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

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Abstract

In 1979, a portion of the research farm was pattern tiled to provide a good soil environment for large tillage trial plots. This was used as an opportunity to compare tile installation methods; 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 remains to be the primary tiling method after the late 1970s for field drainage. Past research on this study has shown that plow and trenching methods were not significantly different and both provided adequate drainage. Research showed that water table measurements were influenced more by timing of water needs of the crop being grown and intensity of the rainfall event.

Disciplines

Agricultural Science | Agriculture

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

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Introduction

In 1979, a portion of the research farm was pattern tiled to provide a good soil environment for large tillage trial plots. This was used as an opportunity to compare tile installation methods; 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 remains to be the primary tiling method after the late 1970s for field drainage. Past research on this study has shown that plow and trenching methods were not significantly different and both provided adequate drainage. Research showed that water table measurements were influenced more by timing of water needs of the crop being grown and intensity of the rainfall event.

Materials and Methods

Four-inch plastic subsurface drainage tile was installed in sets of three at 80 ft spacing by each contractor tile machine so that the water table depth could be measured at intervals (10 ft, 20 ft, and 40 ft) from the center tile. Groundwater table depth observations wells were installed, and records of depths to water table (to a 5-ft depth) have been maintained through 2008.

Results and Discussion

Water tables tended to be higher as you went away from the center tile line during high water tables, but little to no differences in water table measurements occurred during low water tables. Only slight drainage differences were noted by tiling method in early years, which were considered insignificant compared with the cost savings of the tile plow method.

Figures 1–6 show the water table measurements and weekly rainfall for 2003–2008. It is generally believed that when the water table is at least 12 in. below the surface, it does not interfere with machine traffic or plant growth. Using that as a standard, it is easy to see that this has only occurred three times in the past six years. However, only in 2003 and 2008 did it delay planting; whereas in 2007, it occurred before the planting season began. 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 the soil moisture requirement at 25 in. of water for the season. Good agricultural soils hold about 10 in. of available water in the upper 5 ft 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.; August, 4.45 in.; September, 2.15 in.; October, 1.10 in.) for a total of 21 in.

In 2003 (Figure 1), plantings were delayed for the first two weeks of May due to high rainfall events and water tables ranged from 8 to 26 in. from the soil surface in the first 3 weeks of May. By July 25, water tables were at tile line depth (48 in.) and kept dropping. Only 0.49 in. of rainfall occurred in August and tile drainage stopped due to water demands of the crop and remained dry through spring 2004. Well-drained soil types had low yields although poorly drained soil types yielded average to excellent.

In 2004 (Figure 2), no fieldwork delays occurred due to low water tables from late March through mid-May. Two major rainfall events, on May 21 and May 28 totaling 8.61 in. of rain, caused severe erosion, but did not raise water tables within 2 ft of the surface because of high rainfall intensity, causing excessive surface run-off, but little infiltration. Despite timely, but below normal August through November rainfall, water tables remained dry or at tile line depth from mid-August through harvest due to crop demand for water and no end of season recharge.

In spring 2005 (Figure 3), tiles were not running, thus there were no water tables above tile lines until May 13, even though 3.61 in. of rain had fallen in the previous 2 months, indicating that the soils were not fully recharged to field capacity from the previous fall and winter precipitation. Rainfall the second and third week of May made planting difficult. Ample water was available to the crop through July 29. August started out dry, but 3.8 in. of rain fell the week of August 12, bringing water tables back up, followed by 6.62 in. of rain in September. Tile lines remained running and water tables remained at least 1 ft above the tile line depth throughout the fall season. Severe compaction occurred by combines during September soybean harvest.

In 2006 (Figure 4), above normal April precipitation and frequent, but below normal May through August rainfall kept water table depths between 20 and 45 in. from the surface before receding to 60 in. (below 4 ft tile depth) toward the end of July due to crop water needs and no substantial September and October rainfalls to recharge the soil. Because monthly rainfall for 2006 was never excessive, no erosion or few delays were noted in planting, field applications, and harvesting.

