# NCERA59 Annual State Report

| Year: 2015 |
|---|
| Institution: Iowa State University |
| Committee Representative: Michael Castellano |

## Introduction:

The effects of plant litter quality and nitrogen fertilizer on soil organic matter stabilization were the focus on my research in 2015. Soil organic matter increases crop yield amount and stability. Soil organic matter - not nitrogen fertilizer - is the largest source of crop nitrogen uptake and environmental nitrogen loss. We used a long-term nitrogen fertilizer gradient in continuous corn that created a large range in soil organic carbon to determine how plant litter quality and nitrogen fertilizer impact soil organic matter stabilization. We conducted a nitrogen fertilizer use efficiency experiment across long-term nitrogen fertilizer gradients in two corn production systems. These experiments add different amounts of nitrogen fertilizer to corn in order to determine the economic optimum nitrogen fertilizer application rate. We found that although agronomic optimum nitrogen fertilizer input was critical to maintain soil health, historical long-term under-application or over-application of nitrogen fertilizer did not negatively impact corn yield when nitrogen fertilizer input was returned to the optimum amount of nitrogen. In other words, corn yield was remarkably resilient to historical mismanagement of nitrogen fertilizer.

## Relevant Publications:


Castellano MJ, Mueller KM, Olk DC, Sawyer JE, Six J. 2015. Integrating plant litter quality, soil organic matter stabilization and the carbon saturation concept. ***Global Change Biology*** doi: 10.1111/gcb.12982

Mueller K, Hobbie S, Chorover J, et al. 2015. Effects of litter traits, soil biota, and soil chemistry on soil carbon stocks at a common garden with 14 tree species. ***Biogeochemistry*** doi:10.1007/s10533-015-0083-6


## Additional Outcomes:

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

None

# NCERA59 Annual State Report

| Year: 2015 |
| --- |
| Institution: North Dakota State University |
| Committee Representative: Larry Cihacek |

**Activities:**

Activity 1: A site established in 2008 was evaluated for the effects of biomass removal on changes in soil organic C and soil properties. The sites are an irrigated continuous corn and corn-soybean rotation at the Oakes Research Site near Oakes, North Dakota on a loamy fine sand soil and a similar dryland continuous corn and corn-soybean rotation at the Carrington Research and Extension Center, near Carrington, ND on a fine sandy loam to loam soil. Corn residue is being removed using a plot forage chopper by removing the corn residue from none, one-third, two-thirds or all of the rows in the plots. Both sites are under no-till management. Initial and mid-term soil samples have been collected at Oakes and initial samples have been collected at the Carrington and Prosper locations. Research activity in 2013 included determining aggregate stability, wind erodible fraction, penetrability, bulk density, and water infiltration at the Oakes site. In addition, soil samples were collected to a depth of 1 m for SOC analysis at this site.

Activity 2: Currently working on book chapter on "Soil Sampling for Carbon Research and Monitoring" for book being developed by this committee.

## Impacts:

Removal of corn residue at different levels from plots will establish residue harvest levels for biofuel biomass that will sustain soil C and soil productivity.

## Summary of Results:

Activity 1:

During the 2013 growing season, corn stover removal plots at the NDSU Oakes Research Site near Oakes, ND were evaluated for change in soil physical properties including resistance to penetration (hardening), soil aggregate stability and water infiltration. These plots were established in 2008 and include continuous corn and corn/soybean rotation plots. The corn stover is removed annually from the continuous corn plots with treatments including a) no stover removal; b) 33% stover removal; c) 67% stover removal; and, d) 100% stover removal. On the corn/soybean plots, the stover has been removed only from the plots in the corn phase of the rotation with no residue removal from the soybean plots. Yield and other agronomic data can be found at http://www.ag.ndsu.nodak.edu/oakes/oakes.htm.

