# NO-TILLAGE COTTON YIELDS AND ECONOMICS FOR SOUTH TEXAS

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**Abstract**

Cotton production without tillage leaves crop residue on the soil surface to mulch the soil. This crop residue can help to increase water infiltration rates into the soil profile, reduce surface runoff, soil surface evaporation, wind and water erosion and decrease soil temperatures near the surface. Cotton growth and lint yield were measured over a two year period for no-tillage (NT), ridge-tillage (RT) and conventional moldboard tillage (CT). Input costs for crop production and passes over the field were included in an economic analysis of irrigated cotton production for the three tillage systems. In 1996, NT cotton lint yields were 13% less than CT and RT lint yields were almost 20% less than CT. In 1997 the yields were not different for the tillage treatments. An economic analysis was conducted for each crop year and cropping sequence. The CT spring cotton followed by fall corn each year crop sequence had average net returns of \$17 $ha^{-1}$ more than the no-tillage treatment. The CT average net return for the crop sequence where cotton and corn was rotated on an annual basis was \$33 $ha^{-1}$ less than the no-tillage treatment. Results of this two year study indicate that no-tillage cotton production can have crop yields equivalent to conventional tillage and net returns as good or better than conventional tillage. If yields and economic returns can be maintained while reducing labor and trips over the field, and reducing wind and water erosion then no-tillage production of cotton should be an acceptable alternative production practice for cotton producers in south Texas.

## Introduction

Adoption of reduced tillage farming practices for irrigated and dryland cotton in the Lower Rio Grande Valley of Texas has been slow due to lack of knowledge of benefits and risks under a subtropical climate. The conservation compliance provision of the Food Security Act, however, is forcing producers to adopt conservation tillage practices. The warm, subtropical climate creates conditions very different from the Midwest U.S., where conservation tillage methods are widespread.

Conservation tillage production systems can help producers to reduce wind and water erosion and can help reduce water evaporation which occurs with each tillage operation. Other possible advantages of conservation tillage systems are reductions in total pre-harvest production costs per hectare, trips over the field, vehicular soil compaction, labor and man hours, fuel, and equipment needs. Timeliness of operations such as planting or cultivation is generally improved by using conservation tillage.

The objective of this study was to compares the economics of cotton production under conventional moldboard and disk system (CT), a modified ridge tillage system (RT), and no-tillage (NT) systems under irrigated conditions in the Lower Rio Grande Valley of Texas in 1996 and 1997.

## Materials and Methods

Three tillage treatments as main plots and cropping sequences with cotton and corn as subplots were studied at an irrigated site. The tillage treatments were in place in 1995 and this study was initiated in 1996 on an Hidalgo silty clay loam soil (hyperthermic Typic Calciustolls) located on the Soil and Water Conservation District Farm north of Weslaco, Texas (26º. 13' Lat.) Additional soil and precipitation data are listed in Table 1. Yearly rainfall for 1996 was about 200 mm below normal. Precipitation in 1997 was above average but 316 mm occurred over a short time period in March and little rainfall occurred for the remainder of the growing season. About 150 mm of irrigation water were applied twice each season to supplement the rainfall which fell during the growing seasons (March through July) of 1996 and 1997, respectively.

Three tillage systems, conventional moldboard tillage (CT), ridge tillage (RT), and no-tillage (NT), are described in Table 2. CT treatment was a moldboard plow and disk system where ridges or beds were reformed after primary tillage was completed. The RT treatment was a modified form of ridge tillage and consisted of planting into existing beds which remained from the previous crop where fall and winter weeds were chemically controlled. After cotton harvest in the RT system, cotton stalks were removed with a mechanical stalk puller and fall germinating weeds were chemically controlled. If the previous crop was corn only, glyphosate (Roundup) herbicide was used to control weeds during the non-crop period. In the NT treatment the previous crop was harvested but not shredded. If the previous crop was cotton, the stalks were mechanically removed with a cotton stalk puller. If the previous crop was corn, the stalks were left in place. The following cotton crop was planted into the existing crop residue, and fall and winter weeds were chemically controlled with glyphosate. A hooded sprayer which applied glyphosate only between the crop rows was used to control weeds between the crop rows. All treatments had 1.12 kg a.i. $ha^{-1}$ pendimethalin (prowl) plus fluometuron (coteran) at 1.34 kg a.i. $ha^{-1}$ applied in a 0.25 m wide band (0.37 kg a.i. $ha^{-1}$ pendimethalin plus 0.45 kg a.i. kg $ha^{-1}$ fluometuron actual chemical) over the crop row at planting using spray nozzles and shallow incorporation tine rakes attached to back of the planter. The CT and RT crop also received two mechanical

