10. Effect of tile drainage on soil temperature in heavy clay soils

Project duration

- 2021

Objectives

To assess the impact of tile spacing's on soil temperature at two soil depths: 1 inch (seeding depth) and 6 inch (rooting depth) in spring.

Results

The soil temperature at two depths was not recorded in the spring or after seeding due to delay in the arrival of soil temperature sensors. However, sensors were installed in June and observations were recorded in late June. Soil temperature (both on the tiles as well as in between tiles) did not differ for 15- and 30-feet wide tile spacing's when compared with non-tiled land (Fig. 10.1). However, 45-feet spaced tiles had slightly greater temperature on the tiles as compared to non-tiled land.

Project findings

This test in 2021 was a preliminary test. This project would be conducted again in 2022 with replicated measurements. Temperature measurements will be commenced around mid-April and will be continued during the seeding / plant establishment phase of the crops.

Background / Additional resources / References

Removal of excess moisture or water in a waterlogged agricultural field facilitate timely field operations such as seeding and spray. Simultaneously, drainage either natural or artificial decreases heat capacity of the soil, raises soil temperature, thereby warms up and dries the soil quickly. Soil temperature governs the types and rates of chemical reactions in the soil. It also strongly influences biological processes, such as seed germination, seedling emergence and growth, root development, and microbial activity in the soil.

Tile drainage is considered an important agriculture practice to remove excess water or soil moisture from a waterlogged / saturated agricultural fields. Tile drainage practice is quite common in Mid-west and Northern Great Plains of United States. In Canada, this practice is common in Quebec and Ontario. In Manitoba, tile drainage is not common in Red River Basin. This region in Manitoba is a transition zone between humid climate of the east and arid climate to the west.

A common axiom among drainage practitioners is that tile drainage increases spring soil temperatures in cold and humid climates. In Minnesota, Jin et al (2008) evaluated the influence of different tile spacing's (narrow vs. wide tiles) on soil temperature at various soil depths during cropping season. They concluded that soil temperature differences (especially in May / June) were more evident on narrow tiles and in the fine textured soil. These researchers attributed temperature differences between a wet soil and a dry soil to soil type rather than soil moisture content. Thus, soil texture, color, and moisture play important roles in soil temperature through their influence on heat conduction and convection, the two most important processes of heat transport in soil.

This hypothesis regarding influence of tile spacing's on soil temperature in heavy clay soils has not been tested in Manitoba. PESAI site in Arborg has heavy clay soil with clay content of 70-80%. This site has different spaced (15', 30' and 45' wide tiles) tiled plots with three replications. In 2022, PESAI will conduct research to answer the following questions –

- Is there any difference in the soil temperature (in top 6 inches of the soil profile) between tiled and untiled land before and during seeding time?
- If the top soils are relatively warmer on tiles during spring, how early producers can start seeding (than on conventional land)?

References

Jin, C. X., Sands, G. R., Kandel, H. J., Wiersma, J. H., & Hansen, B. J. (2008). Influence of subsurface drainage on soil temperature in a cold climate. *Journal of Irrigation and Drainage Engineering*, *134*(1), 83-88.

Materials and methods

Soil type: heavy clay
Experiment design: Randomized complete block design
Replications: 3
Treatments – on tile, in-between tiles and control
Three tile spacing's (15-, 30- and 45-feet wide) and non-tiled land.
Measurements - Soil temperature was measured on the tiles as well as in between the tiles during June 21- July 2, 2021. These measurements were compared with temperature from non-tiled land. Soil temperature was measured daily at two soil depths (1 inch & 6 inch) using Omega HH11C thermometer.

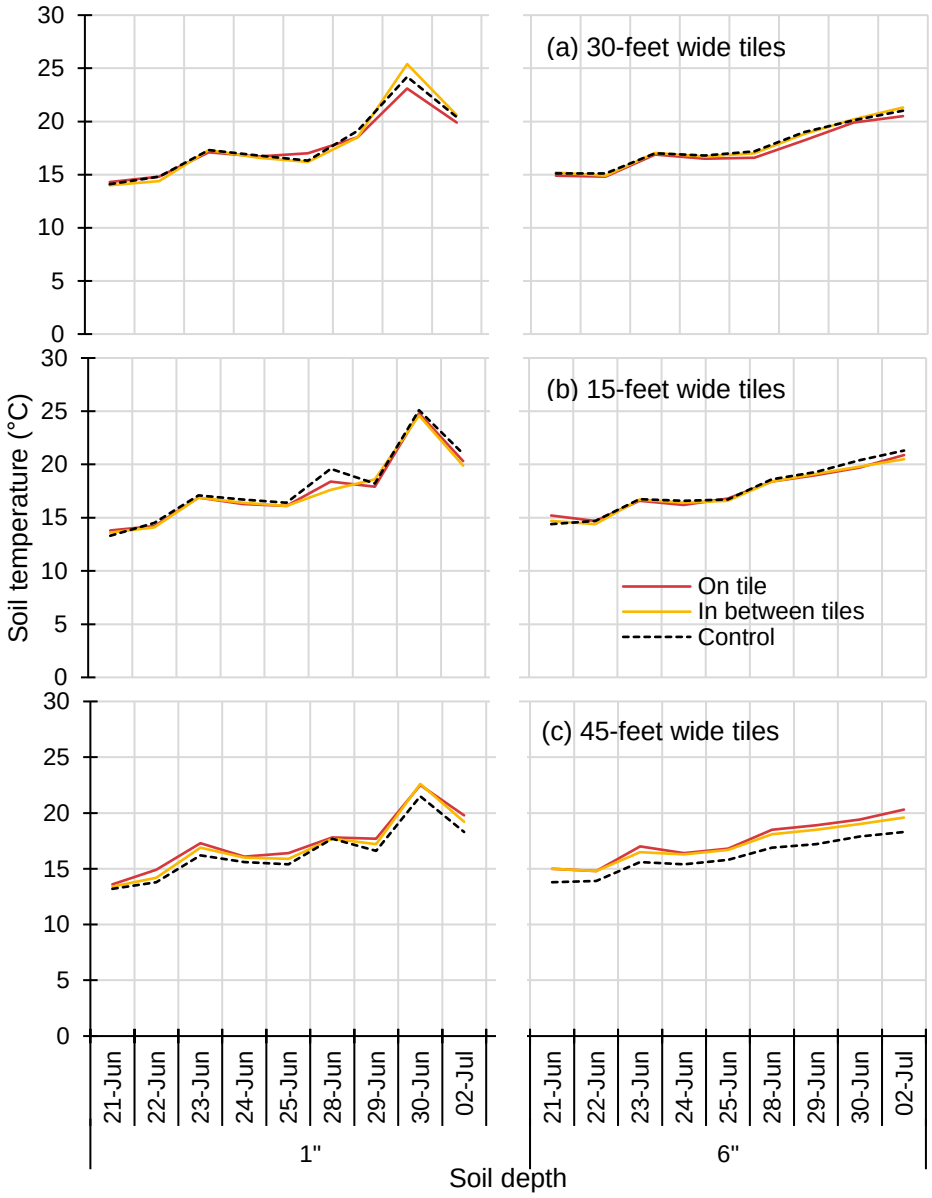

Fig. 10.1. The observed soil temperatures at two soil depths (1-inch and 6-inch) on (a) 30-feet (b) 15-feet and (c) 45-feet spaced tiled plots during late June and early July, 2021.