Soil properties were evaluated in September and October 2013 after irrigation was completed for the season. Soil aggregates were collected with a flat-bottom shovel to a depth of 2-inches from 6 points in each plot. A portion of the soil was hand screened to obtain the 1-2 mm aggregate fraction. This fraction was split into 2 subsamples for determination of aggregate stability under both field- moist and air-dry conditions. The remainder of the unscreened aggregate samples were placed in plastic buckets, taken to a greenhouse and air-dried with minimal disturbance for dry sieving through a 0.84 mm screen for determining the wind erodible fraction.

Resistance to penetration was measured at 9 points in each plot using a Dickey-John Soil Penetrometer. Readings were taken at 3-inch depth increments to a depth of 12 inches.

Water infiltration was conducted using 6-inch diameter aluminum rings driven into the soil to a depth of 10-cm (4 inches). Two rings were installed in each plot and were sealed along the inner wall with bentonite clay. The soil was covered with a circle of filter paper to prevent soil disturbance when adding water. Two liters of water were added to each ring followed by maintenance of at least 10-cm of water in each ring for 1 ½ hours. A 30 cm ruler was then placed in the rings and water depth readings were taken at 10 minute intervals for a minimum of 6 readings over a 1 hour time period to determine the infiltration rate. Water was added as needed to maintain a 10-15 cm water head in the rings.

Two soil cores were collected in each treatment plot in both the continuous corn and corn-soybean rotations from untrafficed row centers. The cores were collected to a depth of a minimum of 1 meter (3.3 feet) using a hydraulic Giddings soil probe using a steel tube with an acetate liner. The cores in the acetate liners were removed from the steel liners, capped and sealed with duct tape in the field for transportation to the laboratory. The cores were stored in a cool environment until processed. During processing, the acetate liners encasing the soil cores were opened and the cores segmented into 4 inch (10 cm) increments for the surface foot of the core and 6 inch (15 cm) increments for depths below the surface foot. The bulk density was determined on each segment by the core method of Blake and Hartge (1986). The two segments of like depth from each plot were composited, air-dried and crushed to pass a 2-mm screen. The samples were thoroughly mixed and a 10-12 gram subsample of each composite sample was milled to pass a 100-mesh screen (Cihacek and Jacobson, 2007) for total, inorganic and organic C determination by high temperature combustion and acid addition. Soil C was reported as kilograms of C per square meter per depth based on bulk density correction of each depth increment.

In addition, soils from the surface samples (0 to 4 inches) were aerobically incubated for 14 days to determine N mineralization potentials as influenced by residue removal rate by the method of Keeney and Bremner (1966) Both ammonium-N (NH4-N) and nitrate-N (NO3-N) were determined on the samples before and after incubation by steam distillation (Bremner, 1965).

Results:

For continuous corn:

1. Wind erodible fraction (<0.84mm) increased with increased residue removal.
2. Field moist water stable aggregate fraction decreased with increase in residue removal.
3. Water infiltration rate decreased with increased residue removal.
4. Apparent soil penetration resistance increased.
5. Little effect on SOC changes and N mineralization were observed.

For corn-soybean rotation, corn phase:

1. Water infiltration rate decreased with increased residue removal.
2. Apparent increase in soil penetration resistance.
3. The magnitude of SOC change decreased.
4. N mineralization did not appear to be affected by residue removal.

For corn-soybean rotation, soybean phase:

1. Air-dry water stable aggregates decreased with increased residue removal.
2. Apparent soil penetration resistance slightly increased.
3. SOC change appeared to decrease with residue removal, But, the changes were small and not significant.

## Relevant Publications:

Cihacek, L. J., L A. Foss and K. A. Jacobson. 2015. A comparison of soil sampling devices for soil bulk density determination for carbon sequestration monitoring. Commun. Soil Sci. Plant Anal. 46(2):180-184.

Dose, H. L., A. M. Fortuna, L. J. Cihacek, J. Norland, T. M. DeSutter, D. E. Clay, and J. Bell. 2015. Biological indicators provide short term soil health assessment during sodic soil reclamation. Ecol. Ind. 58244-253.

