Water Table Level as Influenced by Rainfall, Crop Requirements, and Tiling Method During the Past Four Years

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Introduction

In 1979, a portion of the research farm was pattern tiled. Two drainage installation methods were compared: a conventional trenching machine (used widely prior to the late 1970s) and a trenchless "tile plow" machine. This research showed both tiling methods were not significantly different and both provided adequate drainage. It also showed water table measurements were influenced more by timing of water needs of the crop being grown, intensity of the rainfall event, and distance from tile drainage lines, than tiling method. This report focuses on continued water table monitoring from 2017 to 2020.

Materials and Methods

Four-inch plastic subsurface drainage tile was installed at a 4 ft depth, in sets of three at 80-ft spacing by each tile machine so the water table depth could be measured at intervals (10 ft, 20 ft, and 40 ft) from the center tile. Soils were primarily a Kenyon loam with some Readlyn loam and Clyde silty clay loam. Groundwater table depth observation wells were installed, and records of depths to water table (to a 5-ft depth) have been maintained.

Results and Discussion

It is generally believed if the water table is less than 12 in. below the soil surface, it can interfere with machine traffic or early plant growth and have a detrimental effect on soil compaction from heavy machinery. In the past four years, these conditions have only occurred May 4, 2018, after 3.94 in. rainfall in the previous 3 days (Figure 2); September 7 and 21, 2018, after 12.34 in.and 5.79 in. of weekly rainfall, respectively; May 23, 2019, after 4.4 in. rainfall (Figure 3); and March 19, 2020, after 1.82 in. rainfall (Figure 4). The majority of these times, a higher water table occurred in the 20- and 40-ft distances as water permeates toward drainage tile, which is why many producers are adding drainage lines between old tile lines to speed up drainage in soil types that exhibit poor drainage.

Seasonal available soil moisture requirements are 21 in. of water for corn and soybean, on average. Due to losses from runoff and percolation through the soil, this requirement was estimated at 25 in. of water for the season. Heavy agricultural soils can hold about 10 in. of available water in the upper five feet of the soil profile. Corn and soybean typically root to at least a 5-ft depth. If started with a "full" soil moisture profile (10 in.) at planting, then an additional 15 in. of timely season rainfall to grow a crop is needed. Average soil moisture losses from crop growth and evaporation from the soil are (April-1.3 in., May-2.7 in., June-3.65 in., July-5.65 in., August-4.45 in., September-2.15 in., October-1.10 in.) for a total of 21 in. (Elwynn Taylor, 2003).

In 2017 (Figure 1), frequent but not excessive rain events until August provided adequate soil moisture for crops during peak water use requirements, and water tables were drawn down in August and early September from below normal rainfall.

In 2018 (Figure 2), early water table levels started out low until frequent and excessive rainfall events occurred in May and June, causing severe erosion and planting delays. July was dry, followed by above normal precipitation for late August and September. Harvest delays were frequent due to wet top soil conditions and tile drainage continued through late fall due to no crop utilizing water.

In 2019 (Figure 3), frequent rain events delayed planting in April and May. June through July rainfall was frequent, but below normal, yet adequate for crop growth, since there was no excessive heat. Water tables lowered from August through late October to below tile line depth, but 9.14 in. rain in October and November replenished soil moisture reserves after crop harvest, raising water tables.

In 2020 (Figure 4), mid-March rainfall caused a rise in water tables, followed by a dry April when most corn and soybean planting occurred. May and June rainfall was above normal and water tables started dropping after June 23. Tile drainage stopped at the end of July due to below normal precipitation for July and August. Drought stress and above normal heat caused yield reductions due to crop water use requirements not being met. Yields varied widely due to moisture holding capacity of differing soil types and elevation. Tile lines continue to be dry in winter of 2020, which will be of concern for the water reserve replenishment for the 2021 growing season.

