, NCERA-59, Secretary, 2009

Approved (signed):

Teri Balsler
NCERA-59
Chair, 2009

Gerald Miller
NCERA-59
Administrative Advisor, 2009

NCERA59 Annual California Report

Year: 2009
Institution: University of California Davis
Committee Representative: William R. Horwath

Introduction:

My activities have dealt primarily with objectives 1 and 2. I have primarily looked at humic substance maintenance through examining the transformation of microbial products during decomposition. I have used a number of analytical methods including physical fractionation and pyrolysis mass spectrometer/isotope ratio mass spectrometer to follow the fate of microbial products during the humification process.

Humic substances result primarily from a complex suite of biotic and abiotic processes acting on plant materials. While microorganisms are known to be involved in humification processes, little information exists on how microbes regulate the conversion of plant material into humic substances. An often-overlooked influence of soil microorganisms on C stabilization processes is that their bodies, or biomass, are primary building blocks in the formation of humic substances. Defining the role of microbial community composition will thus enhance our conceptual understanding of C humification processes. This research has followed the fate of ^{13}C -labeled microbial bodies from four groups (fungi, gram-positive bacteria, gram-negative bacteria and actinomycetes) in a temperate and a tropical forest soil. The ^{13}C substrate groups (whole dead cells) were applied reciprocally to each soil to compare the effect of the microbial metabolic capacity in two very different forest soils. The fate of ^{13}C microbial litter was tracked for 2.5 years by measuring total recovery, utilization by indigenous microbial communities and their biomarker components (phospholipid fatty acid - PLFA), conversion to CO_2 , and ultimately humification products (soil organic matter fractionation). The macromolecular biochemical composition of the starting substrates and the fate of added ^{13}C substrates in humic substances was determined over the course of the field study using the complementary tools of $^{13}\text{C}/^1\text{H}$ NMR spectroscopy and pyrolysis GC/MS.

This study has produced several results, which provide insight into biochemical and environmental controls on microbial C turnover and dynamics:

- ◆ Results suggest that there may be a trend of slower initial decomposition of bacteria gram (+) and possibly a long-term persistence or stabilization of fungi in soil. However, if there is a true effect by microbial group, our results indicate that it is relatively minor.
- ◆ In the temperate site, the amount of input microbial ^{13}C recovered in whole soils in the application depth (0 – 7.5 cm) far exceeded that recovered in the soil depth immediately below it (7.5 – 15 cm); whereas for the wetter tropical site, nearly 1/3 of remaining input C was recovered in the lower depths.
- ◆ There were some initial differences between temperate and tropical microbial inputs recovered within the native microbial biomass pool at both sites. However, over time C recoveries became more similar at both sites.

- ◆ Despite the substantial differences in microbial C turnover between California and Puerto Rico soils, this effect was only apparent in the light fraction; microbial C turnover was significantly different in the light fraction, but not the occluded and mineral-associated fractions, which highlights the importance of the soil mineral matrix for protecting microbial carbon.

Relevant Publications:

Rasmussen, C, Southard, RJ, Horwath, WR. 2008. Litter type and soil minerals control temperate forest soil carbon response to climate change. *Global Change Biology* 14, 2064–2080.

Geisseler, D., and W.R. Horwath. 2008. Regulation of extracellular protease activity in soil in response to different sources and concentrations of nitrogen and carbon. *Soil Biol. & Biochem.* 40:3040-3048.

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

NCERA59 Annual State Report

Year: 2009
Institution: University of Wisconsin
Committee Representative: Teri Balsler

Introduction:

Research activities (NCERA59 Obj 2) in Wisconsin in the past couple years have included looking at microbial community composition and soil carbon under various biofuels crops and under different cropping systems, response of soil carbon to increasing temperature, and work on methane fluxes in invaded wetlands. We have a particular interest in understanding microbial control over carbon stabilization in soil (respiration response to temperature and also the contribution of senesced microbial residues to stable carbon). Our various activities have resulted in 15 publications in review or published, and have involved 2 completed PhD candidates, 2 in progress PhD candidates, one MS student completed, and one in progress.