## Additional Outcomes:

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

Addditional results for residue removal study:

*Continuous corn:*

Table 1. Wind erodible fraction, water stable aggregate fractions and water infiltration rates as influenced by corn residue removal rates for continuous corn.

| Residue Removal Treatment | Wind Erodible Fraction (<0.84 mm) | Water Stable Aggregates | | Infiltration Rate |
|---|---|---|---|---|
| | | Field-moist | Air-dry | |
| ---------------------------------------------%----------------------------------------- | | | | -mm/min- |
| 0 | 25.4 a† | 58.7 a | 89.5 a | 22.4 a |
| 33 | 36.9 b | 54.6 b | 84.9 a | 12.6 b |
| 67 | 33.5 ab | 55.5 a | 81.7 a | 13.8 bc |
| 100 | 36.6 b | 48.3 b | 82.2 a | 8.6 c |

†Values followed by the same letter are not different at $P \geq 0.05$.

Table 2. Soil penetration resistance by depth as influenced by corn residue removal treatment for continuous corn based on 9 sampling points.

| Residue Removal Treatment | Depth (inches) | | | |
|---|---|---|---|---|
| | 0-3 | 3-6 | 6-9 | 9-12 |
| | --------------------------psi†-------------------------- | | | |
| 0 | 192 | 168 | 160 | 104 |
| 33 | 253 | 250 | 219 | 166 |
| 67 | 287 | 294 | 279 | 219 |
| 100 | 312 | 300 | 294 | 239 |

†psi – pounds per square inch.

Table 3. Initial and final soil organic carbon (SOC) masses in the surface foot of the soil at the initiation of the study (2008), the final year of the evaluation period (2013) and the change over 5 years of continuous corn.

| Residue Removal Treatment | Soil Organic Carbon Mass | | |
| --- | --- | --- | --- |
| | 2008 | 2013 | Change† |
| ----%---- | ------------------------kg/$m^2$/30 cm--------------------- | | |
| 0 | 5.969 b‡ | 8.592 bc | 2.623 ab |
| 33 | 4.872 a | 6.804 a | 1.932 a |
| 67 | 5.759 b | 8.840 c | 3.082 b |
| 100 | 5.486 ab | 7.683 ab | 2.197 ab |

†Change = 2013 SOC mass – 2008 SOC mass.
‡ Values followed by the same letter are not different at $P \geq 0.05$.

Table 4. Effects of corn residue removal on potential mineralizeable ammonium- and nitrate-N after fourteen days of incubation for the surface soil (0-4 inches) of continuous corn.

| Residue Removal Treatment | Mineralizeable N | |
| --- | --- | --- |
| | $NH_4$-N | $NO_3$-N |
| ----%---- | ----------------------ppm-------------------- | |
| 0 | 0.170 a† | 18.7 a |
| 33 | 0.000a | 12.8 a |
| 67 | 0.135 a | 20.6 a |
| 100 | 0.108 a | 13.2 a |

†Values followed by the same letter are not different at $P \geq 0.05$.

*Corn phase of a corn-soybean rotation:*

Table 5. Wind erodible fraction, water stable aggregate fractions and water infiltration rates as influenced by corn residue removal rates for the corn phase of a corn-soybean rotation.

| Residue Removal Treatment | Wind Erodible Fraction (<0.84 mm) | Water Stable Aggregates | | Infiltration Rate |
|---|---|---|---|---|
| | | Field-moist | Air-dry | |
| --------------------------------------------%----------------------------------- ------- | | | | -mm/min- |
| 0 | 35.1 a† | 52.0 a | 83.1 a | 16.8 a |
| 33 | 43.6 a | 51.4 a | 84.2 a | 11.6 b |
| 67 | 35.5 a | 53.6 a | 82.1 a | 11.9 ab |
| 100 | 47.1 a | 50.6 a | 82.9 a | 10.8 b |

†Values followed by the same letter are not different at $P \geq 0.05$.

