**Annual Report: 2015**

**Report Information**

Annual Meeting Dates: 06/23/2015 - 06/24/2015
Period the Report Covers: 07/01/2014 - 06/22/2015

**Participants**

**Brief Summary of Minutes**

See attached Copy of Minutes file below for NC1178's June 2015 annual report.

**Accomplishments**

In Kansas, residue removal effects on corn yields were studied at three sites (Ottawa, Colby, and Hugoton). Residue was removed at 0, 25, 50, 75, and 100%. One site is in eastern Kansas, and the others are irrigated sites in western Kansas. Crop grain yield is measured annually and soil organic C and bulk density are measured every other year in odd years. There have been few instances where crop residue removal has been detrimental to corn yields. Removal has led to increased crop yields at the irrigated Colby site where irrigation is used to double the natural precipitation each year. Corn yields are high, thus residue production has been high, and removal is leading to increased crop yields at Colby in this high-yielding environment. At the rainfed Ottawa site, differences in crop yields were observed in the first two years of the study, but have not been observed since then. Soil data is collected every two years, and has not yet been compiled at the writing of this progress report.

In Illinois, data collected over a 20-year period at Dixon Springs, ILL, was used to develop a new protocol for more accurately measuring the C removed from the atmosphere and subsequently sequestered in the soil as soil organic C. Researchers know in general that no-till is often better than conventional tillage at building or retaining more of the organic matter in the soil, which is important to crop productivity. However, this does not mean that no-till is necessarily sequestering atmospheric C. It is often just losing C at a lower rate than conventional tillage.” Cover crops were proposed to reduce the loss of gas fluxes and to sequester soil organic C on sloping and eroding soils with a corn soybean rotation. The effects of cover crops on 3 tillage systems was studied for 12 years. Cover crops were found to reduce the soil organic C-rich sediment loss from plots and to sequester soil organic C for no-till, chisel plow, and plow tillage systems.

In Iowa, the short-term and long-term impacts of different corn residue removal rates, N fertilization rates, and tillage systems on soil, air, and water resources were studied. A study was established in fall of 2008 on the Iowa State University Agronomy Research Farm west of Ames, IA and the Armstrong Research and Demonstration Farm southwest of Atlantic, IA. The main treatment is tillage practice (no-till and chisel plow), which was split into three different corn residue removal rates (0, 50, and 100%), The major outcomes of this project over the past five years include the effect of residue removal on (1) amount of C and nutrients removed and returned to the soil, (2) soil physical properties such as bulk density and water infiltration, (3) soil C sequestration potential, (4) soil gas emissions, (5) residue decomposition in the field and nutrient release to soil, and (6) changes in N, P, and K use and fertilization requirements. Findings of this research included: no negative impacts on corn yield due to crop residue removal. Improvement in corn yield was observed with the residue removal, especially on wet and cold poorly-drained soils with continuous corn. Removing 50% or greater of corn crop residue led to a significant decrease in soil C sequestration potential and an increase in CO2 emission from soil under both chisel plow and no-tillage systems.

In Nebraska, a study was conducted to assess water and wind erosion potential, soil physical properties, soil organic C pool, and related properties under perennial warm-season grasses as compared with corn with and without 50% stover removal in an agriculturally marginal land (poorly drained field) in eastern Nebraska. Wet soil aggregate stability of the soil did not differ among the three perennial grass treatments and corn without stover removal. The aggregate stability under corn with 50% residue removal, however, was significantly lower than under perennial grasses and corn without residue removal treatments. These results indicate that perennial grasses maintain or improve soil structural stability or quality, whereas corn stover removal can have negative effects. Similarly, dry aggregate stability of the soil did not differ among the three perennial grass treatments and corn without stover removal. The dry aggregate stability under corn with 50% residue removal, however, was lower than under perennial grasses and corn without residue removal treatments. Effect of growing perennial grasses on dry aggregate stability is positive, whereas the effect of corn stover removal is negative. The reduced dry aggregate stability suggests that residue removal can increase risks of wind erosion. Wind erosion is a major concern in this region. There were no differences in soil organic C and particulate organic matter among the treatments.

