NCERA059 Soil Organic Matter: Formation, Function, and Management
Annual Meeting

Mohican Lodge
Perrysville, Ohio
June 15-16, 2010

Chair:
Richard Dick
The Ohio State University

Chair-elect:
Ann Marie Fortuna
Washington State University

Secretary:
Larry Cihacek
North Dakota State University

Administrative Advisor:
Gerald Miller
Iowa State University

Members in Attendance:
Doug Archibald, PA
Larry Cihacek, ND
Richard Dick, OH
Rhae Drijber, NE
Ann Marie Fortuna, WA
William Horwath, CA
Dan Olk, USDA-ARS
Ron Turco, IN

Members Absent:
Deborah Allen, MN
Teri Balser, WI
John Grove, KY
Peter Motavalli, MO
Charles Rice, KS
Sieglinde Snapp, MI
Alexandra Stone, OR
Dan Sullivan, OR
Robert Tate, NJ
Michelle Wander, IL
Raymond Weil, MD
Cynthia Cambardella, USDA-ARS
Jane Johnson, USDA-ARS
Sharon Lachnicht Weyers, USDA-ARS
Kristine Nichols, USDA-ARS
Rebecca Phillips, USDA-ARS

Advisors Present:
Gerald Miller, IA
Administrative Advisor

Guests:
Nicola Lorenz, OH

The meeting was called to order by Chair Richard Dick at 8:30 A. M., June 15, 2010 at the Mohican Lodge State Park Resort, Perrysville, OH. Richard discussed administrative issues concerning tomorrow's field tour. The meeting agenda was reviewed and accepted by acclamation.

State reports need to be submitted to Secretary Larry Cihacek as soon as possible. Gerald Miller noted that any multi-state collaboration should be noted on the state reports. The elements needed for the report include activities related to NCERA-59, multi-state collaboration(as appropriate), accomplishments, impacts, and publications related to NCERA-59. Larry Cihacek will be e-mailing an electronic notice to all of the committee members to submit their reports in electronic format along with an outline of the format.

The members attending the meeting introduced themselves. Short state reports were presented.

Nebraska: Rhae Drijber reported that she is working with mycohrizzae. She has a Chinese student working with her on the role of mycohrizzae as P transporters as related to N supply. There are 2 types of P transport in plants – root ant root hair transport and AM mycohrizzae transportable. She also noted that these mycohrizzae have the ability to colonize different crops.

USDA-ARS: Dan Olk reported that his laboratory has carbohydrate analysis methodology working and is currently working on phenol analysis procedures. He is also working with various humic material products and their role in crop production.

UC-Davis: Will Horwath reported that he is working on advanced instrumentation related to carbon measurement including mass spectroscopy. His research involves determining whether soil C materials are a result of conservation or resynthesis following C material decomposition, and he is looking at turnover of C after soil fumigation versus the C that remains after the C released after fumigation is decomposed. He will be leading a discussion on the "Regulatory Gate Hypothesis" later in the meeting.
He is also interested in characterizing lipids because existing methods are not very good and has been looking at differential scanning calorimetry.

Washington State University: Ann Marie Fortuna reported that she is working on pyrosequencing and APB and trying to get the cost of analysis down. She is also doing agronomic work on N budgets and other nutrient management in organic production systems. She is also working on utilizing bioreactor products (composts?) using dairy waste, blood and other bioproducts and wastes and making useable fertilizer products for vegetable cropping systems.

Ohio State University: Richard Dick reported that he is doing PLFA profiling work in decomposition studies using plant material from plants exposed to $^{13}C - CO_2$. He is also working on glyphosate effects on soil microorganisms. He reported that apparently certain *Fusarium* spp. is stimulated by glyphosate.

Penn State University: Doug Archibald reported that he is doing work with infrared spectroscopy on labile OM in headwater wetlands. He is also working on methodology where OM is quickly extracted from soils and concentrated on microplates for FTIR analysis. He is also involved with litter bag experiments studying the changes in lignin and phenolic compound contents of forest litter. He is also working at evaluating changes is soil C in long-term cropping systems trials. Also work is being done with the Rodale group on evaluating changes in soil C for C credits and on remote sensing, ground truth and process modeling of C from decomposition of organic matter.