Table 6. Soil penetration resistance by depth as influenced by corn residue removal treatment for the corn phase of a corn-soybean rotation.

| Residue Removal Treatment | Depth (inches) | | | |
|---|---|---|---|---|
| | 0-3 | 3-6 | 6-9 | 9-12 |
| ----%---- | -------------------------psi†------------------------- | | | |
| 0 | 154 | 137 | 161 | 149 |
| 33 | 208 | 201 | 221 | 204 |
| 67 | 256 | 254 | 267 | 263 |
| 100 | 278 | 286 | 294 | 277 |

†psi – pounds per square inch.

Table 7. Initial and final soil organic carbon (SOC) masses in the surface foot of the soil at the initiation of the study (2008), the final year of the evaluation period (2013) and the change over 5 years in the corn phase of a corn-soybean rotation.

| Residue Removal Treatment | Soil Organic Carbon Mass | | |
|---|---|---|---|
| | 2008 | 2013 | Change |
| ----%---- | ------------------------kg/m²/30 cm--------------------- | | |
| 0 | 4.821 a† | 7.293 a | 2.472 b |
| 33 | 4.407 a | 6.216 a | 1.809 ab |
| 67 | 4.856 a | 7.028 a | 2.172 ab |
| 100 | 5.038 a | 6.017 a | 0.963 a |

†Values followed by the same letter are not different at $P \geq 0.05$.

Table 8. Effects of corn residue removal on mineralizeable ammonium- and nitrate-N after fourteen days of incubation for the surface soil (0-4 inches) of the corn phase of a corn-soybean rotation.

| Residue Removal Treatment | Mineralizeable N | |
|---|---|---|
| | $NH_4$-N | $NO_3$-N |
| ----%---- | ----------------------ppm-------------------- | |
| 0 | 0.045 a† | 2.56 a |
| 33 | 0.045 a | 0.045 a |
| 67 | 0.000 a | 4.63 a |
| 100 | 0.000 a | 4.30 a |

†Values followed by the same letter are not different at $P \geq 0.05$.

*Soybean phase of a corn-soybean rotation:*

Table 9. Wind erodible fraction, water stable aggregate fractions and water infiltration rates as influenced by corn residue removal rates for the soybean phase of a corn-soybean rotation.

| Residue Removal Treatment | Wind Erodible Fraction (<0.84 mm) | Water Stable Aggregates | | Infiltration Rate |
|---|---|---|---|---|
| | | Field-moist | Air-dry | |
| ---------------------------------------------%---------------------------------- ------- | | | | -mm/min- |
| 0 | 40.2 a† | 63.9 a | 88.1 a | 16.4 a |
| 33 | 44.7 a | 60.2 a | 84.4 b | 15.9 a |
| 67 | 48.8 a | 67.2 a | 84.9 b | 16.7 a |
| 100 | 46.7 a | 56.7 a | 77.7 c | 13.3 a |

†Values followed by the same letter are not different at $P \geq 0.05$.

Table 10. Soil penetration resistance by depth as influenced by corn residue removal treatment for the soybean phase of a corn-soybean rotation.

| Residue Removal Treatment | Depth (inches) | | | |
|---|---|---|---|---|
| | 0-3 | 3-6 | 6-9 | 9-12 |
| | -------------------------psi†------------------------- | | | |
| 0 | 175 | 187 | 200 | 160 |
| 33 | 250 | 244 | 253 | 226 |
| 67 | 299 | 306 | 303 | 290 |
| 100 | 328 | 372 | 337 | 329 |

†psi – pounds per square inch.

Table 11. Initial and final soil organic carbon (SOC) masses in the surface foot of the soil at the initiation of the study (2008), the final year of the evaluation period (2013) and the change over 5 years in the soybean phase of a corn-soybean rotation.

| Residue Removal Treatment | Soil Organic Carbon Mass | | |
|---|---|---|---|
| | 2008 | 2013 | Change |
| ----%---- | ----------------------- $kg/m^2/30$ cm -------------------- | | |
| 0 | 3.393 a[†] | 4.039 a | 0.645 a |
| 33 | 3.462 a | 4.203 a | 0.742 a |
| 67 | 4.037 ab | 4.243 a | 0.206 a |
| 100 | 4.446 b | 4.665 a | 0.219 a |

[†]Values followed by the same letter are not different at $P \geq 0.05$.

