Water Table Level as Influenced by Rainfall, Crop Requirements, and Tiling Method During the Past Two 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 70s), and a trenchless "tile plow" machine. The tile plow inserted plastic tile using a mole approach, which is the current primary tiling method. This research showed plow and trenching 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 2014 to 2016.

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 three years, these conditions have only occurred before or after the spring planting/early plant growth period—June 20, 2014, after 5.62 in. rainfall in the previous 4 days (Figure 1) and March 31 (1.31 in.), September 9 and 23, 2016, (2.51 in. and 9.47 in., respectively (Figure 3). The majority of these times, a water table less than 12 in. lasts longer 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.

Corn and soybeans have similar available soil moisture requirements. The critical difference is time of season at which limited moisture can most affect the crop (mid- to late-July for silking corn and early August during initial soybean seed development). Seasonal available soil moisture requirements are 21 in. of water. Due to losses from runoff and percolation through the soil, we estimate this requirement 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 we start with a "full" soil moisture profile (10 in.), then we need an additional 15 in. of timely season rainfall to grow a crop. 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 2014 (Figure 1), early water table levels were below the range of monitoring equipment due to the 2013 crop water use requirements and below normal precipitation for the last half of 2013 and first quarter of 2014. It took 5.1 in. of rain throughout April 2014 to finally raise the water tables above tile drainage lines to replenish soil moisture reserves again from nine months earlier. The majority of crops in 2014 were planted in May, due to above normal precipitation occurring on 16 days in April and below normal precipitation in May. June precipitation (10.35 in.), just prior to corn pollination and corn/soybean grain fill, allowed for great crop yields, despite below normal precipitation the rest of the growing season. Similar to the fall of 2013, fall of 2014 water table levels were below tile line depth starting in early August and remained there due to below normal fall and winter precipitation.

In 2015 (Figure 2), water tables did not rise from below tile line depths until April 10, with no heavy rain events throughout the entire summer, allowing early planting, with optimal rainfall for high yields. Tile drainage lines quit running August 1 due to crop growth requirements with one spike in water table August 28 from a 2.6 in. rain event, with water tables lowering below drainage line levels in October. Then tile drainage continued through December from above normal precipitation for the last two months of 2015 when top soils did not freeze.

In 2016, (Figure 3), tile drainage lines continued to run all winter of 2015-2016, due to heavy December 2015 precipitation (5.42 in.) and January through March 2016 precipitation (6.91 in.). April and May 2016 had below average rainfall, allowing us to plant crops in a timely manner in dry conditions, followed by above average precipitation for June through September. Nearly 10 in. of rainfall occurred in a 3-day span in late September, with considerable runoff, due to rainfall intensity. Tile lines continue to drain water, with minimal soil freezing, similar to the past winter, despite below normal precipitation for the November 2016–January 2017 time period.

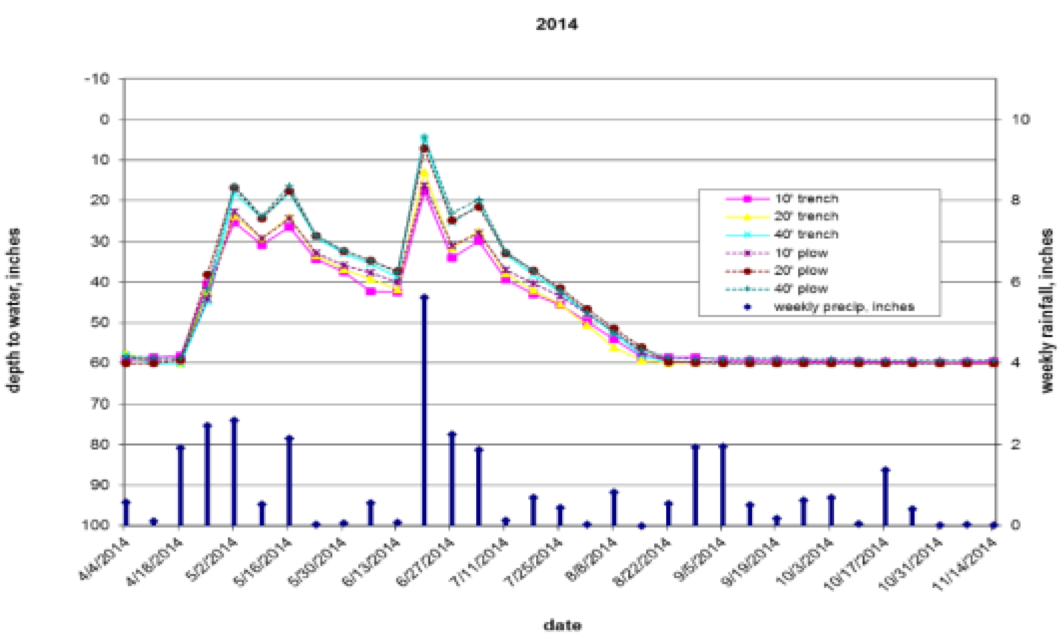

Figure 1. Water table and weekly precipitation in 2014 from two drainage installation methods at three distances.