Since 2008 our outreach activities (Obj 3) have included work on materials for K-12 teacher education and lesson plans for pre-college students, in-service sessions for county extension agents (2 completed), and presentations for growers and citizen groups (4 completed).

Relevant Publications:

In review:

1. Stanger, Trenton F., Jessica L.M. Gutknecht, Teri C. Balsler, and Joseph G. Lauer, 200x. Crop Rotation, Tillage, Soil Fumigation, and Nitrogen Affect Soil Microbial Communities Associated with Corn, *Agronomy Journal*. Submitted July 2 2009
2. Stoffel, Jennifer L., Stith T. Gower, David J. Mladenoff, Jodi A. Forrester, Teri C. Balsler, 200x. In review. Microbial dynamics in canopy gaps following small scale harvesting in northern hardwood forests, Submitted to *Soil Biology and Biochemistry* 6/26/2009
3. Liang, Chao, Guang Cheng, Teri C. Balsler, 200x. In review. An absorbing Markov Chain approach to understanding the microbe in soil carbon stabilization. Submitted to *Journal of International Ecology* July XX 2009.
4. Kao-Kniffin, J., D. Freyre, T.C. Balsler. 200x. In review. Methane dynamics across wetland plant species. Submitted to *Aquatic Botany* July 21, 2009
5. Kao-Kniffin, Jenny T., Dominique S. Freyre, and Teri C. Balsler, 200x. In review. Invasive wetland plant increases methane emissions under elevated atmospheric Carbon Dioxide, *Nature* xx-xxx. Submitted 7/30/09 to *Global Change Biology*
6. Liles, Mark R., Ozgur Turkmen, Brian F. Manske, Mingzi Zhang, Jean Marie Rouillard, Isabelle George, Teri Balsler, Nedret Billor, Robert M. Goodman, 200x. A phylogenetic microarray targeting 16S rRNA genes from the bacterial division Acidobacteria reveals a lineage-specific distribution in a soil clay fraction. Submitted to *Environmental Microbiology and Environmental Microbiology Reports*, July 7, 2009

Published or in press

7. Kao-Kniffin, J., T.C. Balser. In press. Potential impacts of reed canary grass invasion on N and C cycling bacteria. Ecological Restoration (Arboretum publication)
8. Wixon, D.L., T.C. Balser, 200x. In press. Complexity, climate change and soil carbon: A systems approach to microbial temperature response. International Society for the Systems Sciences Journal, xx-xxx
9. Liang, Chao, Joel A. Pedersen, Teri C. Balser, 200x. In press. Aminoglycoside antibiotics may interfere with microbial amino sugar analysis. Journal of Chromatography A, xx-xxx
10. Balser, T, D. Wixon. 2009. Investigating biological control over soil carbon temperature sensitivity. Global Change Biology, doi: 10.1111/j.1365-2486.2009.01946.x
11. Jokela, W. E., Grabber, J. H., Douglas L. Karlen, Teri C. Balser, & Palmquist, D. E. (2009). Cover Crop and Liquid Manure Effects on Soil Quality Indicators in a Corn Silage System. Agronomy Journal, 101(4), 727-737.
12. Dan Lloyd, Soldat, D., T.C. Balser, 2009. Understanding Microbes Helps Explain Nutrient Cycling. Turfgrass Trends February Issue, 50-52.
13. Liang, C., H.W. Read, T.C. Balser. 2008. Reliability of bacterial muramic acid as a biomarker is influenced by methodological artefacts from streptomycin. Microbial Ecology, DOI 10.1007/s00248-008-9406-7
14. Liang, C., T.C. Balser. 2008. Preferential sequestration of microbial amino sugars in subsoils of six soil profiles in Wisconsin, USA. Geoderma 148, 113-119.
15. Liang, C., R. Fujinuma, T.C. Balser, 2008. Comparing PLFA and amino sugars for microbial analysis in an upper Michigan old growth forest. Soil Biology and Biochemistry 40, 2063-2065.
16. Metzger, K.M., E.A.H. Smithwick, D.B. Tinker, W.H. Romme, T.C. Balser, and M.G. Turner. 2008. Influence of coarse wood and pine saplings on nitrogen mineralization and microbial communities in young post-fire *Pinus contortata*. Forest Ecology and Management 256, 59-67.