Table 12. Effects of corn residue removal on mineralizeable ammonium- and nitrate-N after fourteen days of incubation for the surface soil (0-4 inches) of the soybean phase of a corn-soybean rotation.

| Residue Removal Treatment | Mineralizeable N | |
|---|---|---|
| | $NH_4$-N | $NO_3$-N |
| ----%---- | ---------------------ppm------------------- | |
| 0 | 3.63 a[†] | 0.498 a |
| 33 | 4.39 a | 2.99 a |
| 67 | 7.43 a | 4.05 a |
| 100 | 5.03 a | 4.10 a |

[†]Values followed by the same letter are not different at $P \geq 0.05$.

# NCERA59 Annual State Report

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|---|---|
| **Year: 2015** | |
| **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, organic agriculture and rangelands. 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. Nitrogen fertilization at agronomic rates had minimal impact on overall AM fungal diversity and colonization of maize roots (Tian et al., 2013); however, the frequency and distribution of AM fungal phylotypes varied with N fertilization level and may have important implications for agroecosystem management. Although N fertilization level did not impact AM colonization and P metabolism in the roots of maize, the development and biomass of the external mycelium (i.e. ERM) was highly reduced by the application of N fertilizer (Jeske, PhD Thesis 2012). We are currently investigating the interaction between N and P fertilization on AM colonization and plant growth using selected drought tolerant maize hybrids. We have ongoing research collaborations with Hui Tian's group in China and Katsunori Isobe's group in Japan on AM function in cropping systems. Current focus is on expression of plant P and N transporters important for nutrient use efficiency in crops as well as crop rotational impacts on AM function and diversity. These findings may impact how we manage these systems, particularly tillage, fertilizer and crop rotation decisions, given the importance of the ERM to nutrient capture and tolerance to water stress.
- Cover crops are becoming increasing attractive to farmers in Nebraska for soil conservation and nutrient supply. For organic farmers, weeds are the number one issue and cover crops may play a role in weed suppression. To investigate this we are examining several cover crop mixtures and methods/timing of termination on weed establishment and control in an organically managed field. Results from this work were recently published in Wortman et al., 2012 and Wortman et al., 2013. We just received a 180K grant from CERES to continue our research on the benefits of cover crops to organically managed cropping systems.

## Relevant Publications:


1. Humberto Blanco-Canqui, Richard B. Ferguson, Charles A. Shapiro, Rhae A. Drijber, and Dan T. Walters. 2014. Does Inorganic Nitrogen Fertilization Improve Soil Aggregation? Insights from Two Long-Term Tillage Experiments. **Journal of Environmental Quality** 2014 43:995-1003.

2. Lehman, R.M., Ducey, T., Jin, V., Acosta-Martinez, V., Ahlschwede, C., Jeske, E., Drijber, R., Cantrell, K., Frederick, J., Fink, D., Osborne, S., Novak, J., Johnson, J.F., Varvel, G., 2014. Soil Microbial Community Response to Corn Stover Harvesting Under Rain-Fed, No-Till Conditions at Multiple US Locations. **Bioenergy Research** 7: 540-550.

3. Jianfeng, Duan, Hui Tian, Rhae A. Drijber, Yajun Gao. 2015. Systemic and local regulation of phosphate and nitrogen transporter genes by arbuscular mycorrhizal fungi in roots of winter wheat (Triticum aestivum L.). **Plant Physiology and Biochemistry** 96:199-208.