In North Dakota, 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. 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 soil organic C analysis at this site. Wind erodible fraction (<0.84mm) increased with increased corn residue removal, field moist water stable aggregate fraction decreased with increase in residue removal, water infiltration rate decreased with increased residue removal, and little effect on soil organic C changes and N mineralization were observed.

In Ohio, the impacts of residue removal on soil properties and crop growth were assessed. Long-term field experiments on residue management under no-till system of seedbed preparation were established in 2004 at the experimental farm of the North Appalachian Experimental Watershed of USDA-ARS at Coshocton, Ohio. The site at South Charleston has a Miamian silt loam soil, and that at Hoytville has poorly drained clay loam soil. Treatments involved crop residues retention rates of 0, 25, 50, 75, 100 and 200%. The same experiment was established again in 2011, at Coshocton, in close proximity to that established in 2004, to assess the impact of the duration of residue removal on soil properties and crop yield. Therefore, there are four experiments on residue removal rates in Ohio, under NC-1178, two at Coshocton and one each at South Charleston and Hoytville. At Coshocton, there were no differences in agronomic yield among the residue removal treatments. For the 2004 experiment, the trend of the highest grain yields was observed for the 100% residues retention treatment. For the 2011 experiment also, there were no significant differences among treatments neither for the grain nor the stover yield. At the Hoytville site, while there were no significant differences in grain yield for this poorly drained and heavy-textured soil on a flat terrain, the least yield of 8.4 Mg/ha was observed for the 200% residue retention treatment. At the South Charleston Site, residue removal rates had no significant impact on grain and stover yields in 2014 for a well-drained soil of loamy texture at South Charleston, Ohio. Overall, there were small or no negative effects of residue removal on corn yields.

In South Dakota, a study was conducted to assess the impacts of corn residue and cover crops on some of the soil quality parameters. The experimental site was located in Brookings County, South Dakota (SD) at the USDA-ARS North Central Agricultural Research Laboratory on a silty clay loam soil. The treatments included: three different residue removal rates: low residue removal (LRR), medium residue removal (MRR), and high residue removal (HRR), and cover crop and no cover crop. The LRR treatment consisted of harvesting only the corn grain, leaving all other plant materials on the soil surface, MRR consisted of harvesting the grain and then chopping the leftover stalks to be windrowed and baled, and the HRR consisted of cutting the stalks 0.15 m from the ground and removing that portion of the plant. Data from this study show that in general crop residue removal significantly impacted the soil properties, however, little differences were observed between cover crops and no cover crops. Corn residue removal and cover crop impacted soil properties such as soil organic C, microbial activity, water stable aggregates, and wettability of the soil for the 0-5 and 5-15 cm depths. The LRR treatment resulted in higher soil organic C concentrations thus enhancing the aggregate stability compared to other treatments (MRR and HRR). The presence or absence of a cover crop did not have a significant impact on microbial activity for any of the three years (2008, 2009 and 2011). Results from this study concluded that removal of high residue lead to soil organic C decomposition and affect soil properties and soil quality, therefore, maintaining LRR and using the cover crop can improve the soil quality. However, a long-term study needed to assess the impacts of cover crop and residue removal on soil quality.

In Wisconsin, a site was selected and plots established in Fall 2010 at a location in south-central Wisconsin for assessing the impact of corn stover harvest on water runoff, soil erosion, crop productivity, and soil quality parameters (e.g., soil organic C, infiltration, aggregate stability, nutrient content, etc.) on slopping land. Additionally, the impact of different corn planting configurations, such as higher seeding rate and narrow row spacing, is been investigated to establish the potential to mitigate runoff and erosion. This project is also comparing the biomass production potential and environmental impacts of these corn production systems to switchgrass. All crops are grown and harvested using recommended practices from the University of Wisconsin-Extension. Harvesting corn stover reduced grain production 2 out of 3 years. The largest decrease in grain yield was 14.3% in 2013. A severe drought during the 2012 growing season affected most of the Midwest and affected productivity at this site. There was a 2.0% increase in grain yields when the stover was harvested, but this increase is minimal when compared to the decreases caused by the harvesting stover practices in 2012 and 2013 (10.9 and 14.3% decrease, respectively). Biomass production with switchgrass was greater than corn for all three growing seasons. Water runoff data show a trend of greater runoff during the growing season when corn stover is harvested (Fig. 3). Stover harvest increased runoff volumes by 38.0, 38.5, and 4.0% when compared to leaving the corn stover residue on the soil surface in 2012, 2013, and 2014, respectively. In general, runoff from switchgrass was lower than any of the corn systems, with runoff from switchgrass been 17% lower relative to the stover not harvested management. Further, planting corn in a narrow (15-inch) rows had similar runoff as switchgrass. Results indicate runoff and sediment losses from switchgrass during the establishment year of 2011 were similar to corn systems, given that switchgrass establishes slowly and produces little biomass the first year after planting. Similarly, there were no appreciable differences in runoff volumes and sediment losses between corn systems, but there was a trend of lower runoff volumes with narrow corn planting spacing (15-inch) during the 2011 establishment season.