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

We have collaborated with a range of researchers interested in land use management and sustainable crop production. We have interest in a collaborative venture looking at invaded wet prairie or wetland and soil carbon.

NCERA59 Annual State Report

Year: 2009
Institution: Ohio State University
Committee Representative: Richard Dick

Introduction:

Research has revolved around biodiversity and structure of microbial communities applied in a variety of settings that have included C sequestration in forest and ag soils, shrub-crop systems of West Africa, methane oxidation in wetlands, and impacts of long-term use of glyphosate on microbial communities and functions. Some of these are related to manipulations of organic inputs and rhizosphere dynamics. Research is proceeding on tracking ^{13}C through methanotrophs during methane oxidation in wetlands. Studies on microbial controls on C sequestration and developing methods to track ^{13}C into lipid biomarkers are in process.

Relevant Publications:

Moore-Kucera, J., and R. P. Dick . 2008. PLFA Profiling of Microbial Community Structure and Seasonal Shifts in Soils of a Douglas-Fir Chronosequence. *Microbial Ecology* 55:500–511.

Dossa, E.L. M. Kouma, I. Diedhiou, M. Sene, F. Kizito, A.N. Badiane, S.A.N. Samba, and R.P. Dick. 2009. Carbon, nitrogen and phosphorus mineralization potential of semiarid Sahelian soils amended with native shrub residues *Geoderma* 148:251–260

Dossa .E. L., J. Baham, M. Kouma, M. Sene, F. Kizito, R.P. Dick. 2009. Phosphorus Sorption and Desorption in Semi-arid Soils of Senegal Amended with Native Shrub Residues *Soil Science* 173:669-682.

Moore-Kucera, J., and R. P. Dick . 2008. Application of ^{13}C -labeled litter and root materials for *in situ* decomposition studies using phospholipid fatty acids. *Soil Biol. Biochem.* 40:2485–2493.

Diedhiou, S., A.N. Badiane, I. Diedhiou, M. Khom, A.N.S Samba, M. Sène and R.P. Dick. 2009. Succession of Soil Microbial Communities during Decomposition of Native Shrub Litter of Semi-Arid Senegal. *Pedobiologia* 52:273—286.

Dick, R.P. 2008. Engineering Soil Microbial-Rhizosphere Systems for Agroecosystems of Sub-Saharan Africa and South Asia. *Emerging Technologies for South Asia and Sub-Saharan Africa*. National Academy of Science.

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

Organizing Committee Chair of the conference – Enzymes in the Environment: Ecology, Activity and Applications, July 17-21, 2011, Frankfurt, Germany.

Special Symposium Co-chair, Soil Science Society of America 2009 Annual Meetings. Linking Soil Enzyme Activities to Ecosystem Functions, Pittsburgh PA Eight invited speakers.

NCERA59 Annual State Report

Year: 2009
Institution: University of Nebraska
Committee Representative: Rhae Drijber

Introduction:

My research program aims to quantify microbial community structure and function using newer biochemical (i.e. lipids) and molecular approaches in both natural and agroecosystems. Ecosystems under study include intensively managed cropping systems, the Nebraska Sand Hills and afforested grasslands. Current projects include:

- Spatial and temporal dynamics of arbuscular mycorrhizal (AM) fungi in high production corn systems. Our research confirms carbon allocation to AM fungi from corn during the reproductive stages of growth. Evidence suggests a role in P acquisition given a significant proportion of P is taken up from the soil during this period. We have recently developed a combined DGGE-Cloning Method to elucidate AM ribotypes significant to this process. Current research is focused on the impact of N rate on the diversity and colonization rate of roots by AM fungi in field grown maize and soybean
- Influence of occasional tillage on AM fungal dynamics and soil microbial ecology. Stratification of immobile nutrients such as P and K during long-term no till necessitates redistributed by occasional tillage. Unfortunately, tillage is also destructive to the microbial community and fungal network that has developed in the soil over years of no-till. Guidelines are being developed for eastern Nebraska soils that will alleviate stratification with minimal impact on the soil ecology.
- Recent completion of a Grassland Destabilization Experiment (GDEX), <http://sandhills-biocomplexity.unl.edu>, attributed short-term geomorphic stability of the Nebraska Sand Hills to below ground processes, where root detritus, soil organic matter (SOM) and microbial activity persisted into the third and fourth years of the study. This resilience could not be explained by extensive soil aggregation or large pools of stabilized SOM, both absent from this ecosystem. Rather, it appears to be a legacy of the former grassland root system.
- Vulnerability of soil organic matter to temperature changes: exploring constraints due to substrate decomposability and microbial community structure. This NSF funded project examines the impact of temperature on the decomposability of soil organic matter fractions. Our research indicates that the temperature sensitivity of SOM decomposition increases with decreasing SOM lability. Furthermore, shifts in microbial community composition are consistent among soils spanning several latitudes and cropping systems indicating similar adaptive processes to temperature across wide geographical regions.