Purdue University: Ron Turco reported on work dealing with a Biofuels Transition Program which involves looking tools to describe C transformations in soils with crops such as miscanthus, sorghum, and switchgrass. He is also working on processes involving transformations of C nanomaterials in organic matter. He is also working on research dealing

with watershed protection in the Wabash River Basin and the relationships between pathogens in water and the nutrient composition of the water.

North Dakota State University: Larry Cihacek reported that current research work involves changes in total organic C and dissolved organic C in soils under selected mixed grassland plant species over time. He is also looking at TOC and DOC under mixed plantings of several grassland species. In addition, work is being initiated on changes in soil C due to varying corn residue removal rates for biofuels. This is in conjunction with the new NC-1178 (formerly NC-1072) project.

Four discussion sessions were held to discuss specific topics of interest in dealing with soil C changes, monitoring of the changes, current national initiatives and potentials for collaboration.

The first session was led by Doug Archibald on depth and distribution of carbon with particular emphasis on modeling subsurface C. The first topic involved issues raised during studies of soils from a long-term trial (with graduate student Vanathi Duraisamy). The initial discussion centered on a poster handout with SOC map of the trial. Other handout materials included a poster on a method for depth-wise variation in soil color and an abstract/figures on depth-wise bulk density measurements from the study. The discussion moved to the question of how does bulk-density correction alter our understanding of SOC profiles? Doug's discussion covered measurement techniques including adjustments for coarse materials and roots and the accuracy of the measurements (in different scenarios). The discussion also covered the implementation of equivalent soil mass vs. soil volume. The discussion, then moved on the question of how can we make measurement of soil profile SOC faster and more efficient? Doug has been working with the Rodale Institute on a project developing a soil C crediting system for Pennsylvania. Most approaches today have issues with accuracy of measuring C or high costs. A recent proposal to evaluate approaches was submitted but not funded. The final item of discussion was the question of whether process models accurately describe development of SOC profiles? Most models have general limitations on either the processes that are being modeled or the depth to which the SOC changes are estimated. Doug is hoping to work with a new PSU faculty member that has a focus on modeling (Armen Kemanian).

The second session was led by Will Horwath on the "Regulatory Gate Hypothesis" of the role of dissolved organic C in soil C cycling. As part of the discussion, Will presented a recent paper by Kemmitt et al. (2008) entitled "Mineralization of native soil organic matter in not regulated by the size, activity or composition of the soil microbial biomass – a new perspective" (Soil Biology & Biochemistry 40:61-73). The paper proposes that the rate limiting step of organic matter mineralization is governed by a biological processes. However, the prevailing thought is that DOC is produced by microbial activity. Will presented data that showed results that were contradictory to the paper. The discrepancies discussed are relevant to C cycling through soils and how C models work. Will suggested that a collaborative paper that review the discrepancies in the prevailing concepts on C cycling with the concepts proposed by Kemmitt et al. as a collaborative project for the NCERA-59 committee.

The third session was led by Larry Cihacek on the new USDA-NRCS "Rapid Assessment of U. S. Soil C for Climate Change and Conservation Planning" project. This is a national project in

which it is anticipated that approximately 36,000 sample points will be evaluated by soil horizon to a depth of 1 m which will represent 7,200 sampling sites or 144,000 horizons across the U. S. From this data and currently archived soil survey data, soil C maps will be generated for all of the MLRA's in the U. S. Soil organic matter will be estimated using VNIR techniques. Most of the discussion involved the volume of samples to be collected, the amount of labor that will be required and the time frame in which the project is to be done as well as the use of VNIR for soil C estimation. Larry also discussed the activities that are now ongoing in North Dakota relative to this project.

The fourth session on collaborative research was led by Richard Dick and Dan Olk. Dan opened the discussion by relating some work he was involved in studying N relationships in soils where mesquite was invading grasslands in Texas and asked whether there was interest in developing collaborative research. Larry Cihacek presented a possibility for doing collaborative work on DOC analytical methods that would not require a great deal of cost on the part of participants. The group then discussed the nature of the work and several committee members expressed interest in the collaboration based on their individual laboratory capabilities. Ron Turco discussed the potential for CAP or AFRI project collaboration and laid out the availability of research programs that will be funded over the next several Federal funding cycles. Next year, proposals will be solicited for research on pastures, grasslands, rangelands and grazing lands. The group plans to get together during the ASA-CSSA-SSSA meetings in Long Beach, CA to work on developing a collaborative project.