In Guam, a study is evaluating the different cropping practices including the conventionally tilled cropping where the soil disturbances are at maximum including the removal of the crop residue from the soil surface. Preliminary results from the study have shown that the higher percent C content of the soil under the no-tillage was due to no disturbances to the soil surface during the study period. On the reduced till treatment plots the percent C content also remained high next to the NT plots mainly due to the reduced disturbances as compared to conventional tillage practices. On the other hand, it was shown that the percent C content in the conventional tilled plots were the lowest for all sampling events while the conventional tilled with sunn hemp rotation had higher C as compared to conventional tillage treatment plots mainly due to the green manure effect that added more organic matter as well as C to the soil as the result of sunn hemp biomass production as rotating crop and its incorporation into the soil between the main crops. Same trend have been observed in the previous years with NT showing the highest amount of C content compared to the other treatments under the study. Although not conclusive the accumulated data for this study has shown that tillage systems affect the amount of soil C storage/sequestration, hence the C dioxide emission into the atmosphere.

**Impact Statements**

1. Decisions concerning the harvesting of crop residues for bioenergy feedstock need to be made with caution and on a site-specific basis.
2. Cover crops can sequester C and reduce sediment and soil C loss.
3. Corn residue removal at 50% can reduce soil structural quality compared with perennial warm-season grasses and corn without residue removal near the surface.
4. Switchgrass can be a better performing biomass production system than corn since it has significantly greater yields with less inputs, and lower water runoff and sediment losses.
5. Conservation farming practices such as no-till has potential to increase soil organic C sequestration as disturbances within the plow layers was reduced to minimum and/or to zero.
6. Tillage systems and residue removal affect the amount of soil C content especially near the soil surface.

**Publications**

Peer-reviewed published manuscripts, including book chapters (29):

1. Platt, Jenna, DeAnn Presley, Peter Tomlinson, Johnathon Holman, Michelle Busch-Hilburn and Yuxin He. 2015. Soil Erodibility, Phosphorous, and Microbial Biomass within a Switchgrass Stand . Transactions of the Kansas Academy of Science. 118:113-118.

2. Busch, M., and D.R. Presley. 2014. Cedar afforestation of prairie alters soil properties on a decadal time scale. Soil Horizons. doi:10.2136/sh13-05-0015

3. Olson, K.R. and L W Morton. 2015. Sinkholes and sand boils during 2011 record flooding in Cairo, Illinois. Soil Water Conservation 70 (3): 49A-54A.

4. Olson, K.R and M.M Al-Kaisi. 2015. The importance of soil sampling depth for accurate account of soil organic C sequestration, storage, retention and loss. Catena 125(2): 33-37.

5. Olson, K.R. and L W Morton. 2015. Impacts of levee breaches, flooding, and land scouring on soil productivity. J. Soil Water Conservation.70 (1): 5A-11A.

6. Olson, K.R, M.M Al-Kaisi., R. Lal and B. Lowery. 2014. Examining the paired comparison method approach for determining soil organic C sequestration rates. Journal of Soil and Water Conservation 69(6): 193A-197A.

7. Olson, K.R. and L W Morton. 2014. Runaway barges damage Marseilles lock and dam during 2013 flood on the Illinois River. J. Soil Water Conservation. 69(4): 104A-109A.

8. Olson, K.R.,S.A. Ebelhar and J.M. Lang. 2014. Long-term effects of cover crops on crop yields, soil organic C stocks and sequestration. Open Journal of Soil Science 4(8): 284-292.

