Soil Heating and Drying among Reduced Tillage Practices in Frigid Corn-Soybean Fields

Rashad Alghamdi[1], Aaron L.M. Daigh[1], Jodi DeJong-Hughes[2], and Abbey Wick[1]
North Dakota State University[1], University of Minnesota[2]

OBJECTIVES

Determine the effects of reduced tillage practices on:

- Soil temperatures prior to and during the growing season
- Soil water contents prior to and during the growing season
- Soil penetration resistance throughout the growing season
- Crop yields

MATERIALS & METHODS

Reduced tillage practices included:

- Vertical till (VT)
- Strip till with shanks (ST-S)
- Strip till with coulters (ST-C)
- Chisel plow (CP)

Tillage plots (12 x 550m per plot) were installed at three producer farms in the Red River Valley of North Dakota and Minnesota during 2014 and 2015.

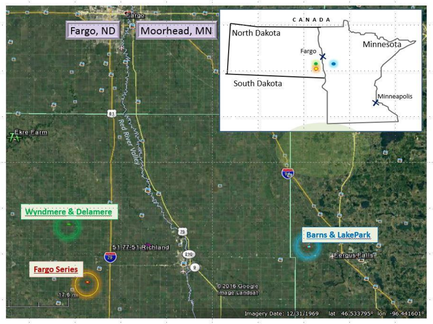


Figure 1: Field site locations in Richland County, ND and Ottertail County, MN

Soil Series/Textures
Wyndmere fine sandy loam
Delamere fine sandy loam
Barnes loam
Lakepark clay loam
Fargo silty clay

Tillage treatment were replicated three times in a randomized complete block design at each farm. Sampling transects were set up for five soil series among the three farms.

Soil temperature (T) & volumetric water contents (θ) were measured near the soil surface using thermo-couples and Decagon GS3 sensors. All temperature readings were taken at 0.5, 2, 5, and 12cm. Within each plot, three subplot soil T and θ measurements were taken for VT, CP, within the strip till zones of ST-S and ST-C, and between the strip till zones of ST-S and ST-C. These soil T and θ measurements were made bi-weekly from 76 to 282 day of year (DOY) in 2015 and from 58 to 252 DOY in 2016

Additional soil sensors (Decagon 5TM) were deployed with EM50G dataloggers for select soil series at each sites and treatment at depths of 5, 10, 25, and 40 cm depths with measurements take at 30 minute intervals throughout the year.

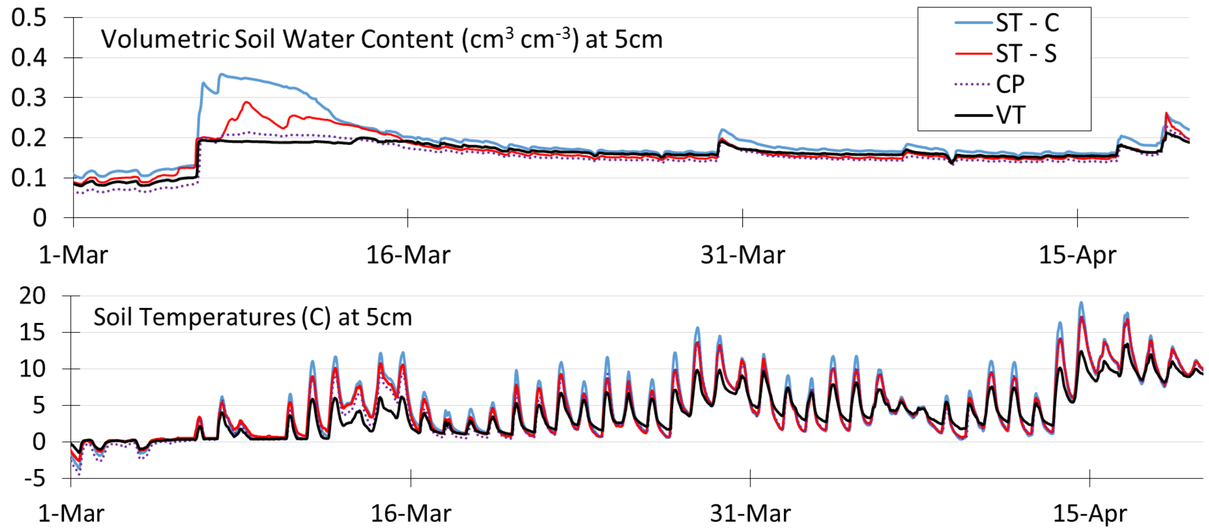
Soil penetration resistance was measured using a soil compaction meter (SC 900). Penetration resistance was conducted the in early growing season near planting, after full canopy, and again near harvest in 2016.