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cultivations, the second cultivation was done with ridging wings to form a water furrow for irrigation and to rebuild beds for the next cropping season. In the RT and NT systems a pre-plant burndown application of glyphosate (0.74 kg $ha^{-1}$) was used. Following planting, weed control methods in the CT and RT were the same.

The study included two cropping systems, composed of spring cotton and fall corn, spring cotton one year followed by spring corn the next year. This treatment also was planted so that a separate plot had spring corn one year followed by spring cotton the next. Crop production sequences are presented in Table 3. Main plot size was 41 by 122 m and subplot size was 13.7 (18- 0.76-m rows) by 122 m. Treatments were replicated four times.

Cotton was planted in early March with a John Deere 7200 Maxemerge conservation tillage planter. Different attachments and settings were used for the three tillage systems. In the CT system, double disk row cleaners in front of the double disk furrow-openers were used to provide a firm level seedbed on top of the ridges. The RT and NT treatments were planted with 0.55 m diameter ripple (1.2 cm wide ripple, 48 ripple waves/coulter) coulters mounted in front of the toothed finger-wheel residue row cleaners (Dawn Equipment Co., Sycamore, IL). The mechanical fingers removed crop residue from a 0.2 m wide path where seed was to be planted and deposited most of the crop residue in the furrows on either side of the crop row. Double disk furrow-openers were mounted behind the coulters and residue fingers but immediately in front of the planter seed tube where seed were deposited into the soil. Individual row units had a greater down-pressure from springs to achieve the same planting depth (35 mm) as for the CT treatment. The seed furrow was closed with two narrow, rubber press wheels mounted in a “V” formation behind the seed drop tube. Cotton variety DPL-50 (Delta Pine and Land Company) was planted at all locations and at a seeding rate of 123,500 seeds/hectare.

All cotton was fertilized twice with 56 kg N per hectare applied as liquid N32 with a "CADY" brand spoke wheel applicator. One application was made at 30 and again 50 days after planting for a total of 112 kg/ha of N. Cotton for all treatments were irrigated twice each season.

Insecticides included Guthion and methyl parathion. Seven insecticide applications were used in 1996 and only four applications were made in 1997 to manage insects. Cotton was defoliated about l40 days after planting with DEF™ (720 g/l) at 1.68 kg a.i./ha plus 0.165 l/ha Silwett. Estimates of cotton lint yield were made by handpicking 6 subsamples from each plot. Cotton was handpicked twice about 130 and 140 days after planting.

## Results and Discussion

Input costs for crop production and passes over the field were included in an economic analysis of irrigated cotton production for the three tillage systems.. In 1996, NT cotton lint yields were 13% less than CT and RT lint yields were almost 20% less than CT. In 1997 the yields were similar between the tillage treatments. An economic analysis was conducted for each crop year and cropping sequence. The 1 996 cotton was valued at $1.54/kg and 1997 cotton was valued at $1.43/kg for the economic analysis. In 1996 the spring cotton/fall corn sequence, NT net returns were $48 $ha^{-1}$ less than the CT but in 1997 the NT net returns were $14 $ha^{-1}$ more than the CT. The crop sequence where cotton was grown one year and corn the next had a 1996 cotton net return for the NT treatment of $12 $ha^{-1}$ less than the CT and in 1997 net returns were $77 $ha^{-1}$ more than the CT. Results of this two year study indicate that no-tillage cotton production can have crop yields equivalent to CT and net returns as good or better than CT. If yields and economic returns can be maintained while reducing labor and trips over the field, and reducing wind and water erosion then no-tillage production of cotton should be an acceptable alternative production alternative for cotton producers in south Texas.