In 2007 (Figure 5), late March and late April rainfall raised water tables within 15 in. of the surface, causing some delays in fieldwork. In the last two weeks of July, 4.56 in. of rainfall occurred, but water tables were nearly at tile line level due to water requirements of the crops. In mid August, another 3.57 in. of rainfall also failed to raise water tables. In the third week of August, 5.36 in. of rainfall finally overcompensated for crop water removal raising water tables to 21 in. below the surface, keeping water tables above tile lines throughout the fall. In October, 5.38 in. of rainfall occurred during corn and soybean harvest, causing severe soil compaction from harvesting equipment for those who wouldn’t wait for water tables to lower.

In 2008 (Figure 6), April recorded 8.94 in. of rainfall, a 50+ year record near Nashua. Substantial erosion occurred the night of April 24 from 4.05 in. of rain. Erosion was lessened due to minimal fieldwork activity, because soils never dried in April. Water tables were within 0.5 in. of the surface after the rain event and dropped to about 30 in. due to tile drainage for the following 3 weeks allowing planting operations to begin after April 29. Rainfall intensities increased at the end of May/early June with 6.09 in. of rainfall from June 5–8 causing another bout of severe soil erosion with flooding of cities/towns near rivers. Minimal fieldwork was possible in the first 2 weeks of June. Water tables on June 8 were less than an inch from the soil surface and went from 17 in. to 42 in. by mid-July due to tile drainage and water requirements of the crop. Many areas in southern and eastern Iowa received greater rainfall amounts in May and June than did the research farm causing some planting delays into early July. By mid-August, water tables were below tile line depths and remained there until after harvest due to crop needs and below normal rainfall in August and September.

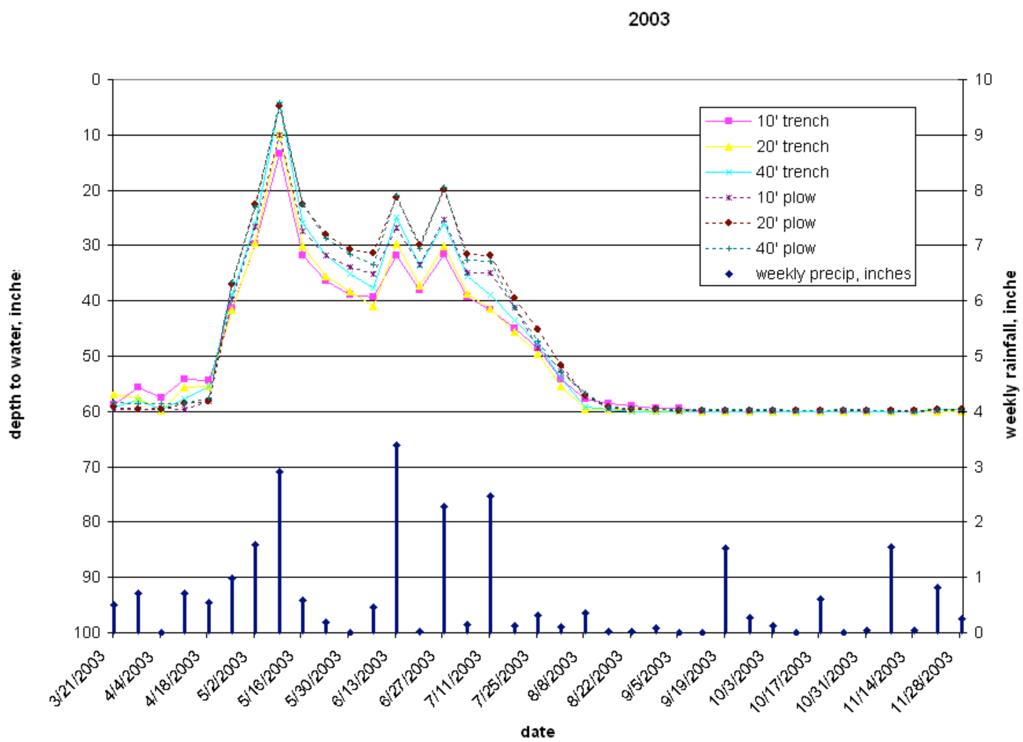

Figure 1. Water table and weekly precipitation in 2003.