The Committee business meeting followed. The officers for this meeting (2010) are Richard Dick (Chair), Ann Marie Fortuna (Chair-elect), and Larry Cihacek (Secretary).

Jerry Miller gave the Administrators Report. He reported that a major transition has occurred in NIFA where Director Beachy has evaluated programs and instituted changes in the vision for NIFA resulting in the AFRI program. He also reported that the candidate for Undersecretary of Agriculture, Catherine Woteki has gone through her first round of Congressional hearings and anticipates that her appointment will be approved by Congress.

Jerry also laid out the tasks for the committee and especially for the writing committee regarding writing the project renewal particularly the deadlines for submitting the "Issues and Justification Statement" to NIMSS (September 15). The full proposal must be submitted by November 15th. The current project is active through September 30, 2011. The notification of approval for the new project will be available sometime in May 2011 and the new project will begin on October 1, 2011. Gerry also noted that Appendix E must be submitted by those individuals and Experiment Stations that wish to participate in the new project.

Following the Administrator's Report, an election was held for the 2011 Secretary's position. Ann Marie Fortuna nominated Rhae Drjiber and Ron Turco seconded the motion. Rhae was elected Secretary by a unanimous vote.

Officers and executive committee members for FY11, effective October 1, 2010 are: Ann-Marie Fortuna, chair; Larry Cihacek, chair-elect; Rhae Drijber, secretary; Richard Dick, past-chair.

The committee confirmed that the writing subcommittee for the 5-year proposed renewal will consist of Ann-Marie Fortuna, chair, Will Horwath, Dan Olk, and Ron Turco.

The 2011 meeting will be held at Puyallup, WA hosted by Ann Marie Fortuna. A meeting date was set for the third week of June 2011.

Following the business meeting, time was spent in a working discussion developing revisions for the project proposal renewal.

The meeting was adjourned by Richard Dick at 6:15 P. M.

On June 16, the group visited the Ohio Agriculture Research Development Center at Wooster, Ohio. A tour of the Triplett-Van Dorn Long-Term No-Till Plots was hosted by Warren Dick. The group also visited an urban ecology study being conducted by entomologist Joe Kovach. The OARDC tour ended with a tour of the Genetic Sequencing Laboratory.

The afternoon was spent touring Malibar Farm once owned by author Louis Bromfield who instituted conservation systems in order to restore productivity of degraded farmland and wrote several books describing his efforts.

Submitted by:

Larry Cihacek, Secretary, 2010

Approved (signed):

Richard Dick
NCERA-59
Chair, 2010

Gerald Miller
NCERA-59
Administrative Advisor, 2010

NCERA59 Annual State Report

Year: 2009-2010
Institution: University of California Davis
Committee Representative: William Horwath

Introduction:

My activities have addressed objectives 1 and 2. I continue to examine humic substance maintenance as a function of the transformation of microbial products. I have used a number of analytical methods including physical fractionation and pyrolysis mass spectrometer/isotope ratio mass spectrometer, differential scanning calorimetery to follow the fate of microbial products and plant litter during the humification process. I use stable carbon and nitrogen isotopes to elucidate pathways of humification.

Often-overlooked, the influence of soil microorganisms as a source of stable soil C has been debated intensively, but their contribution to the building blocks of humic substances is still not well defined. Defining the role of microbial community composition will thus enhance our conceptual understanding of soil C stabilization processes. My research has followed the long-term fate of ^{13}C-labeled microbial bodies from four groups (fungi, gram-positive bacteria, gram-negative bacteria and actinomycetes) and plant litters in a temperate and a tropical forest soil. The ^{13}C substrate (whole dead cells and intact plant litter) was applied to different forest soils across a range of mineralogy and climate gradients. The fate of ^{13}C microbial litter was tracked 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 were determined over the course of the field study using the complementary tools of $^{13}C/^{1}H$ NMR spectroscopy, pyrolysis GC/MS and differential scanning calorimetery.