Relevant Publications:

Frey, S.D., Drijber, R., Smith, H., Melillo, J. 2008. Microbial biomass, functional capacity, and community structure after 12 years of soil warming. *Soil Biology & Biochemistry* 40:2904-2907.

Miller, G., Mamo, M., Drijber, R., Wortmann, C., Renken, R. 2009. Sorghum growth, root responses, and soil solution aluminum and manganese in pH stratified sandy soil. *Journal of Plant Nutrition and Soil Science* 172:108-117.

Okalebo, J., Yuen, G.Y., Drijber, R.A., Blankenship, E., Eken, C., Lindquist, J. Biological suppression of velvetleaf (*Abutilon theophrasti*) in an Eastern Nebraska soil. Submitted to Weed Science

Haddix, M.L., Plante, A.F., Conant, R.T., Paul, E.A., Six, J., Steinweg, M.J., Magrini-Bair, K., Drijber, R.A., Morris, S.J. Temperature sensitivity of active and resistant soil organic matter decomposition during long-term incubation. Submitted to Soil Biology & Biochemistry.

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

NCERA59 Annual State Report

Year: 2009
Institution: North Dakota State University
Committee Representative: Larry Cihacek

Introduction:

Activities:

During 2006, 2007 and 2008, approximately 13,620 acres of cropland, undisturbed native grassland and CRP of a wide range of age classes were sampled for carbon (C) in the surface 30-cm of the soil. Sampling sites were selected using a benchmark system with recorded GPS locations. A total of 1362 "benchmark" sites were established. Each site was selected on the basis of soil type and landscape that represented at least 10 acres in the field. Sampling areas included northeastern Montana, central North Dakota, northeastern North Dakota, northern South Dakota, central South Dakota, and western Minnesota and southern Minnesota and Northern Iowa within the Prairie Pothole Region of the northern Great Plains. This has resulted in two M.S. theses completed and a PhD. and two more M.S. theses in progress. The very large data base is being evaluated statistically to determine the effects of vegetation type, landscape position, slope, and aspect on C sequestration in restored grasslands. The Century Model is being utilized to compare actual sequestration rates with predicted sequestration rates. Other activities include evaluating C sequestration under grass monocultures, C distribution relationships with landscape position and plant species effects on soluble organic C in the soil profile.

Impacts:

Models are being developed to describe the rate of C sequestration in grasslands in each of these areas. These models will demonstrate the C sequestration potential of soils across the region with respect to the effects of climatic gradients (both temperature and rainfall) on C accretion.

This information will aid in establishing more accurate carbon credits for grasslands that will assist scientists, public policy makers, government and non-government agencies and land owners and operators in making land management decisions related to utilizing soils and land areas for sequestering C to mitigate global climate change.

Relevant Publications:

Augustin, C. L. 2009. Relationship between carbon sequestration and soil texture in the northern Great Plains. M. S. Thesis. North Dakota State University. March 2009.

Riopel, J. 2009. Carbon sequestration in CRP and restored Grasslands in the north central U. S. M. S. Thesis. North Dakota State University. May 2009.