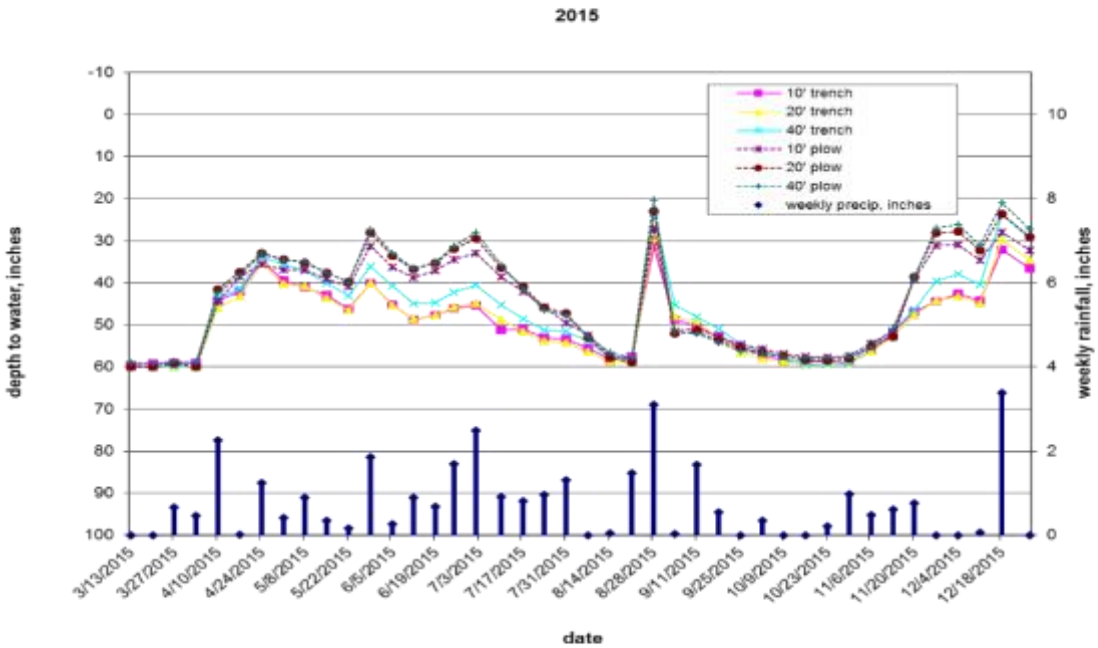

Figure 2. Water table and weekly precipitation in 2015 from 2 drainage installation methods at 3 distances.

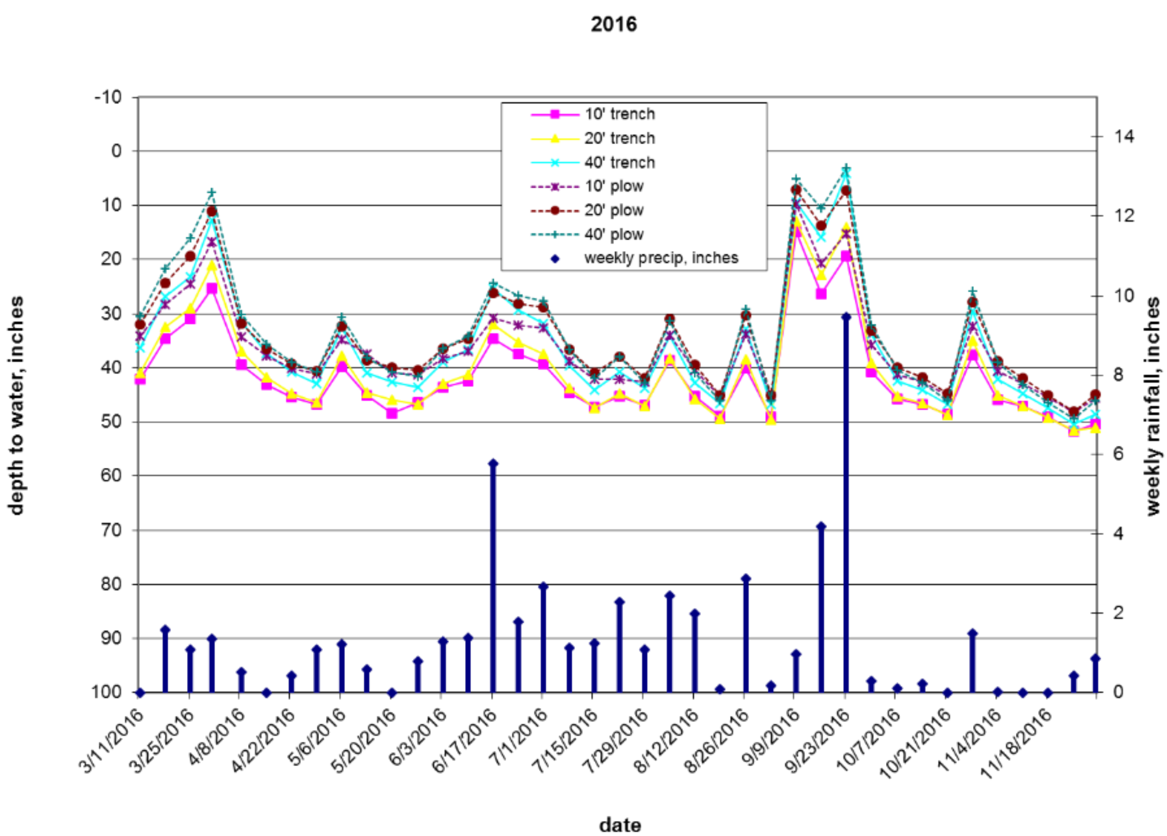

Figure 3. Water table and weekly precipitation in 2016 from 2 drainage installation methods at 3 distances.