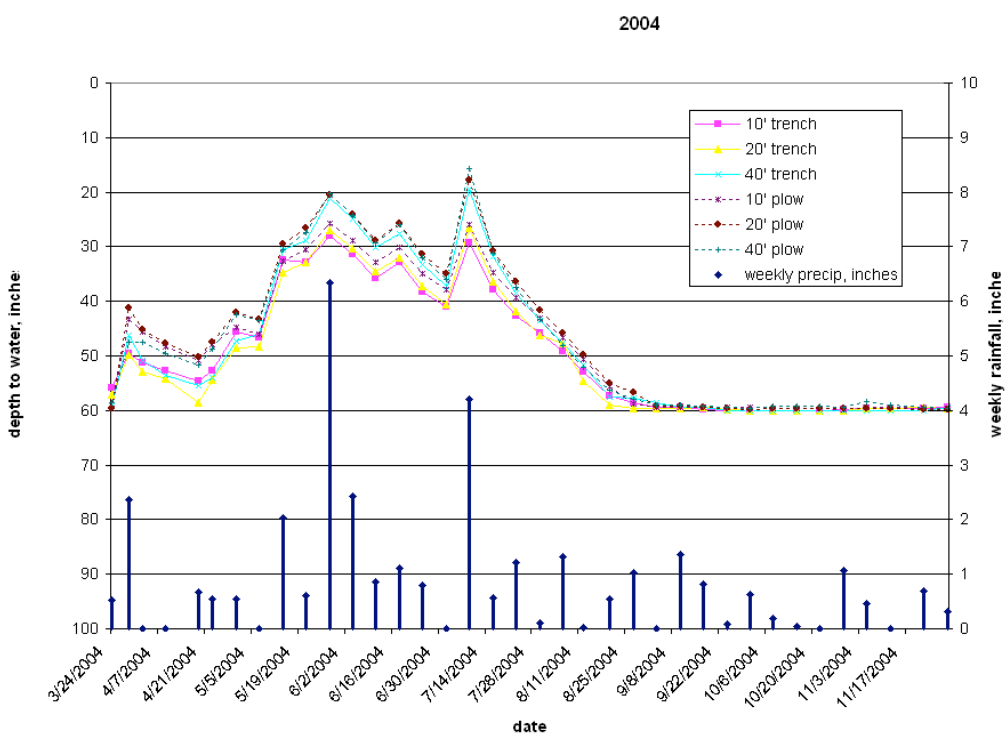

Figure 2. Water table and weekly precipitation in 2004.

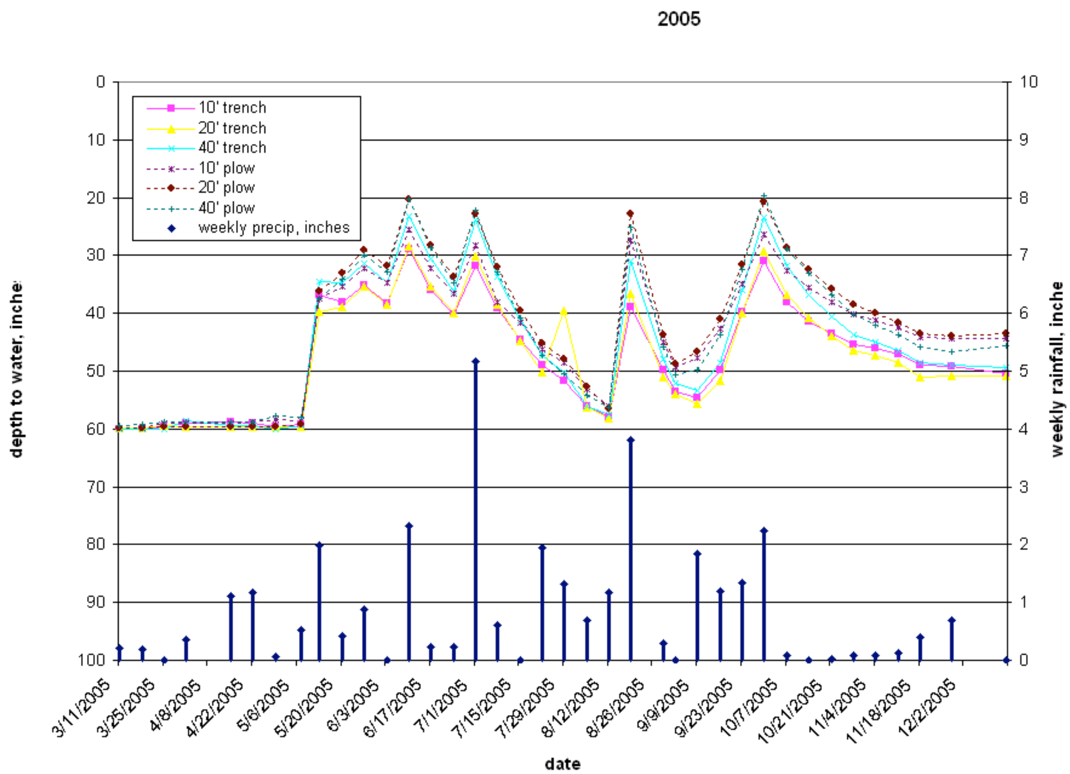

Figure 3. Water table and weekly precipitation in 2005.