The following insights on biochemical and environmental controls on microbial and plant litter have been established:

- Results show initial differences in microbial group C stabilization, however after 2 years there is no significant difference in C stabilizing from fungi, actinomycetes, and gram- and gram + bacteria.
- 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.
- Despite the substantial differences in microbial C turnover between California and Puerto Rico soils, this effect was only apparent in the light fraction not the occluded and mineral-associated fractions, which highlights the importance of the soil mineral matrix for protecting microbial carbon.
- Plant litter diversity changes the soil organic matter enthalpic characteristics with higher energy associated with diverse litter inputs versus monoculture forest stands. These results have implication for long-term soil C storage and the sustainability of plantation forests.

Relevant Publications:

Delgado-Caballero CE, Gomez-Guerrero A, Valdez-Lazalde JR, and WR Horwath. 2009. Site Index and Soil Properties in young plantations of Eucalyptus. Agrociencia 43: 61-72.

Geisseler D, WR Horwath. 2009. Relationship between carbon and nitrogen availability and extracellular enzyme activities in soil. Pedobiologia.: 53: 87-98.

Additional Outcomes:

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

NCERA59 Annual State Report

Year: 2010
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 13C through methanotrophs during methane oxidation in wetlands. Studies on microbial controls on C sequestration and developing methods to track 13C into lipid biomarkers are in process.

Relevant Publications:

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

Lufafa, A.; Diedhiou, I.; Ndiaye, N.A.S.; Sene, M.; Kizito, F.; Dick, R.P.; Noller, J.S. 2009. Allometric relationships and peak-season community biomass stocks of native shrubs in Senegal's Peanut Basin. Journal of Arid Environments. 73:260-266

Diedhiou, S., A.N. Badiane, I. Diedhiou, M. Khoum, 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.

Giovani Stefani Faé, R. Mark Sulc, David J. Barker, Richard P. Dick, Maurice L. Eastridge, and Nicola Lorenz. 2009. Integrating Winter Annual Forages into a No-Till Corn Silage System Agron J. 101:1286-1296.

Lufafa, A., Diedhiou, I., Ndiaye, N.A.S., Sene, M.; Kizito, F., Dick, R.P., Noller, J.S. 2009. Allometric relationships and peak-season community biomass stocks of native shrubs in Senegal's Peanut Basin. Journal of Arid Environments. 73:260-266.

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

NCERA59 Annual State Report

Year: 2010
Institution: Purdue University
Committee Representative: Ronald Turco with Matt Roark, Sylvie Brooder, M. Bischoff, Tim Filly (Collaborators)

Introduction:

The Purdue University program is concentrated on the fate and movement of carbon in soil systems. To date the functional relationship between fertilizer and manure applications and mass loss of dissolved organic carbon (DOC) and nitrate-nitrogen (NO_3-N) discharging with tile drainage water remains poorly understood. The objectives of this study were to determine the effects of spring applied urea-ammonium-nitrate (UAN), spring applied swine manure, and fall applied swine manure on fluxes and flow-weighted (FW) concentrations of DOC and NO_3-N in drainage water during discrete drainage events. The study used Purdue University's Water Quality Field Station (WQFS) where replicated treatment plots feature large drainage lysimeters. Drainage water was sampled from each treatment plot during 11 rainfall events over two years. Nutrient management practice did not affect average event DOC and NO_3-N fluxes. Among treatments, increases in DOC concentrations were observed only in manure treatments and only in drainage events following applications; for NO_3-N, manure increased concentrations for several events following application. Highest FW-NO_3-N concentrations occurred with fall manure applications indicating an overall reduction in nitrogen use efficiency for this nutrient management strategy. In general, drainage events with high flow volumes were associated with lower solute concentrations, but this dilution effect was not significant among treatments. Within an event, peak solute concentrations occurred near the onset of drain flow and decreased steadily over time. Manure application greatly increased NO_3-N concentrations during drain flow above baseline levels, but only increased DOC concentrations during the first event following application. Within event analysis suggests DOC is transported via preferential flow pathways and can occur throughout the year without recent additions of C to the soil system.