9. Olson, K.R.,A.N. Gennadiyev, R.G. Kovach, and T.E. Schumacher. 2014. Comparison of prairie and eroded agricultural lands on soil organic C retention (South Dakota). O.J. of Soil Science 4(8): 135-150.

10. Guzman, J.G., M. Al-Kaisi, and T. Parkin. 2015. Greenhouse Gas Emissions Dynamics as Influenced by Corn Residue Removal in Continuous Corn System. Soil Sci. Soc. Am. J. 79:612–625. doi:10.2136/sssaj2014.07.0298

11. Guzman, J. and Al-Kaisi, M. 2014. Residue removal and management practices effects on soil environment and C budget. Soil Sci. Soc. Am. J. 78: 609-623.

12. Mahdi M. Al-Kaisi and Jose G. Guzman. 2013. Managing crop residue removal and soil quality changes. PM3052A, Extension Publication, Iowa State University, Ames.

13. Mahdi M. Al-Kaisi and Jose G. Guzman. 2013. Managing crop residue removal and soil organic matter. PM3052B, Extension Publication, Iowa State University, Ames

14. Kibet, L.C., H. Blanco-Canqui, and P. Jasa. 2015. Long-term tillage impacts on soil organic matter components and related properties on a Typic Argiudoll. Soil & Tillage Research (in press).

15. Ozaslan A., M. Parlak, H. Blanco-Canqui, W.H. Schacht, J.A. Guretzky, and M. Mamo. 2015. Patch Burning: Implications on water erosion and soil properties. J. Environ. Qual. doi:10.2134/jeq2014.12.0523 (in press).

16. Blanco-Canqui, H., G.W. Hergert, and R.A. Nielsen. 2015. Cattle manure application reduces soil's susceptibility to compaction and increases water retention after 71 years. Soil Sci. Soc. Am. J. 79:212-223.

17. Blanco-Canqui. H., J. Gilley, D. Eisenhauer, and A. Boldt. 2014. Soil C accumulation under switchgrass barriers. Agron. J. 106:2185-2192.

18. Kenney, I., H. Blanco-Canqui, D.R . Presley, C.W. Rice, K. Janssen, and B. Olson. 2014. Soil and crop response to stover removal from rainfed and irrigated corn. Global Change Biol. Bioenergy. 7:219–230.

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

20. 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.

21. Beniston, J.W., Shipitalo, M.J., Lal, R., Dayton, E.A., Hopkins, D.W., Jones, F., Joynes, A., Dungait, A.J. 2014. C and macronutrient losses during accelerated erosion under different tillage and residue management. European Journal of Soil Science, DOI: 10.1111/ejss.12205

22. Lal, R. 2014. Biofuels and C offsets. Biofuels. 5(1), 21-27.

23. Lal, R. 2014. Societal value of soil C. Journal of Soil and Water Conservation 69: 186A-192A.

24. Lal, R. 2015. Sequestering C and increasing productivity by conservation agriculture. J. Soil Water Conserv. 70(3):55A-62A

25. Lal, R. 2015. A System Approach to Conservation Agriculture. Journal of Soil and Water Conservation. (In press)

26. Olson, K. R., M. Al-Kaisi, R. Lal, B. Lowery. 2014. Experimental considerations, treatments and methods in determining soil organic C sequestration rates. Soil Sci. Soc. Am. J. 78:348–360 DOI:10.2136/sssaj2013.09.0412

27. Osborne, S. L., Johnson, J. M. F., Jin, V. L., Hammerbeck, A. L., Varvel, G. E., and Schumacher, T. E. (2014). The impact of corn residue removal on soil aggregates and particulate organic matter. BioEnergy Research, 1-9.

28. Golabi1 Mohammad H, S.A. El-Swaify2, and Clancy Iyekar1 ( 2014). Experiment of ‘No-tillage’ farming system on the volcanic soils of tropical islands of Micronesia? International Soil and Water Conservation Research. Vol. 2, No. 2, June 2014. Pp 30-39.

29. Golabi, M. H., Pavlina Fojtikova, Kawika Davis, and Robert Mendi (2014). Soil C Sequestration. Brochure supported by the USDA/NIFA grant no. 61-1F-243018-R-5200510.