## Relevant Presentations:

1. Crespo, R.J., M.L. Ali, M. Higo, A.J. Lorenz, T. Shaver, R.A. Drijber. Arbuscular Mycorrhizal Fungi Colonizing Maize Genotypes Under Two Contrasting Water Levels. ASA-CSSA-SSSA Annual Meetings, Nov. 2-5, 2014. Long Beach CA. Poster.
2. Crespo, R.J., B.J. Wienhold, T. Awada, T. Arkebauer, A.J. Lorenz, R.A. Drijber. Physiological Responses of Maize to Arbuscular Mycorrhizal Fungi Under Variable Phosphorus and Nitrogen Levels. ASA-CSSA-SSSA Annual Meetings, Nov. 2-5, 2014. Long Beach CA. Oral.
3. Blanco-Canqui, H., C.A. Shapiro, R.A. Drijber, R.B. Ferguson. Implications of Inorganic Fertilization on Soil Aggregation. ASA-CSSA-SSSA Annual Meetings, Nov. 2-5, 2014. Long Beach CA.

## Additional Outcomes:

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

**Relevant current grants:**

Drijber, R. (PI), Project ID 29247, "Soil Microbial Community Structure and Function in High Production Corn-Soybean Systems", Dept of Agriculture-ARS, Federal, Research, Awarded. 08/01/2014-07-31/2019. $100,000.

Drijber, R. (PI), Lindquist, J., Blanco-Canqui, H. Project ID 29381. "Cover Crop Strategies to Build Soil Organic Matter, Thereby Enhancing Soil Biology, Water Retention and Weed Control in Organic Cropping Systems of the Western Corn Belt", Ceres Trust, Associations/Foundations, Research, Awarded. $180,000.

Drewnoski, M. (PI), R. Drijber, G. Lesoing, T. Shaver. Project ID 28812: A producer driven approach to demonstrating soil health and economic benefits of cover crop adoption and livestock integration in Nebraska cropping systems. CIG Grant, Dept. of Agriculture-NRCS. Awarded. 09/01/2014 - 05/31/2016. $74,958.

# NCERA59 Annual State Report

| Year: 2015 |
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| **Institution: University of California Davis** |
| **Committee Representative: William Horwath** |

## Introduction:

The role of soil physical fractions and iron were topics of my research in 2015.

The role of soil physiochemical properties was examined to determine fators controlling soil carbon stabilization. The diversity of microbial inputs and iron were examined in separate studies. It has been hypothesized that a fungal-dominated community stabilizes more C than a bacterial-dominated community, in part due to chemical recalcitrance of their non-living biomass, particularly cell wall components and pigments. The stabilization of microbial carbon was examined in soil physical fractions in temperate and tropical forest soils. There was no microbial group effect (i.e., differences in fraction C recovery among different microbial cell types). Our findings suggest that mineral association is more important for stabilizing non-living microbial C in soil than the cellular structure of the initial source of microbial inputs, with site specific edaphic factors as the major controllers of the amount of microbial residues stabilized. Using isotopic and elemental analyses, we tested the hypothesis that plant-derived carbon accumulation was triggered by the formation of iron-coordinated complexes, stabilized into physically protected (occluded) soil fractions. Confirming this hypothesis, we identified a fast formation of microaggregates shortly after the application of iron-rich biosolids, which was characterized by a strong association between pyrophosphate-extractable iron and plant-derived organic matter. The formation of microaggregates preceded the development of macroaggregates, which drastically increased soil carbon content (~140 Mg C/ha) a few years after restoration. The effectiveness of coupled organic matter and iron "fertilization," combined with management of invasive species, has the possibility to enhance terrestrial carbon sequestration

## Relevant Publications:


Throckmorton, HM, JA Bird, N Monte, T Doane, MK Firestone, WR Horwath. 2015. The soil matrix increases microbial C stabilization in temperate and tropical forest soils. Biogeochemistry 122: 35-45

Silva, LCR, TA Doane, RS Corrêa, V Valverde, EIP Pereira, WR Horwath. 2015. Iron-mediated stabilization of soil carbon. Ecological Applications. 25: 1226-1234


## Additional Outcomes:

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

None

# NCERA59 Annual State Report

| Year: 2015 |
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| Institution: University of Illinois |
| Committee Representative: Michelle Wander |

## Activities:

Recently completed a project to**:** 1) Evaluate the potential of organic and conservation practices to sequester soil organic carbon and improve soil health within the state of Illinois. 2. Use on-farm research to critically assess and/or validate tools farmers can use to improve management of soil organic matter, soil health, soil and water quality, and nutrient use efficiency and to reduce their carbon footprint. 3. Identify factors that help or hinder farmer's ability to achieve their stewardship goals in a socially and economically viable manner.

