Several agricultural land management practices, such as cover crops and tillage, can influence soil physical and hydraulic properties, soil health indicators and crop productivity. This study evaluated the influence of cover crops and tillage management practices on soil physical and hydraulic properties. The objectives of this study included: (i) evaluate water retention and ability of the soil to transport water under saturated conditions (Ksat) for soils managed by cover crops and tillage, (ii) assess the influence of cover crops and tillage management on water infiltration into the soil, and (iii) evaluate heat transport properties for soils managed by perennial biofuel and cover crops. Two field sites were used for the study; the first and second objectives were conducted at Lincoln University Freeman Research Center while the third objective was conducted at University of Missouri Bradford Research Center. The cover crop grown at Freeman Research Center was Cereal rye (Secale cereal), while Cereal rye, Hairy vetch (Vicia villosa) and Austrian winter pea (Pisum sativum subsp. arvense) were grown at Bradford Research Center. The perennial biofuel crops at Bradford Research Center included giant miscanthus (Miscanthus x gigantus) and switchgrass (Panicum vergatum). The tillage treatments at Freeman Research Center included tillage using a moldboard plow to a depth of 15 cm (6 in.) and no-till. The soil at Bradford Research Center was managed with no-till. Intact soil samples were collected using soil cores that measured 76 by 76 mm (3 by 3 in.) for objectives one and three. These soil samples were taken in 2014 (objective one) and 2015 (objective three). Infiltrometers were used to measure infiltration rates for objective two during 2014 and 2015. Results showed that bulk density values for tillage were 13% lower compared with no-till management right after tillage. At the 0-10 cm (0-4 in.) soil depth, water content was significantly higher at the 0.0 and -0.06 psi soil water pressures for tillage compared with no-till management, right after spring tillage. However, this effect this not persist over time probably due to soil consolidation after some rainfall events. Tillage improved coarse mesopores (60 – 1000 µm diameter) by 32% compared with no-till; and this effect resulted in 87% higher Ksat values in tillage compared with no-till management. Cover crops improved macropores (> 1,000 µm diameter) by 24% compared with no cover crop; this can potentially increase water infiltration and reduce runoff. As a result of higher macroporosity, Ksat was higher in the cover crop compared with no cover crop management. This study demonstrated that the effects of tillage in improving some soil hydraulic properties may not persist over time. In 2014, cumulative infiltration was significantly higher under cover crop management compared to no cover crop management. In 2015, cumulative infiltration was numerically higher under cover crop management compared to no cover crop management. In both years, cumulative infiltration was numerically higher under tillage compared to no-till management. This study showed that cover crops can improve water infiltration and may reduce water and nutrient runoff which can lead to enhanced agricultural productivity. Results of the third objective showed that perennial biofuel crops (giant miscanthus and switchgrass) had 11% higher heat retention at saturation compared to row crops (cover crops and no cover crops). Cover crops compared to no cover crop had 18% higher volumetric water content at saturation and 26% higher soil organic carbon; this led to 13% higher heat retention compared to no cover crops. Row crops had significantly higher heat transport parameters compared to perennial biofuel crops. This study showed that perennial biofuel and cover corps can change soil thermal properties and enable the soil to better handle a more variable climate. Results from these studies showed that tillage may influence some soil properties temporarily; however, these influences may be diminish over time. Cover crops can improve soil physical and hydraulic properties and soil health indicators and this can lead to improved productivity. However, longer term studies are needed to evaluate these effects over time, especially with an
increasingly variable climate.