# Rooting Dynamics Associated with Minimal Tillage in the Semi-Arid Peanut Production Region of West Texas

Diane Rowland[1], Wilson Faircloth[1], and Paxton Payton[2]
[1]USDA-ARS, NPRL, 1011 Forrester Dr. SE, Dawson, GA 39842;
Diane.Rowland@ars.usda.gov
[2]USDA-ARS, PSGDL, 3810 4th St., Lubbock, TX 79415

## ABSTRACT

Conservation tillage systems have the potential to significantly affect the rooting architecture of many crops. These effects can include increases in overall root mass, changes in fine vs. large root partitioning, changes in effective rooting depth, and concentration of root mass at deeper soil depths. Determining changes in crop root systems in response to tillage are important to quantify because they can have far reaching implications on a host of biotic and abiotic processes including: crop water-use, organic carbon cycling, soil aeration and compaction, and microbial population dynamics. Recently, research has demonstrated the positive effects on crop root systems in conservation tillage systems in the southeastern U.S. In particular, benefits to soil water holding capacity and concomitant decreases in crop water uptake have been quantified and used as evidence for the ability of conservation tillage to increase the water-use efficiency of a reduced cropping system as a whole. One particular environment that could dramatically benefit from a more water efficient production environment is the peanut and cotton production area of west Texas, U.S. In order to investigate the practicality and utility of conservation tillage systems in west Texas peanut and cotton production, the following objectives were addressed in both conventional and conservation tillage treatment plots: **1) to document and quantify variation in root production and architecture between the two tillage systems,** and **2) determine if irrigation deficit could be ameliorated through the use of conservation tillage in this semi-arid region.**

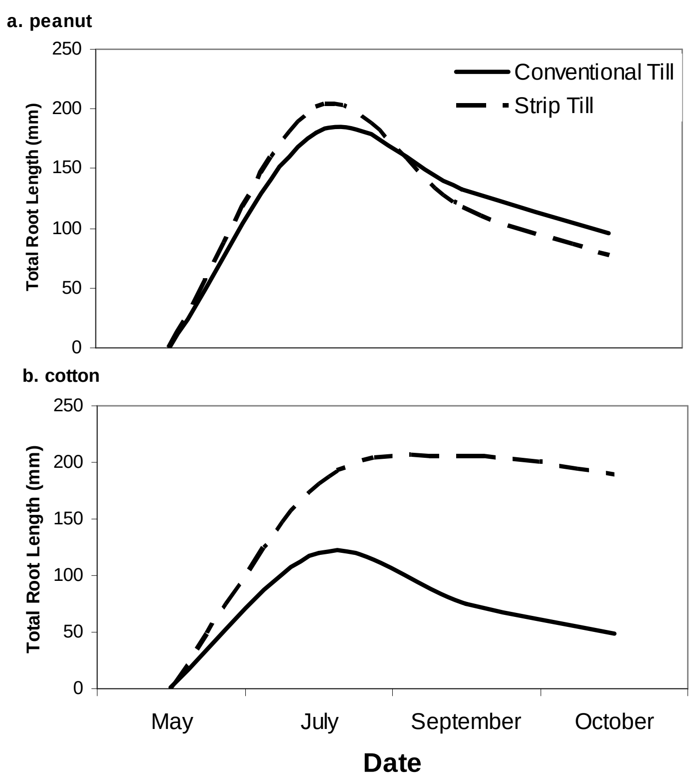


Figure 1: Sum of total root length produced (from 0 to 0.9 m depth) in a west Texas peanut and cotton production system over the growing season as measured by minirhizotrons.

Root system establishment, development, and architecture were examined throughout the growing season in a peanut and cotton production system in Lubbock, Texas through the use of mini-rhizotrons. Peanuts were grown in a factorial combination of two irrigation regimes (50% and 100% ET replacement) and two tillage systems (conventional, and strip tillage). The strip tillage system utilized a full bed cover crop in the previous fall and winter seasons which was terminated just prior to planting the primary crop. Rhizotron tubes were installed within the row and images were taken four times during the season.

In 2007, rainfall was much higher than average and the field site experienced water-logging and probably hypoxic soil conditions during the early and mid-season. Therefore, irrigation treatments were not able to be established and all measurements were taken under a "100%" or fully irrigated condition. With water-logged soils, root establishment was likely to be significantly reduced for the year. Despite the overall high moisture status of the soils within these experimental plots, measurements of soil moisture in the mid- to late-season revealed improved water retention in the strip tillage plots. Therefore, root system dynamics had the potential to respond differentially between conventional and conservation tillage systems due to differences in water availability at the height of the growing season. This was certainly the case for root production in the cotton crop but the effects of tillage were negligible in the peanut crop (Figure 1). For peanut, total root production was slightly higher in the strip tillage system during mid-season but fell off to lower levels than in the conventional tillage treatments later in the season. In contrast, significant differences between the tillage systems in the cotton crop were evident beginning with the first set of images and continuing into the late season. Cotton root production was much greater in the strip tillage system than in the conventional.

The potential for strip tillage systems to increase crop root growth in the semi-arid region of west Texas could have important impacts for increasing the water-use efficiency of peanut and/or cotton production. For the cotton crop, greater overall root production and deeper rooting depths (data not shown) have the potential to increase water uptake, decrease effects of soil moisture deficit, and increase overall crop water-use efficiency. This could still be the case for peanut because the unusual hypoxic soil conditions may have contributed to the lack of variation between conservation and conventional tillage in 2007. Although the unusually high precipitation in 2007 precluded the ability to assign causality, ongoing tests within these same plots are currently being conducted to further quantify effects of tillage in full and deficit irrigation systems on crop rooting patterns in this semi-arid region in 2008.