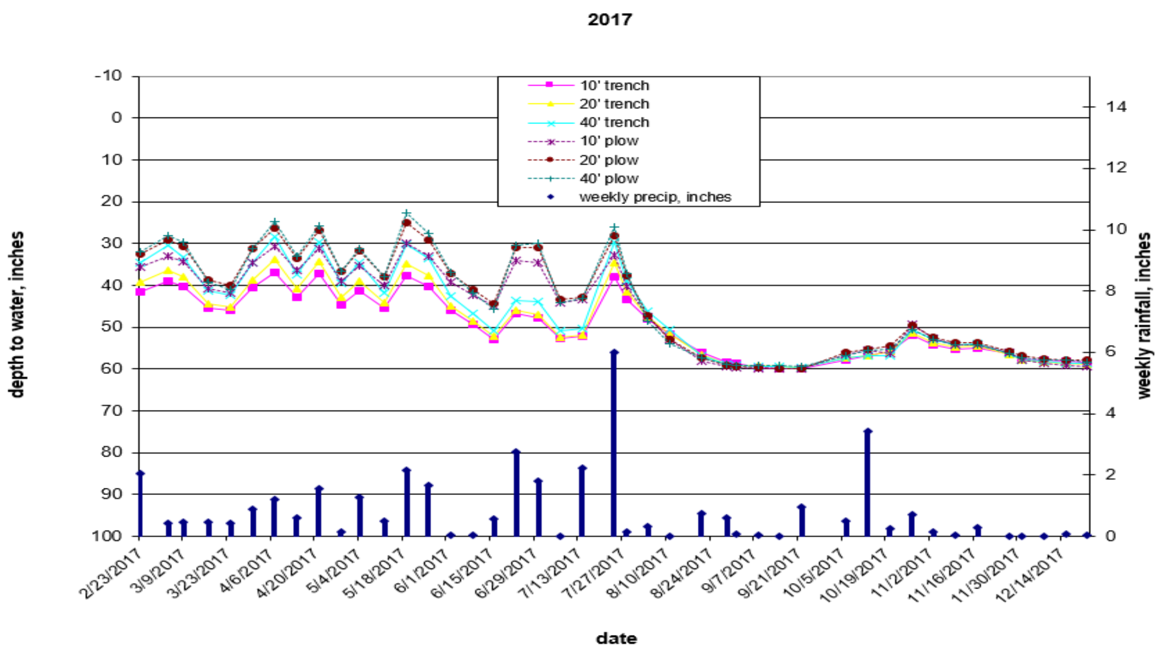

Figure 1. Water table and weekly precipitation in 2017 from two drainage installation methods at three distances.

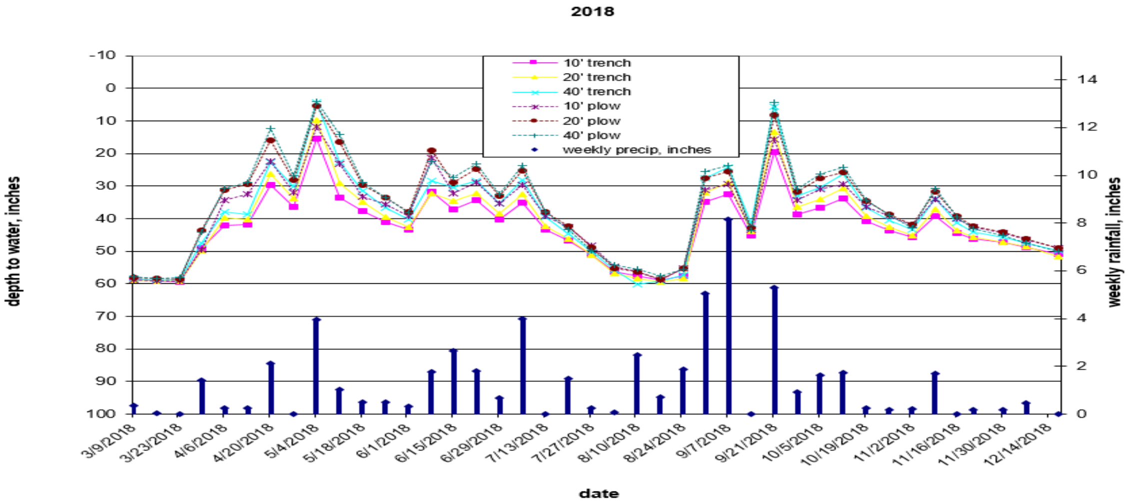

Figure 2. Water table and weekly precipitation in 2018 from two drainage installation methods at three distances.

