Eastern South Dakota Soil and Water Research Farm

Purpose: to find solutions to national and regional concerns related to soil and water conservation and the efficiency and sustainability of agricultural production.

Goal: to conduct research and provide technology transfer in areas that are directly or indirectly related to clean water, clean air, soil stewardship, and sustainable agriculture.

Research and technology transfer activities on the farm are conducted by a partnership including: USDA-Agricultural Research Service, USDA-Natural Resources Conservation Service, South Dakota State University, South Dakota Agricultural Experiment Station, and Brookings County Conservation District.

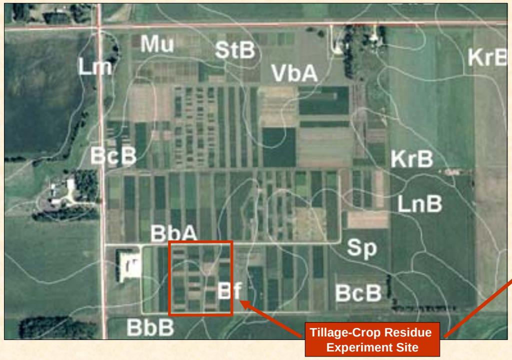
Farm Board of Directors – 2005 to 2006

The 150 acre farm is located approximately two miles north of the campus of South Dakota State University.

Aerial View of the Eastern South Dakota Soil and Water Farm

Soil Taxonomy and Map Unit Names

The soils found on this farm are characteristic of those found in northeastern South Dakota and west central Minnesota and are similar to soils common to the northern corn belt.



Symbol	Map Unit Name (US Soil Taxonomy)
Bf	Brookings silty clay loam (Fine-silty, mixed, superactive, frigid Aquic Hapludolls)
VbA	Vienna-Brookings complex: Vienna silt loam and Brookings silty clay loam (Fine-silty, mixed, superactive, frigid Aquic Hapludolls and Fine-loamy, mixed, superactive, frigid Calcic Hapludolls)
StB	Strayhoss-Maddock complex (Strayhoss loam and Maddock sandy loam) (Fine-loamy over sandy, mixed, superactive, frigid Calcic Hapludolls and Sandy, mixed, frigid Entic Hapludolls)
Sp	Spottswood clay loam (Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aquic Hapludolls)
BbA	Barnes clay loam: 0-2% slopes (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls)
BbB	Barnes clay loam: 2-6% slopes (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls)
BcB	Barnes-Buse loams (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls and Fine-loamy, mixed, superactive, frigid Typic Calciudolls)

Presented at
ASA/CSSA/SSSA Annual Meeting
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New Orleans, LA

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Research Results from the Eastern South Dakota Soil and Water Research Farm:

Tillage Management and Previous Crop Effects on Soil Physical Properties and Maize Yield

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North Central Agricultural Research Laboratory, USDA-ARS, Brookings SD; Plant Science Department, South Dakota State University, Brookings, SD

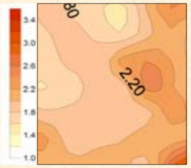
Attributes and Risks of No-Till Farming

1. No-till farming practices are important components of sustainable agriculture systems.
2. In no-till soil management, the residue mulch that remains on the soil surface after crop harvest protects the soil from wind and water erosion, smothers weeds, reduces evaporation from the soil surface, and helps increase soil organic matter.
3. Research has shown that the residue mulch also delays soil warming in the spring which causes slower seed germination and less vigorous early crop growth.
4. Soils under no-till management tend to have increased bulk density and penetration resistance when compared with tilled soils.
5. These contrasting characteristics of no-till farming practices add extra dimensions of complexity and uncertainty to sustainable agriculture, causing some producers to view no-till farming as a risky practice in the northern corn growing regions.