Continue to serve as the National Lead of the Soils Community of Practice for eOrganic/eXtension and serves on the National Soil and Water Conservation Society Policy Committee

Recently completed an evaluation of Natural Resources Conservation Services Conservation Measurement Tool which is the tool used to rank applications for the Conservation Stewardship Program.

Co-developed the organic matter modeling framework used by Argonne National Lab to support the Department of Energy's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) life cycle analysis tool to calculate changes in U.S. soil organic matter levels associated with biofuel production.

Was a lead-developer of the soils indicator section of the American National Standards Institute (ANSI)/Leo-4000 American Sustainable Agriculture Standard which is a voluntary sustainable agriculture standard for businesses developed using ISO-compliant multi-stakeholder processes.

## Impacts:

Improvement of tools for soil stewardship, soil and water conservation and land use change policy support, organic certification

## Relevant Publications:


Marzano, S.Y., Wander, M.M., Villamil, M., Ugarte, C.M. and D. Eastburn. 2015. Organic transition effects on soilborne diseases of soybean and populations of Pseudomonadaceae. Agronomy J. 107:1087-1097.

Qin, Z., Dunn, J.B., Kwon, H-Y, Mueller, S. and M.M. Wander. 2016. Influence of spatially-dependent, modeled soil carbon emission factors on life-cycle greenhouse gas emissions of corn and cellulosic ethanol. Global Change Biol. DOI: 10.1111/gcbb.1233

Lazicki, P.A., Liebman, M., M.M Wander. 201X. Effect of management on soil quality and root parameters in conventional and low-input rotations in Central Iowa. PlosOne. In review.

Qin, Zhangcai; Canter, Christina E.; Dunn, Jennifer B.; Mueller, Steffen; Kwon, Ho Young; Han, Jeongwoo; Wander, Michelle M.; Wang, Michael. 2015. Incorporating agricultural management practices into the assessment of soil carbon change and life-cycle greenhouse gas emissions of corn stover ethanol production

**Additional Outcomes:**

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

2015 Phillips, E., Marriott, E., and M. Wander, Using and Interpreting Soil Tests. For the Organic Track at the Illinois Specialty Crops, Agritourism and Organic Conference, Springfield, IL. Jan.

2105 Wander, M.M. 2015. Environmental Benefits of Organic Agriculture: Soil. Oregon Tilth and USDA Natural Resources Conservation Service. http://www.conservationwebinars.net/webinars/environmental-benefits-of-organic-agriculture-soil. Webinar. Aug.

2015 Wander, M.M., The Legacy of the Morrow Plots: The Plot Thickens, Symposia on Long-Term Agricultural Research: A Means to Achieve Resilient Agricultural Production for the 21st Century and Beyond. ASA-CSA-SSSA Annual Meeting, Minneapolis, MN. Nov.

A recently funded NIFA effort to develop Agricultural Information Systems (AIS) for organic farmers will leverage an existing decision support tool (goCrop™) that uses integrated web and mobile applications for crop and soil management to help farmers to plan, monitor, analyze, and report with ease. By drawing on existing collaborations with farmers, farm data, and modeling tools, this project will carry out an integrated Extension and research program to develop modules that can estimate plant available nitrogen (PAN) and greenhouse gas emissions (GHG) derived from nitrous oxide release from organic crop systems.

Will collaborate with Drijber to complete paper on Morrow Plots and finalize book chapter for NCERA 59

# NCERA59 Annual State Report

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| **Year: 2015** |
| **Institution: University of Maryland** |
| **Committee Representative: Ray R Weil** |

## Introduction:

Soil organic matter and soil biology in general continue to increase in prominence in the ecosystem and soil science arena. In addition, farmers in the region increasingly express an interest in learning about and managing the biology of their soils. At University of Maryland, my lab addressed these issues in 2015 through work on soil health, soil-improving cover crops (including grasses, legumes and brassicas), labile carbon investigations, and deep cycling of C and N in agricultural soils.