Other work is looking contributions to the Wabash River. As part of a 319 project related to developing a Watershed Management Plan (WMP) for the area, three subwatersheds along the Great Bend of the Wabash (Lafayette/West Lafayette reach) are being evaluated for the impacts of land use and management on water quality in the Wabash River. Two of the streams, Little Wea and Little Pine, are highly agricultural, while the third, Elliot Ditch, is urban. Water quality parameters collected include E. coli, total suspended solids, nitrate+nitrite, carbon and total phosphorus. Water samples are collected and analyzed on a weekly basis. In addition, measurements of flow, pH, turbidity, dissolved oxygen and temperature data are also collected continuously at each site. These were selected to meet identified assessment needs for implementing the WMP. Initial results show seasonal variability in load for all parameters at all

three sites, with lowest values occurring during summer months. Of particular interest is NO3-N which is constantly lower at the urban site. Mean daily *E. coli* levels vary greatly between sites, but Little Wea consistently has lower values than either Little Pine or Elliot Ditch. Turbidity, temperature, dissolved oxygen and pH all show daily fluctuations in their values. Turbidity consistently spikes during high flow periods while pH varies between sites with the two agricultural sites having higher pH values than the urban location. The urban site has higher dissolved oxygen values than either of the agricultural sites but has more daily fluctuation. Little Pine had the lowest dissolved oxygen values of the three sites. While there is little variation between all sites in temperature, Little Wea shows greater daily fluctuation. There is a seasonal variability across all sites for total phosphorus, carbon, and total suspended solids levels, but little difference between the sites. Our data set also demonstrates the value of developing a long-term flow record and conducting frequent sampling in order to arrive at a picture of loading levels in the system.

Relevant Publications:

Ruark, M., S.M. Brouder and R.F. Turco 2009. Dissolved Organic Carbon Losses from Tile Drained Agroecosystems. Journal of Environmental Quality 38:1205-1215 .

Habteselassie, M., M. Bischoff, B. Applegate, B. Reuhs, and R. F. Turco. 20xx. Understanding the role of agricultural practices in the potential colonization and contamination by E. coli in rhizosphere of fresh produce. (In final review) Journal of Food Protection.

Additional Outcomes:

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

NCERA59 Annual State Report

Year: 2010
Institution: North Dakota State University
Committee Representative: Larry J. Cihacek

Introduction:

During 2009, a study was initiated on evaluating contribution of individual mixed grassland plant species to soil carbon sequestration when the grassland is utilized for biofuels production at locations in southeastern and central North Dakota. Eight individual grass and forb species were evaluated at the southeastern North Dakota location and six mixed species compositions were evaluated at the central North Dakota site. Soils are currently being evaluated to a depth of 1m for total organic C as well as dissolved organic C.

Additional work is being done to evaluate data collected is a previous study from soil samples collected from over 1400 sites across the northern Great Plains. Current efforts include using the CENTURY Model to compare its predictions of C sequestered over time with actual field data across time gradients. In addition, cooperative work is being done to incorporate our data with the national USDA-NRCS Rapid C Survey that is now ongoing.

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. In addition, the role of movement of dissolved organic C into the profile is being evaluated to with regard to its significance in contributing to long-term C storage in soils.

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:

Cihacek, L. J., B. B. Botnen and E. N. Steadman. 2010. A Sampling Protocol for Monitoring, Measurement, and Verification of Terrestrial Carbon Sequestration in Soils. Plains CO_2 Reduction Partnership (PCO_2R) Value-Added Report. Univ. of North Dakota, Grand Forks, ND. April 2010.

Published Abstracts (2009 SSSA Symposium --Soil Carbon and Greenhouse Gas Dynamics in Agricultural Lands: II):

Annam, D., and L. Cihacek. 2009. Factors Influencing C Sequestration in Northern Great Plains Grasslands. SSSA AnMtgsAbsts2009.52325. ASA, CSSA, and SSSA, Madison, WI.

Macha, D., and L. Cihacek. 2009. Carbon Storage in Plant and Soil Components of Selected Grass Monocultures. SSSA AnMtgsAbsts2009.53321. ASA, CSSA, and SSSA, Madison, WI.

