COTTON CONSERVATION TILLAGE STUDIES IN ARKANSAS

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Introduction

Cotton (*Gossypium hirsutum* L.) production in the United States is typically a tillage intensive culture. Tillage operations employed in most cotton production include disking to disrupt the soil surface, re-smoothing the field, bedding, knocking down the beds, and shallow cultivation for weed control during the growing season. These tillage practices have been linked to soil compaction (McConnell, et al., 1989) and soil erosion (Mutchler et al., 1985) which may reduce yield.

Arkansas producers typically prepare seed beds for cotton in early spring. Conventional tillage operations used for seed bed formation are primarily disking and raised crown bed (CB) formation (Bonner, 1993). The finished beds, approximately 1 to 1.5 ft tall prior to planting, allow the soil to warm rapidly and promote drainage of excess surface water. The weather conditions in the Arkansas Delta region vary widely from season to season, and early spring rains frequently prevent timely field operations necessary for CB formation. Delays in seed bed preparation may delay planting, thereby reducing the length of the growing season (Waddle 1984). Reducing the time required to prepare seed beds could be beneficial to cotton producers by allowing more timely planting.

Surface soil strength is decreased by the disking and bedding of conventional tillage compared to reduced tillage. The greater the surface soil strength the heavier load the soil will bear without deforming (Hill, 1990). The reduction in soil strength may prohibit tractor traffic in conventionally tilled fields, particularly when spring rains saturate the soil. Practically, this means that producers may use heavy tractors and implements on the field earlier without cutting deep ruts and damaging the field.

Soil erosion of level, Delta, cotton fields under conventional tillage ranges from 2.3 to 5.3 ton soil/acre/year (Dendy, 1981). Minimum tillage cotton production has been shown to substantially reduce soil erosion (Mutchler et al., 1985). However, residue cover of the soil surface from cotton alone is usually less than high residue crops such as corn or grain sorghum.

Production systems that include winter cover crops further reduce soil loss by reducing raindrop impact, slowing runoff and holding soil in place (Stallings, 1957). Fields in Arkansas are especially vulnerable to water erosion during late winter and spring months when intense rainfall may occur. Leguminous cover crops provide nitrogen (N) to the subsequent summer crop and protection from water-induced soil erosion. The predominant use of leguminous cover crops as an N source continued until they became less economically important due to the advent of cheap chemical fertilizers in the 1940's (Stevenson, 1982).

Field experiments have been established at three University of Arkansas Experiment facilities under many production conditions to determine if reduced tillage/conservation tillage is a viable option for cotton producers.

Scientists Conducting Tillage Research on Cottonat the University of Arkansas

Five University of Arkansas Experiment Station scientists have conducted most of the research tillage technology for cotton.

- Robert E. Frans (Retired). Agronomy Department. Fayetteville, AR.
- Terry C. Keisling. Northeast Research and Extension Center. Keiser, AR.
- Marilyn McClelland. Agronomy Department. Fayetteville, AR.
- J. Scott McConnell. Southeast Research and Extension Center. Monticello, AR.
- Craig S. Rothrock. Plant Pathology Department. Fayetteville, AR.

Weed Control

Experiments were designed to examine weed control in cotton grown in conservation tillage systems. These experiments were conducted at the Cotton Branch Station at Marianna, Arkansas and the Delta Branch Station at Clarkedale, Arkansas during the early 1990's. These early experiments resulted in many conclusions and technological developments that increased the viability of conservation tillage in the Arkansas Delta region.

Some of the conclusions reached in these studies are listed below (McClelland, et al., 1993).

- Early season horseweed and cutleaf evening primrose were controlled with glyphosate alone and with oxyfluorfen, and glufosinate + oxyfluorfen. Cutleaf evening primrose was also controlled with pyrithiobac-sodium.
- Henbit, mayweed and little barley were controlled with paraquat + oxyfluorfen.
- Pennsylvania smartweed was controlled with oxyfluorfen and later applications of paraquat.
- Morningglories, annual grasses and other weeds were controlled with glyphosate or paraquat as a pre-emergent tank mix.

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- Seed cotton yields from conservation tillage cotton were not significantly different from conventionally tilled cotton.

Since these studies have been completed other weed control technologies have become available for producers that fit will into conservation tillage systems. Two areas of improvement that have the potential to influence weed control in conservation tillage systems include: the use of genetic engineering to produce RR and BXN cotton varieties; and the utilization of pyrithiobac-sodium. Both of these technologies may increase weed control with over the top and post-directed herbicide applications not previously available.

Mr. Bill Teeter has been a proponent of conservation tillage for cotton in Arkansas for many years. He has shown the effectiveness of herbicidal control of weeds in no-till cotton production in large scale demonstrations on his farm near Winchester, Arkansas. Currently, all of Mr. Teeter's cotton is produced using conservation- and no-tillage technology.

Cover Crops

Incorporation of cover crops into cotton production systems was investigated at the Delta Branch Station (DBS) near Clarkedale, Arkansas and at the Southeast Branch Experiment Station (SEBES) near Rohwer, Arkansas. Both tests were conducted on silt loam soils.

Studies conducted at the DBS examined the use of cover crops used in conjunction with conventional and ridge tillage (Keisling, et al., 1995). Their results are listed below .

- Combinations of cover crops and tillage methods did not influence lint yields.
- Cover crops that combined wheat with either vetch or clover resulted in higher lint yields than native vegetation or vetch alone.
- Conventionally tilled cotton did not produce any increase in yield compared to ridge tilled cotton.
- Soil tested results were very similar between conventional and ridge tilled cotton.

Studies conducted as SEBES examined the effects of five cover crops, reduced and conventional tillage, and burn down herbicide under irrigated and dry land production conditions (McConnell, et al., 1994; McConnell, et al., 1994). The reduced tillage system used in these studies was shredding stalks, cover crops and winter weeds in the early spring and reforming beds on the old rows.

Major findings and conclusions from these studies are listed below.

- Irrigation and tillage did not interact to influence lint yields. Irrigated cotton was higher yielding than dry land cotton.
- Tillage method did not significantly affect yield. Reduced tillage cotton was not lowering yielding than conventionally tilled cotton.
- Wheat and rye cover crops caused cotton to be lower yielding than legume cover crops or native, winter weeds. This was probably due to nitrogen immobilization by the wheat and rye cover crops as they decayed during the growing season.
- This effect was observed with soil test results, petiole nitrate-nitrogen analysis, and with maturity measurements of the developing cotton crop.
- Under the reduced tillage system employed in these studies the use of a burn down herbicide did not influence either weed pressure or yield.

Future Research

The University of Arkansas remains dedicated to supplying research and technology to provide answers to applied problems for cotton producers. Areas of potential investigations include:

- Fertilizer application technology and utilization in conservation tilled cotton. Solutions and solid banders.
- Ultra narrow row cotton production under conservation tillage.
- Border irrigation of cotton grown under conservation tillage.
- Utilization of GIS/GPS technology in conservation tillage systems.

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