## Relevant Publications:


1. Wang, F., Y.A. Tong, P. Gao, J. Zhang, **R.R. Weil**, and J.N. Coffie. 2014. Organic amendments to a wheat crop alter soil aggregation and labile carbon on the loess plateau, China. Soil Science 179:166-173.

2. Belle, A.J., S. Lansing, W. Mulbry, and **R.R. Weil**. 2014. Anaerobic co-digestion of forage radish and dairy manure in complete mix digesters. Bioresource Technology. 178:230-237.

3. Lounsbury, N.P., and **R.R. Weil**. 2015. No-till seeded spinach after winterkilled cover crops in an organic production system. Renewable Agriculture and Food Systems 30:1-13. 10.1017/S1742170514000301

4. Belle, A.J., S. Lansing, W. Mulbry, and **R.R. Weil**. 2015. Methane and Hydrogen Sulfide Production during Co-digestion of Forage Radish and Dairy Manure. Biomass and Bioenergy 80:44-51.

5. Tully, K., C. Sullivan, **R. Weil**, and P. Sanchez. 2015. The state of soil degradation in sub-Saharan Africa: Baselines, trajectories, and solutions. Sustainability 7:6523-6552.

6. Poffenbarger, H., S.B. Mirsky, **R.R. Weil**, J.J. Meisinger, J.E. Maul, M.A. Cavigelli, and J.T. Spargo. 2015. Legume-grass proportions, poultry litter, and tillage effects on cover crop decomposition. Agronomy Journal 107:2083-2096.


## Additional Outcomes:

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

Through the NCERA59 participation and objectives, we made several presentations to large groups of farmers and extension educators. We held a field days on soil quality and organic matter management with notill and cover crops.

1. Hirsh, Sarah, Ray Weil, Jim Lewis, Sjoerd Duiker. 2015. "Planting Early Cover Crops to Capture and Recycle Deep Soil Nitrogen: an Untapped Resource for Profitability and Environmental Stewardship", Presentation at Commodity Classic Field Day Tour. Centreville, Md. 23 July 2015. 50 farmers and ag professionals in attendance.

2. Weil, Ray. 2015. Soil Health Systems. Keynote talk. The Conservation Cropping Systems Initiative and Purdue University. August 18, Covington, IN. 180 farmers and agric. professionals in attendance.

3. Weil, Ray. 2015. Lessons Learned from Chesapeake Bay**-** Soil Organic Matter Management for Nutrient Cycling and Agricultural Sustainability. Keynote talk. The Conservation Cropping Systems Initiative, Moody Farms**.** August 19, Fremont, IN. approx.100 farmers and agric. professionals in attendance.

4. Weil, Ray. 2015. Lessons Learned from Chesapeake Bay**-** Soil Organic Matter Management for Nutrient Cycling and Agricultural Sustainability. Keynote talk. The Conservation Cropping Systems Initiative and Bartholomew County Soil and Water Conservation District. Columbus, IN. August 20, 80 farmers and agric. professionals in attendance.

5. Weil, Ray. 2016. Creativity in Cover Cropping Systems for Farm Profitability and Clean Water. Invited Presentation to Howard County Extension Winter Ag Meeting. 17 Feb. 2016. Glenwood, Md. 60 farmers and ag professional in attendance.

6. Weil, Ray. 2016. Managing Plants for Better Soils. Keynote Talk for Spring Growth Conference on Soils. Maine Organic Farmers and Gardeners Association (MOFGA), Common Ground Education Center, Unity, Maine. March 5, 2016. 80 farmers in attendance.

We continued research collaboration with USDA/ARS scientists at Beltsville Agricultural Research Center (see Poffenbarger et al, above). Hanna Poffenbarger was my MS student.