Riopel, J. A., and L. Cihacek. 2009. Differences in Soil Organic Carbon Between Cropland, Restored Grassland and Native Grassland in the Northern Great Plains. SSSA AnMtgsAbsts2009.53012. ASA, CSSA, and SSSA, Madison WI.

Cihacek, L., and J. A. Riopel, 2009. A Comparison of Soil Organic Carbon Levels in Cropland, Restored Grassland and Native Grassland. SSSS AnMtgsAbsts2009.53683. ASA, CSSA, and SSSA, Madison WI.

Additional Outcomes:

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

NCERA59 Annual State Report

Year: 2010
Institution: The Pennsylvania State University
Committee Representative: Douglas D. Archibald

Introduction:

My activities in this area focus on improving and applying spectral analytical techniques for analysis of soil organic matter and related materials for agricultural and ecological studies that must assess large numbers of specimens. A part of this effort is analysis of total soil organic carbon by visible, NIR and FTIR analysis conducted in the lab or field. Another part applies laboratory spectroscopic techniques to characterize soil fractions, organic and inorganic, derived by simple extraction procedures.

PSU Agronomy graduate student V. Duraisamy and collaborators have made progress in characterization of depth-wise bulk density, soil color and soil organic carbon in soils from the long-term moldboard-plowed crop-rotation by fertility experiment at the R.E. Larson Agricultural Research Farm at Penn State University. PSU Ecology graduate student J. Moon and collaborators have made progress in high-throughput infrared characterization of extractable (highly labile) organic matter in soils from headwater wetland soils spanning a disturbance gradient. The lab has developed some related infrared characterization techniques for assessing the colloid producing potential of soils. PSU Ecology graduate student M. Goebel and collaborators made progress in infrared spectroscopic characterization of roots to enhance a litterbag study of root turnover under forest soils.

Relevant Publications:

Publications

1. M. Goebel, S. E. Hobbie, B. Bulaj, M. Zadworny, D. D. Archibald, J. Oleksyn, P. B. Reich and D. M. Eissenstat. "Decomposition of the finest root branching orders: Linking carbon and nutrient dynamics belowground to fine root function and structure." *Ecological Monographs* (accepted for publication, 6-25-2010).

Presentations/Abstracts

1. E. Fares, M. Goebel and D. Archibald. “Sample preparation techniques for infrared analysis of lignin in very small root specimens.” *2010 Undergraduate Exhibition – Poster Sessions: The Pennsylvania State University : April 7, 2010*, p. 18 (poster, summary)
2. V. Duraisamy and D. Archibald. "Characterization of depth-wise variation in soil color between two crop-soil management systems in a long-term trial in central PA." *The 13th Annual Environmental Chemistry Student Symposium : The Pennsylvania State University : March 26th - 27th, 2009*, p. 40 (poster, abstract).

Additional Outcomes:

I was a participant at: Soil Carbon Workshop – The Determination of Soil Organic Carbon in Agricultural Soils Spanning North America (California Institute of Technology Jet Propulsion Laboratory; Pasadena, CA; May 26-28, 2009), where I was co-presenter of "Instrumentation for Measuring SOC" by D. Archibald, D. J. Brown & A. Plante. This led to a manuscript submitted to EOS and our participation in a large NASA Venture proposal on regional soil organic carbon assessment that is led by Kansas State University and the Caltech Jet Propulsion Lab (but not funded). Additionally, the interactions led to a much smaller project in a related area with The Rodale Institute. That project seeks to improve the ability to conduct soil organic carbon surveys in Pennsylvania and includes technology and techniques for managing soil specimens, as well as spectral technologies for characterization of soil cores at the sampling points and at the site.

NCERA59 Annual State Report

Year: 2010
Institution: Washington State University
Committee Representative: Ann-Marie Fortuna

Introduction:

This year my work addressed NCERA-59 objectives 1, 2 and 3. My research at WSU integrates microbial ecology, molecular biology, biogeochemistry and long-term ecosystems management. My program objectives contribute to: the development of novel cropping systems and land-use managements that maintain and promote efficient cycling of N and C; provide management guidelines to growers that improve N use efficiency and management by integrating information on microbial community structure and function; and utilize molecular techniques to study soil processes at field and ecosystem scales. These efforts will contribute 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.

