# IF IT WAS EASY, EVERYBODY WOULD BE DOING IT: WHY CONSERVATION TILLAGE HAS NOT BEEN ADOPTED BY SOUTHERN HIGH PLAINS PRODUCERS

R. Scott Van Pelt[1*]

[1]USDA-ARS Cropping Systems Research Laboratory, 302 I-20, Big Spring, TX 79720
[*]Corresponding author's e-mail address: svanpelt@lbk.ars.usda.gov

## SUMMARY

Conservation tillage has been widely adopted in many regions of North America. Well documented benefits of energy savings, erosion control, and improved infiltration have profited producers who have adopted conservation tillage systems elsewhere and generated some interest among producers in the southernmost areas of the Southern High Plains (SHP) of Texas. In spite of this interest, few producers have adopted conservation tillage and their neighbors are skeptical of their chances for success. The southern end of the SHP is characterized by sandy loam soils with less than 0.5 % organic carbon formed under a thermic soil temperature regime, less than 19" of average annual rainfall, and a cotton monoculture. Under dryland conditions in the SHP, cotton generally produces less than 1500 lbs $ac^{-1}$ of crop residue which is only about 20 % of the Soil Conditioning Index (SCI) maintenance amount required to maintain steady state soil carbon reserves. Thus, cultivated soils tend to be very low in organic matter, poorly structured, compact easily, and rapidly disperse during rain events effectively sealing the surface and limiting infiltration. Research conducted at the USDA-ARS Big Spring Field Station (BSFS) over the last 5 years indicates that the time required to successfully convert from conventional tillage to no-till systems may be exceptionally long under these conditions.

A field at the BSFS that was planted with native grass for 50 years was deep chiseled and disc plowed in 2000. Since the initial field preparation, it has been maintained in a no-till system. It has been planted with high residue crops such as sorgho-sudan, sorghum, and barley in rotation with cotton every third crop. Cotton yields from this field have been less than half the yield from an adjacent field with the same planting patterns maintained under conventional tillage. Soil compaction problems are evident in this field and sorghum roots have, in some cases, failed to extend beyond the seed furrow. Another field at the BSFS that had been in conventional tillage for 80 years was sub-divided into 24 treatment plots in 2003 following a crop of sorghum. This field was planted with cotton the following year and four tillage treatments were randomly assigned to three blocks. The tillage treatments were: 1.) (CT) a conventional tillage system of shredding residues, disc plowing twice, and listing the tilled soil into beds, 2.) (RT) a modified ridge till system of listing new beds around standing residues, 3.) (NTM) a no-till system where crop residues are shredded post-harvest, and 4.) (NTS) a no-till system where crop residues are left at full harvested height. Two rotations are also a part of the experimental design with a cotton-fallow-sorghum-fallow rotation and a cotton-fallow-cotton-fallow-sorghum rotation. During the three growing seasons since inception, cotton has been grown on at least half the field in all tillage treatments. Record rainfall in 2004 and very timely rainfall in 2005 resulted in record crops of cotton in and around Big Spring. These ideal growing conditions may have partially masked the tillage system effect on the growth and yield of the crops expected in more normal years.

For most growth and yield parameters in most years, the CT and RT treatments have resulted in the highest yields. In 2003, the CT treatment resulted in significantly higher yield that the other 3 treatments. Stand establishment, growth, and phenology data were better and earlier for the RT treatment until 60 days of drought followed by ample rains in September 2003. The extra protection from sandblast injury afforded the seedlings by the roughened beds and standing residue in the RT treatment may be partially responsible for the early response. The higher leaf area at mid-season in the RT treatment and expected greater water use may have reduced soil water to levels resulting in stress from which the RT plants never fully recovered. A large percentage of the cotton bolls in the RT treatment failed to mature and open in 2003.

In 2004, the CT and RT treatments yielded approximately 50 % more cotton TDM and more than twice as much lint yield compared with the NTM and NTS treatments. Although significance for treatment effects on cotton TDM was not found at the $p<0.05$ level, treatment effects were significant at the $p<0.1$ level. Sorghum TDM yields were also larger for the CT and RT treatments.

The 2005 data for cotton and sorghum tend to encourage enthusiasm that we are beginning to see the benefits of reduced tillage or at least beginning to overcome early problems with the conversion process. Lint yields were very similar for all treatments as are sorghum TDM yields. Sorghum mean TDM yield for the NTS treatment was actually greater than for the RT treatment. Cotton TDM yields showed a significant treatment effect at the $p=0.0621$ level and so it can easily be argued that the CT and RT treatments were still resulting in better growth. Hand harvest lint data taken two weeks prior to the mechanical harvest indicated a significant treatment effect with the CT and RT treatment means found not significantly different and the RT, NTM, and NTS treatment means not found significantly different. This indicates that the CT and RT treatments resulted in earlier crop maturity.

This investigation has been in place for 3 years will continue for another 9 years. Soil chemical and physical measurements including soil carbon, soil enzyme activities, wet aggregate stability, bulk density, and infiltration rate will be measured at the end of years 6 and 12. We are also hopeful that other fields at BSFS on which no-till and conservation tillage are being investigated will successfully be converted. Agricultural producers, however, cannot afford the yield losses we have experienced and may continue their resistance to change. It is probable that fuel costs, commodity supports, and market opportunities will remain the primary catalysts for change, or lack of it, in SHP agriculture.