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

NCERA59 Annual State Report

Year: 2009
Institution: Purdue University
Committee Representative: Ronald Turco

Report:

Our recent work has been concentrated on artificial subsurface drainage as it is commonly used in Midwestern agriculture and drainage losses of dissolved organic carbon (DOC) from such systems are an under-quantified portion of the terrestrial carbon (C) cycle. The objectives of this study were to determine the effect of common agricultural management practices on DOC losses from subsurface tile drains and to assess patterns of loss as a function of year, time of year, and drainflow. Daily drainflow was collected across six water years (1999–2004) from a restored prairie grass system and cropping systems which include continuous corn (*Zea mays* L.) and corn-soybean [*Glycine max* (L.) Merr.] rotations fertilized with urea-ammonium-nitrate (UAN) or swine (*Sus scrofa*) manure lagoon effluent. The DOC concentrations in tile drainflow were low, typically $<2 \text{ mg L}^{-1}$. Yearly DOC losses, which ranged from 1.78 to 8.61 kg ha^{-1} , were not affected by management practices and were small compared to organic C inputs. Spring application of lagoon effluent increased yearly flow-weighted (FW)-DOC concentrations relative to other cropping systems in three of the years and increased monthly FWDOC concentrations when drainflow occurred within 1 mo of application. Drainflow was significantly and positively correlated with DOC loss. Drainflow also affected DOC concentrations as greater 6-yr cumulative drainflow was associated with lower 6-yr FW-DOC concentrations and greater daily drainflow was associated with higher daily DOC concentrations. Our results indicate that lagoon effluent application and fertilizer N rates do not affect long-term losses of DOC from tile drains and that drainflow is the main river of DOC losses.

Relevant Publications:

Matthew D. Ruark, Sylvie M. Brouder and Ronald F. Turco. Dissolved Organic Carbon Losses from Tile Drained Agroecosystems *J. Environ. Qual.* 38:1205–1215 (2009).

Additional Outcomes:

Proposal Title: Biomass productivity and environmental impacts.

PIs: Sylvie Brouder, Jeff Volenec and Ronald Turco

Source of Support: USDA-Managed Ecosystem Program

Total Award Amount: 399,000

NCERA59 Annual State Report

Year: 2009
Institution: University of Illinois
Committee Representative: Michelle Wander

Introduction:

This past year I maintained collaborative ties to members in NCERA-59 through research proposals and development of content for eOrganic. This is the group of scholars working on content for the Organic community of practice publishing in eXtension (www.extension.org).

Relevant Publications:

Wander, M. 2009. Strategy for agroecosystem development: updating the humus theory. 2009. In Agricultural Ecosystems; Unifying Concepts II. Bohlen, P. and G. House. Taylor and Francis, NY.

Coulter, JA., Nafziger, ED. and M.M. Wander. 2009. Soil organic matter response to crop rotation and nitrogen fertilization. *Agronomy Journal*. 101:592-599.

Khanna, M. Önal, H., Dhungana B. and M. Wander. 2009 Economics of bioenergy crops for electricity generation: Implications for land use and greenhouse gases. 2009. *American Journal of Agricultural Economics*. In review.

Wander, M.M.. 2009. Sustainable Agriculture in the Great Lakes Region; In: *Ecosystem Health and Sustainable Agriculture*, eds: Christine Jakobsson, Jeff Levensgood. Baltic University Press. In press.

Feher, S. and M.M. Wander, 2009. Assessment of Sustainable Land Use. In: *Ecosystem Health and Sustainable Agriculture*, eds: Christine Jakobsson, Jeff Levensgood. Baltic University Press. In press.

eOrganic articles

Wander. M.M. – with input from Richard Dick and others in NCERA-59. 2009. Measures of Soil Biology and Biological Activit. <http://www.extension.org/article/18626>

Wander. M.M. 2009. Managing Manure Fertilizers in Organic Systems; eOrganic <http://www.extension.org/article/18628>

Zaborski, E. et al. 2009. NRCS EQIP: What You Need to Know About the Organic Initiative. <http://www.extension.org/article/21072>

Wander. M.M. 2009. Nutrient Budget Basics for Organic Systems. <http://www.extension.org/article/18794>

Wander, M.M. and S.A. Andrews. 2009. Organic Certification and Conservation Compliance.
<http://www.extension.org/article/18658>

Wander, M.M. Soil Fertility in Organic Systems: Much More than Plant Nutrition.
<http://www.extension.org/article/18636>

Gruver, J. and Wander M. 2009. Use of Tillage in Organic Systems: the Basics.
<http://www.extension.org/article/18634>

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

I missed the meeting this year as I was in China, working to develop educational exchange on soil organic matter management. Teri Balsler will be a collaborator on that work.

