**Objectives:**

Transfer the information to producers in several formats, including but not limited to, inclusion in soil health field days, winter programming and the CTC (Conservation Tillage Conference), videos and circulars.

**Achievements:**

* Visited the NWS and local farmer fields in Grafton, Australia to learn from sugarcane growers how they are incorporating soybeans and cover crops into their rotations and to share research data pertaining to reducing tillage.
* Executive Summary for Tillage Research (repeat from the last quarterly update):

This project evaluates soil warming and drying, crop yields, and soil health among chisel plow, strip till with shank, strip till with coulter, and vertical tillage practices using full-sized tillage equipment. This research is located on both tile drained and naturally drained clay and loam soils in the Red River Valley to asses if tile drainage does or does not change the performance (and thus producer preference) of tillage for each soil type and drainage management system. The ultimate goal of this project is to improve soybean and corn yields while at the same time building soil health and to provide information from this research to producers through field days, winter programs, videos, extension circulars, etc.

There are many advantages of reducing soil tillage for building soil health.  However, the idea of reducing tillage oftentimes causes concerns of yield reductions due to cool and wet soils in the poorly-drained landscape that dominates much of the Red River Valley.

In 2014 two farms (near Barney, ND and Fergus Falls, MN) and a third farm in 2015 (SHARE Farm near Mooreton, ND) were solicited to evaluate a variety of conservation tillage practices in a multistate collaboration with NDSU and UofM. These farms ranged in soil series with sandy, loamy, and clayey textures, to provide farmers with realistic expectations for over an extent of 67 million acres in the region.

Among these tillage practices, we have evaluated soil moisture and temperatures throughout the year, a variety of soil health indicators, and crop performance.

During each spring and early summer, the chisel plow and strip-till berms consistently had the driest and warmest soil conditions followed by the areas between the strip-till berms and then the vertical till as the wettest and coolest soil conditions. Most notably, these drying and warming differences among the tillage practices where largest at the farm with sandy soils, moderate at the farm with loamy soils (see figures below), and minimal at the farm with clayey soils. As the surface of these clay soils dry, we suspect that moisture is more readily replaced by the capillary rise of deeper water than what occurs in the sandy soils.
However, the trends in soil moisture and temperatures did not cause any differences in soybean or corn plant populations, growth, or yields. In fact, soybean yield was not affected by tillage at any of the farms during the past four growing seasons, except on the farm with sandy soils in 2018. At that farm, both strip tills yielded 3.7 bu/ac more than either chisel plowing or the shallow vertical till. Yield differences were observed in corn during some years, but these differences were not consistent year-to-year, farm-to-farm, or among the tillage practices. Instead, benefits or consequences to corn yields were explained by whether timely fertilizer application and placement was done or whether soil conditions were too wet for proper tillage operations.

**Challenges:**

None

**Tech Transfer:**

**PUBS/TECH TRANSFER**
The tillage research data has been used in over 100 presentations and 10 publications have been given/written by Jodi DeJong-Hughes and Aaron Daigh, in MN, ND and surrounding states.
Academic Publications and Posters

1. Daigh, ALM, Z. Leitner, C. Gasch, J. DeJong-Hughes. 2019. Temporal Fluctuations of PLFA-Derived Microbial Community Structures within the Crop Growing Season. ASA Tri-Societies Annual Conference. San Antonio, TX.
2. Daigh, A.L.M., Ghosh, U., DeJong-Hughes, J. & Horton, R. (2018). Spatial response of near-surface soil water contents to newly imposed soil management. Agricultural & Environmental Letters. 1-4.
3. DeJong-Hughes, J., A.L.M. Daigh, A. Wick. August 2017. Effect of Crop Residue Management on Grain Yield and Soil Properties in Minnesota. Soil and Water Conservation Society (SWCS) Annual Conference oral presentation. Madison, WI.
4. DeJong-Hughes. J. October 2017. Including Private and Public Partners to Improve Impact and Further the University's Soil Health Message. ASA Tri-Societies Annual Conference. Tampa, FL.
5. Leitner, Z. R., A.L.M. Daigh, C. Gasch, J. DeJong-Hughes, A. Wick. October 2017. Tillage Effects on Temporal Dynamics of Soil Microbial Community. ASA Tri-Societies Annual Conference. Tampa, FL.
6. Daigh, A.L.M., J. DeJong-Hughes, A. Wick, R. Horton. October 2017.  Spatial response of near-surface soil water contents to newly imposed soil management. Soil and Water Management and Conservation General Poster Session.

1. Alghamdi, R., A.L.M. Daigh, J. DeJong-Hughes, A.F. Wick. 2016. Soil Heating and Drying Among Reduced Tillage Practices in Frigid Corn-Soybean Fields. Poster at American Society of Agronomy (ASA) abstract International Conference, Phoenix, AZ.
2. Aaron Lee M. Daigh and Jodi DeJong-Hughes. Fluffy soil syndrome: When tilled soil does not settle. 2016 Journal of Soil and Water Conservation 72(1):10A-14A Feature. [www.swcs.org](http://www.swcs.org/)

Professional Publications

1. DeJong-Hughes, J., Daigh, A.L.M. Upper Midwest Tillage Guide. November 2017. University of Minnesota Extension publication. <https://www.extension.umn.edu/agriculture/soils/tillage/tillage-guide-implements/>
2. Notwatski, J., G. Endres, J. DeJong-Hughes, D. Aakre.  Strip Till for Field Crop Production (Revised June 2017). North Dakota State University fact sheet #AE1370. <https://www.ag.ndsu.edu/publications/crops/strip-till-for-field-crop-production>