Research funded via a USDA-STEEP grant focused on nutrient cycling, nitrogen use efficiency and carbon storage (objective 1). My research incorporates measurements of soil quality and nitrogen indexes with geospatial information collected annually for ten years at reference sites across landscape position under direct seed and varying alternative rotation managements. This research determines which land-use and management practices have the greatest impact on soil quality and nitrogen cycling.

An additional cover crop project that included a master's student focused on predicting nutrient release from mixtures of rye and hairy vetch cover crops (objective 2) in situ and via potentially mineralizable nitrogen in laboratory incubations.

This year my program has focused on conducting outreach activities and training to scientists in other areas via the National Science Foundation's Integrative Graduate Education and Research Traineeship (NSF IGERT) Program at Washington State University, Nitrogen Systems: Policy-oriented Integrated Research and Education (NSPIRE). I have participated in and provide lectures for core courses created for the NSPIRE program. These courses integrate faculty from Crop & Soil Sciences, Engineering, Animal Science, Biological Science, Natural Resources and Political Science. Our focus is the nitrogen cycle. My course materials address N mineralization, nutrient cycling and soil quality. I successfully recruited an IGERT PhD fellow to my program. This individual will be trained cross disciplinarially Her research will determine the affects of land management on greenhouse gas emissions and nitrifier-denitrifier communities.

I have conducted additional cross-disciplinary research via a master's student's project that includes faculty from Animal Science. We looked at nitrogen use efficiency in forage systems receiving digested and undigested dairy waste, as well as, provide estimates of gaseous loss of ammonia and nitrous oxide (objective 1). The research was funded through the Natural Resource Conservation Service and the Dairy Association. This experiment provided valuable research and information that growers could utilize.

- Biogas treatment of dairy effluent and mixed wastes reduced the potential for nitrous oxide emissions relative to urea and untreated dairy wastes.
- Plant available N is sufficient for use in place of N fertilizer potentially reducing the demand for N fertilizer.
- Treated waste can be used for fertigation reducing agricultural demands for water.
- Wastes that were partially incorporated had significantly less ammonia and nitrous oxide losses.

Relevant Publications In Review:

1. **Fortuna* A.**, C.W. Honeycutt, G. Vandemark, T.S. Griffin, R.P. Larkin, Z. He, B.J. Wienhold, K. R. Sistani, S.L. Albrecht, B.L. Woodbury, H.A. Torbert, J.M. Powell, R.K. Hubbard, R.A. Eigenburg, R.J. Wright. Nitrification potential in contrasting soils following dairy manure application. *Soil Sci. Soc. of Am. J.* (resubmitted July 2010).

2. **Fortuna*, A.**, K. Gunning* and C.W. Honeycutt. Comparison of DGGE and microarray technologies for the detection of 16S rRNA obtained from beta-ammonia oxidizer cultures and soil. (Submitted 2010, *Environ. Sci. Tech*.).

Additional Outcomes:

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

Committee on Organic & Sustainable Agriculture, ASA, ACS238

Gollany H. and **A. Fortuna** Using CQESTR to Estimate the Impact of Agriculture Management on Soil Carbon Sequestration Global Research Alliance Fellowship, USDA Foreign Agricultural Service. **funded** estimated $15,000

Huggins, D.R. (PI)., **Fortuna, A.**, Kok, H., Kruger, C., Painter, K., Paulitz, T., Stockle, C, Wysocki. Assessing Environmental and Economic Trade-offs of Residue Removal in Dryland Cropping Systems. USDA –CSREES, STEEP 20093426120309 $150,000

Harrison, J. (PI); Bary, A.; Cogger, C.; **Fortuna A.**; O'Rourke E. Management Factors Affecting Fall Soil NO_3 & N_2O Emissions. WA Dairy Prod. Comm. ADDM55 $54,000

Cogger, C. (PI); Bary, A.; **Fortuna**, A. Northwest Biosolids Management. Assoc. Res. and Exten. Act. 20278-013 $69,599

Fortuna, A. and D.R. Huggins. 2009. Linking a decade of geospatial information and alternative land-use management to soil quality. SSSA, Pittsburgh, PA.