Adoption of No-Till Soil Management in South Dakota

Effects of Tillage and No-Till Soil Management on Penetration Resistance

Plots in late summer

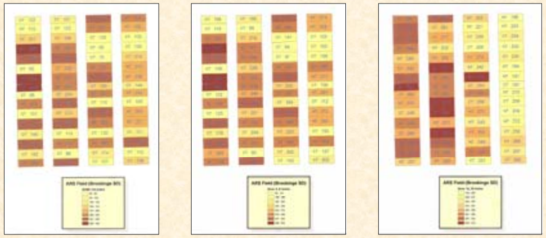


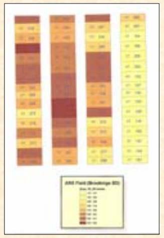
Soil carbon (g/kg) top 20 cm

Observations:

1. In the top 20 cm, soil penetration resistance is greater under no-till soil management than under tillage.
2. This increased penetration resistance in no-till appears to be independent of soil type and soil carbon concentration.
3. Below 30 cm soil depth, soil management treatments seemed to have little impact on penetration resistance.
4. Below 30 cm soil depth, the Barnes clay loam had larger penetration resistance values than the Brookings silty clay loam.

7.5 to 15 cm soil depth | 15 to 22 cm soil depth | 30 to 37 cm soil depth | 82 to 90 cm soil depth



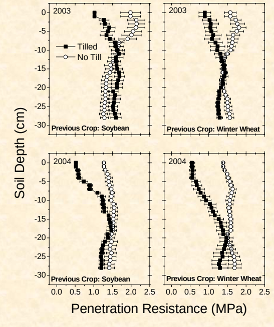


Materials and Methods

Main plots: Tillage (fall chisel, spring disk/harrow) or no-till (since 1996).
Sub plots: Rotation (corn/soybean or corn/corn/soybean/spring wheat/winter wheat)
Penetration Resistance: Veris Profiler 3000 during (Fall 2004) or Eijkelkamp recording penetrometer fitted with a 1-cm 60-degree cone (mid-summer 2003 and 2004).

Soil Physical Properties, Previous Crop, and Grain Yield

Research Objectives: to characterize soil physical properties, maize yield and seed composition under tilled and no-till soil management, and to investigate the potential role of the previous crop on these parameters.



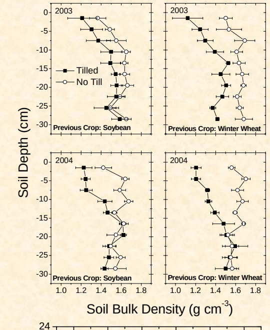
Root growth is inversely correlated with soil bulk density and penetration resistance.

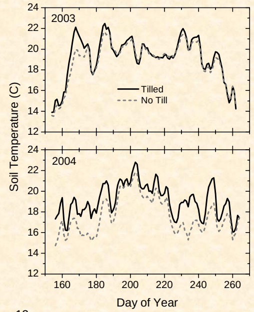
Higher soil surface bulk density and penetration resistance values associated with no-till soil management in the present study may have had deleterious effects on maize root system growth.

Root growth will likely be significantly impaired at soil density values greater than 1.4 g cm^{-3} or penetration resistance levels greater than 2.0 MPa.

The bulk density readings recorded under no-till in the top 30 cm of the soil profile exceeded this critical value while penetration resistance exceeded this critical value in 2003.

Thus root growth may have been reduced under the no-till treatment compared with the tilled treatment.

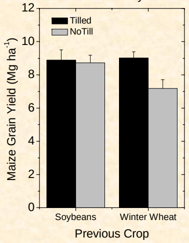




The figure to the left shows soil temperature (30 cm depth) in tilled and no-till plots for the 2003 and 2004 growing season where the previous crop was winter wheat.

These yearly differences in soil temperature may result from much lower air temperatures, greater precipitation, and less pan evaporation in 2004 than 2003.

Thus, soil temperatures from planting until the maize crop research the V6 development stage were between 4 to 7 C greater in tilled plots than no-till plots with heavy residue cover.



The figure to the left shows grain yield, combined over the 2 years of the study, for corn grown after soybeans or winter wheat with tilled and no-till soil management.

No-till corn following soybean as well as tilled corn following soybean or winter wheat all had similar yields.

No-till corn following winter wheat had lower yields than the other treatments. Cooler soil temperatures under no-till soil management following winter wheat (compared with the tilled treatment) may have contributed to these lower yields.

Conclusions

Higher bulk density and penetration resistance levels under no-till soil management, along with cool soil conditions that typically occur in the spring in eastern South Dakota, could work together to reduce maize yield under no-till in soils with low internal drainage.

It is likely that additional research and development into residue management systems or strip tillage systems will be needed to develop crop and soil management systems that address this problem.