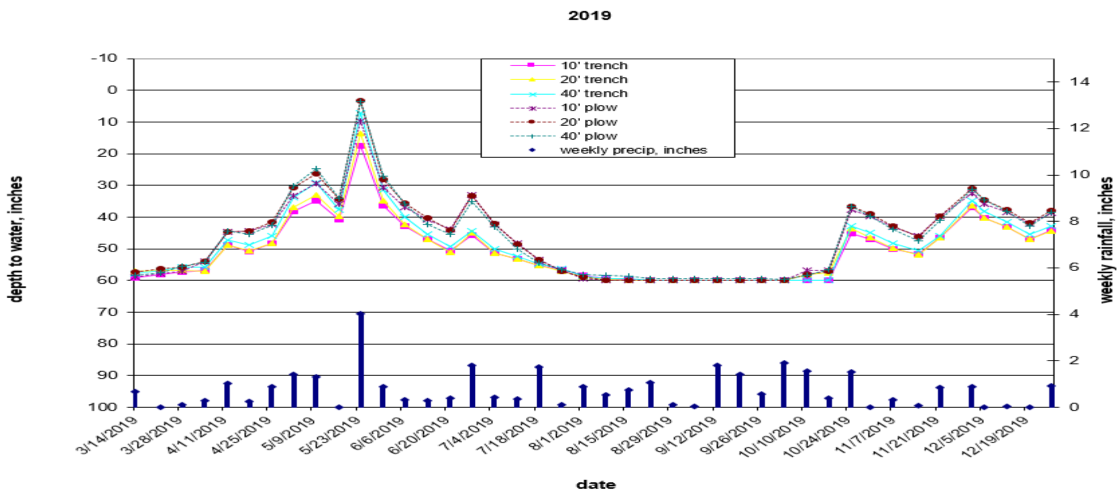

Figure 3. Water table and weekly precipitation in 2019 from two drainage installation methods at three distances.

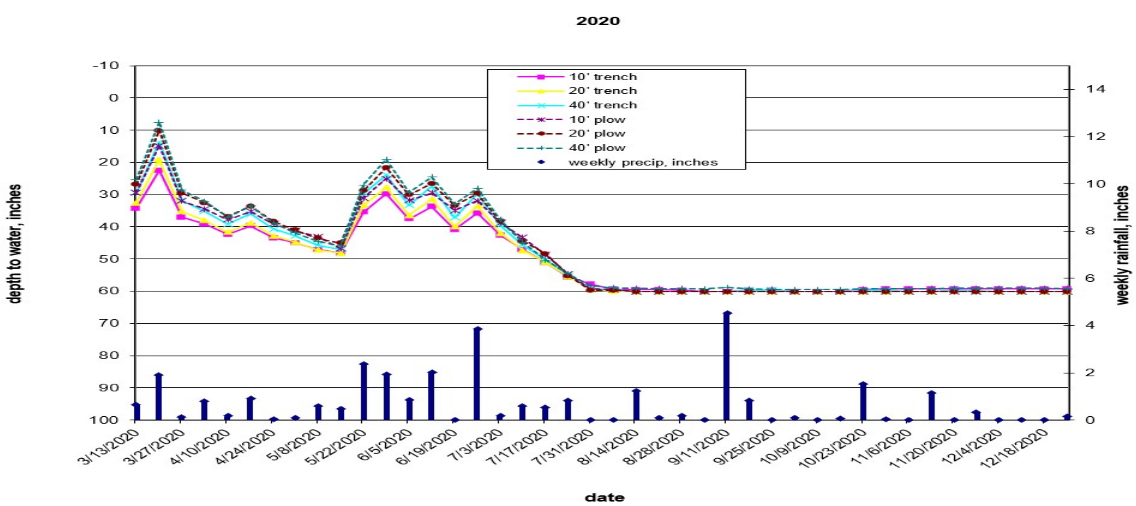

Figure 4. Water table and weekly precipitation in 2020 from two drainage installation methods at three distances.