Table 1. Annual rainfall, soil type, and selected soil percentages at Weslaco, Texas.

| growing season | Rainfall[1] (mm) | Soil `type | pH | Soil Texture organic -----------% --------- carbon | | | |
|---|---|---|---|---|---|---|---|
| | | | | sand | silt | clay | % |
| 1996 | 171 | Hidalgo, sandy clay loam | 8.0 | 56 | 19 | 25 | 1.2 |
| 1997 | 524 | | | | | | |

Table 2. Description of conventional moldboard, ridge-till and no-tillage systems. Parentheses ( ) indicate number of operations, Weslaco, Texas.

| Conventional (CT) | Ridge Till (RT) | No-tillage (NT) |
|---|---|---|
| shred residue | shred residue | ----- |
| disc | ----- | ----- |
| moldboard plow | stalk puller (cotton only) | stalk puller (cotton only) |
| disc (2) | ----- | ----- |
| form beds | ----- | ----- |
| cult. beds (3) | spray weeds (2) | spray weeds (2) |
| plant | plant | plant |
| pre-emerge herb. | pre-emerge herb. | pre-emerge herb. |
| cultivate (2) | cultivate (2) | hooded sprayer(2) |

Table 3. Crop production sequences within a tillage treatment for corn and cotton grown at the irrigated site, Weslaco, Texas, beginning in 1995.

| crop sequence | Crop year 1995 spring/fall | 1996 spring/fall | 1997 spring/fall |
|---|---|---|---|
| 1 | cotton/corn | cotton/corn | cotton/corn |
| 2 | corn/fallow | cotton/corn | corn/fallow |
| 3 | cotton/corn | corn/fallow | cotton/corn |

Table 4. Cotton lint yields for tillage treatments at Weslaco, Texas.

| Tillage | crop sequence | Lint Yields (kg $ha^{-1}$) 1996 | 1997 |
|---|---|---|---|
| Conventional tillage | 1 | 823 ab | 805 a |
| | 2 | 851 a | ------- |
| | 3 | ----- | 742 a |
| ridge tillage | 1 | 601 c | 770 a |
| | 2 | 687 bc | ------- |
| | 3 | ----- | 765 a |
| no-tillage | 1 | 696abc | 719 a |
| | 2 | 746 bc | -------- |
| | 3 | ----- | 695 a |

Comparisons are made within a year (column) using a Waller-Duncan k-ratio T-test. ($\propto$=0.05).

Table 5. Average economic analysis (U.S. dollars/ha) for irrigated cotton on alternative tillage systems for 1996.

| Tillage | crop sequence | pre-harvest costs | hvst. ginning storage | gross lint & seed returns | net returns |
|---|---|---|---|---|---|
| Conventional tillage | 1 | 474 | 353 | 1437 | 608 |
| | 2 | 519 | 368 | 1492 | 605 |
| | 3 | ----- | ----- | ----- | ----- |
| ridge tillage | 1 | 388 | 257 | 1045 | 400 |
| | 2 | 417 | 294 | 1195 | 484 |
| | 3 | ----- | ----- | ----- | ----- |
| no-tillage | 1 | 356 | 296 | 1213 | 560 |
| | 2 | 385 | 321 | 1299 | 593 |
| | 3 | ----- | ----- | ----- | ----- |

No cost attributed for land usage
Approximately $210.00/hectare is standard rent

Table 6. Average economic analysis (U.S. dollars/ha) for irrigated cotton on alternative tillage systems for 1997.

| Tillage | crop sequence | pre-harvest costs | hvst. ginning storage | gross lint & seed returns | net returns |
|---|---|---|---|---|---|
| Conventional tillage | 1 | 442 | 346 | 1312 | 524 |
| | 2 | ----- | ---- | ----- | ----- |
| | 3 | 487 | 319 | 1210 | 405 |
| ridge tillage | 1 | 356 | 329 | 1255 | 571 |
| | 2 | ---- | ----- | ----- | ----- |
| | 3 | 385 | 329 | 1247 | 534 |
| no-tillage | 1 | 324 | 309 | 1171 | 538 |
| | 2 | ----- | ----- | ----- | ----- |
| | 3 | 353 | 299 | 1134 | 482 |

No cost attributed for land usage
Approximately $210.00/hectare is standard rent