Figure 2: Aerial image of the Fargo soil series tillage plots at planting in 2016, Richland Co., ND

Soil T, θ, and penetration resistance among VT, CP, ST-S, ST-C were evaluated with a Mixed model ANOVA for each soil series individually in SAS 9.4. Measures were separated using Tukey at the 0.05 significance level.

RESULTS & DISCUSSION

Early Season Soil Water Contents and Temperatures 2016: Wyndmere fine sandy loam



Mean Growing Season Soil Water Contents ($cm^3\ cm^{-3}$)

Soil Series/Textures	VT	ST-S in row	ST-S btw row	ST-C in row	ST-C btw row	CP
Wyndmere fine sandy loam	0.29b	0.25c	0.31a	0.26c	0.30ab	0.23d
Delamere fine sandy loam	0.30b	0.27c	0.32a	0.28c	0.31ab	0.25d
Barnes loam	0.30b	0.24d	0.33a	0.28c	0.32ab	0.22d
Lakepark clay loam	0.29b	0.26c	0.32a	0.27bc	0.33a	0.22d
Fargo silty clay	0.23b	0.22b	0.27a	0.21b	0.27a	0.18d

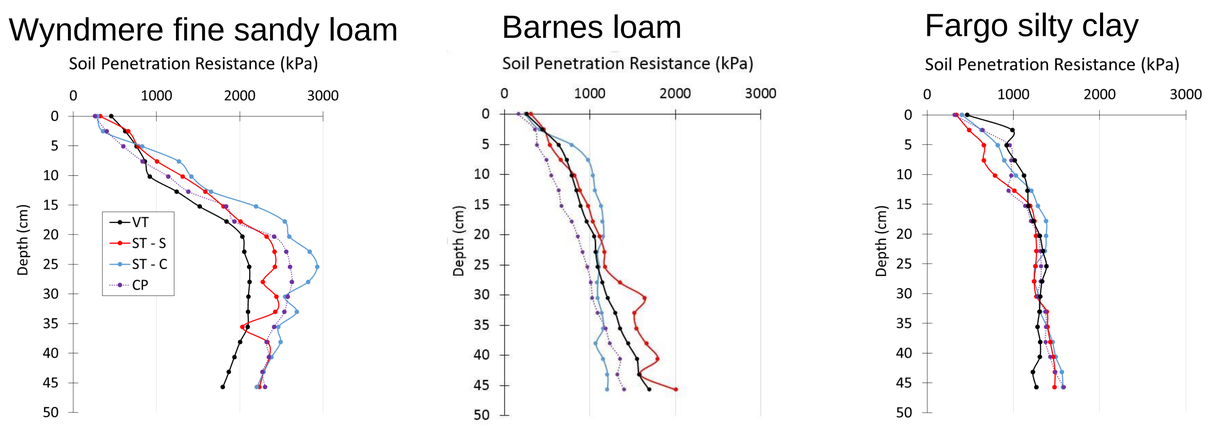
Different letters within a soil series/texture (i.e., within a row) are significantly different at the 0.05 level using Tukeys

Mean Growing Season Soil Temperatures (°C)

Soil Series/Textures	VT	ST-S in row	ST-S btw row	ST-C in row	ST-C btw row	CP
Wyndmere fine sandy loam	16.4c	17.0b	16.4c	16.9bc	16.5c	19.3a
Delamere fine sandy loam	16.0d	17.4b	16.9bc	17.3b	16.7c	20.3a
Barnes loam	15.3c	16.6b	16.6b	16.0bc	15.9bc	18.0a
Lakepark clay loam	15.7d	17.1b	16.2c	17.0b	16.4c	19.0a
Fargo silty clay	17.1c	17.8b	17.7b	17.6bc	17.5bc	19.5a

Different letters within a soil series/texture (i.e., within a row) are significantly different at the 0.05 level using Tukeys

Early Season Soil Penetration Resistance 2016



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