NCERA59 Annual Michigan Report

Year: 2009
Institution: Michigan State University
Committee Representative: Sieg Snapp

Introduction:

Active research interests include cropping system design for efficient nitrogen cycling and ecologically based management for carbon sequestration in rain-fed row crop systems. My laboratory is investigating how organic inputs from cover crop and manure influence carbon assimilation and mineralization processes that determine nitrogen and phosphorus availability. Two approaches to mitigating nitrogen loss and increasing nitrogen fertilizer efficiency in corn-based ecologies are being tested: 1) enhancing the duration of living plant cover from 6 months to 12 months by integrating cover crops and perennial grains into row crops and 2) manipulating microbial immobilization of inorganic nitrogen to reduce the pool size and thus loss through leaching and gaseous pathways, using mixed quality residues from cover crops and composted dairy manure.

Integration of cover crop and perennial species in row crop systems requires improved understanding of plant functional traits in row cropping systems. Optimizing carbon assimilation while maintaining nitrogen availability and water efficiency may require integrated use of diverse cover crops and organic inputs with inorganic sources. Nitrogen availability indicators and farmer participatory research on soil quality management are related interests, including work on Alfisols in tropical Africa and the Upper Midwest. Snapp's lab is particularly interested in how to link process research carried out on long-term trials with on-farm research.

Extension:

Over 1400 farmers have been reached over the last 3 years through training of extension educators, talks given, and field days held at the Kellogg Biological Station, on farmer fields, and at a new, private sector compost facility that supports farmer adoption of organic-N management. Further, we hosted a multi-state meeting of 45 extension educators and agricultural consultants from the North Central region in August, 2009 which provided an opportunity to highlight these findings. Extension is also underway through publication of technical articles on an MSU extension website for farmers interested in carbon management practices, the New Ag Network (<http://www.ipm.msu.edu/new-ag.htm>).

Relevant Publications:

McSwiney, C.P., Snapp, S.S. and L.E. Gentry. 2009. Use of N immobilization to tighten the N cycle in conventional agroecosystems. *Ecological Applications*, In press

Po, E.A., S.S. Snapp and A.N. Kravchenko. 2009. Rotational and cover crop determinants of soil structural stability and carbon in a potato system. *Agronomy J.* 101:175-183

McSwiney, C.P., Snapp, S.S., and L.E. Gentry. Ms. submitted to *Ecosystems*. Is synchrony between N availability and crop uptake possible in a rainfed maize agroecosystem?

Gentry, L., S.S. Snapp, C. McSwiney, and G. Parker. Ms. submitted to *Agronomy J.* Rotated and Continuous Corn Performance in a Long-Term Study: Nitrogen credits for crop rotation, cover crops, and composted dairy manure.

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

NCERA59 Annual State Report

Year: 2009
Institution: Washington State University
Committee Representative: Ann-Marie Fortuna

Introduction:

This past year I maintained collaborative ties to members in NCERA-59 through development of content for eOrganic. I helped Alex Stone to gather information to put together a number of e-Organic videos.

My research contributes to the development of novel cropping systems and land-use managements that maintain and promote efficient cycling of N and C; management guidelines to growers by improving N use efficiency and management through integration of information on microbial community structure and function; and adaption of molecular techniques to study soil processes at field and ecosystem scales. These contributions may lead to greater acreage in sustainable managements: no-till, mixed cropping and perennial systems, more efficient use of wastes and organic amendments resulting in a measurable reduction in waste and improvements in N use. My basic research will improve our understanding of the microbiology of N cycling which may lead to further reductions in N losses and increased nitrogen use efficiency.

Relevant Publications:

Stubbs, T.L., A.C. Kennedy and A. Fortuna. Use of NIRS to predict cereal residue fiber content and decomposition. (In-press) 2009, Journal of Agricultural and Food Chemistry)

Additional Outcomes:

(e.g. sponsored events, collaborations, grants, others)

Fortuna, A. Physical, chemical, biological impacts of manure on soil. eXtension webcast