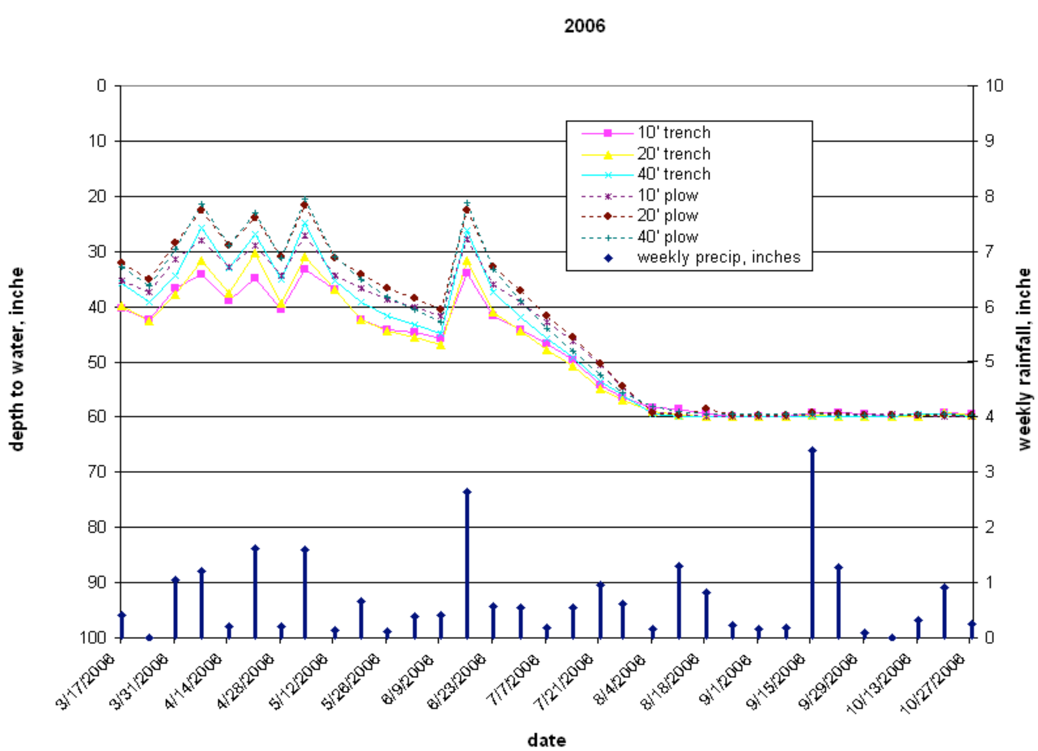

Figure 4. Water table and weekly precipitation in 2006.

