# Time Dependent Changes in Soil Hydraulic Conductivity at Till and No-Till Sites

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Soil hydraulic conductivity is important for understanding water and solute movement in soil. Field values of hydraulic conductivity, saturated and unsaturated, can be determined by tension infiltrometer measurements. However, few field studies have determined changes in hydraulic conductivity with time after a soil is tilled. Following a tillage operation, soil compaction can occur over time as a result of subsequent rain events. Soil hydraulic conductivity also changes with time. In this study, we investigated changes in field saturated and near saturated hydraulic conductivities over time at till and no-till sites.

A field at the Agricultural Engineering and Agronomy Research Farm near Ames, IA was tilled on July 17, 2017 to a depth of 20-cm with a roto-tiller, while the adjacent no-till field had not been tilled for 1 year. The soil surface of both fields was kept bare through October 2017 for measurements. Both fields had similar Nicollet loam soil. Tension infiltrometers were used to determine soil hydraulic conductivity of the till and no-till sites after subsequent rain events. At each measurement time, four locations in both the till and no-till sites were randomly selected for the infiltrometer measurements. Two locations in each field were used to measure infiltration into the natural soil surface, and the surface crust layer was first removed before making infiltration measurements at the other two locations in each field. At each measurement location, steady state infiltration measurements were made at tensions of 0 cm and 3 cm. Soil water content ( $\theta$ ) and soil bulk density ( $\rho_b$) were measured with core samples taken under the base of the infiltrometer after each infiltration measurement.

Saturated hydraulic conductivity values observed at 0 cm tension were larger than unsaturated hydraulic conductivity values observed at 3 cm tension. The relatively large decreases in infiltration rates from 0 cm tension to 3 cm tension indicated that macropore flow (pore radius > 0.5 mm) was dominant under saturated flow conditions. Differences between 0 cm tension values and 3 cm tension values were larger at the till site than the no-till site with the surface crust removed, and the differences increased with time. This indicates that the rates of macropore flow were largest at the till site with the surface crust removed. Saturated hydraulic conductivity of the natural soil surface remained somewhat stable over time, because the first rainfall event led to the formation of a surface crust which persisted throughout the season. Unsaturated hydraulic conductivity was relatively constant over time, but slight decreases did occur. With the surface crust removed, saturated hydraulic conductivity was larger than for the natural soil condition with a surface crust. Thus, the surface crust definitely impacted field soil hydraulic properties. The presence of the surface crust masked differences between the till and no-till treatments. In a few cases the field saturated hydraulic conductivity increased with time, due to earthworm activity. It is important to consider multifunctional effects of soil physical processes and biological activities when measuring hydraulic conductivity in real fields.

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