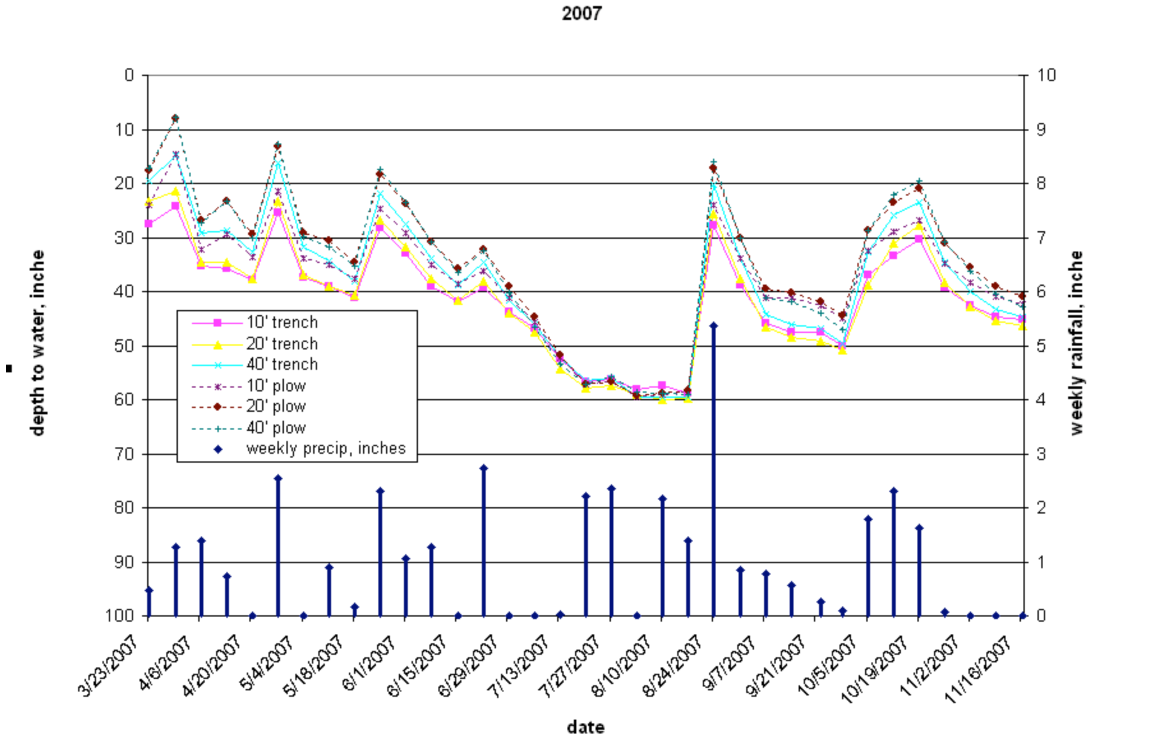

Figure 5. Water table and weekly precipitation in 2007.

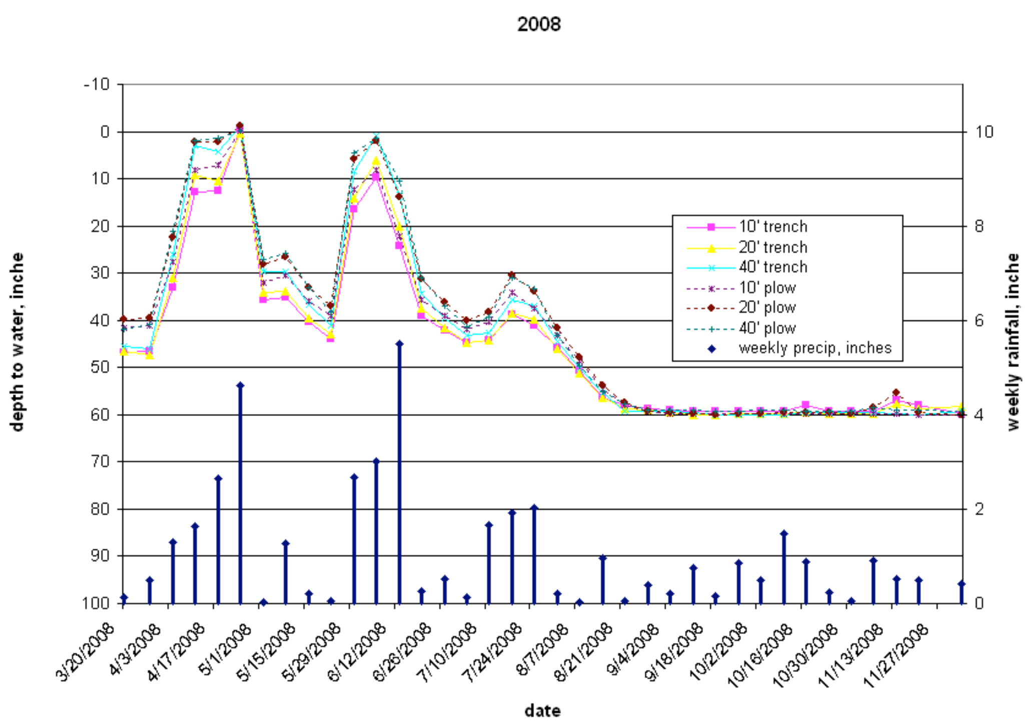

Figure 6. Water table and weekly precipitation in 2008.