COTTON RESPONSE TO REDUCED TILLAGE MANAGEMENT AND NITROGEN FERTILIZATION

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Abstract

Reduced tillage can conserve soil, increase moisture in the soil profile and in some instances enhance crop yields. Conservation tillage can lower production costs because it requires fewer trips over the field. A six-year study was conducted to evaluate cotton lint yield response to different tillage systems and nitrogen fertilization rates. Results showed tillage practices had a direct effect on lint yields while nitrogen fertilizer rates affected yields only in certain years. Lint yields varied during the six year period from a high of 1047 pounds of lint to a low of 232 pounds largely due to wide variation in precipitation. Rainfall during the growing season varied from 4.72 inches in 1996 to 23.53 inches in 1992.

Introduction

Research evaluating crop response to tillage practices and fertilization is important to improve regional technology useful to cotton producers in assessing costs of production and in increasing the conservation of soil and moisture. Different tillage methods and fertilizer application rates have shown to have a direct effect on cotton lint yields (Matocha and Barber,1992; Smart and Bradford, 1996).

The purpose of this study was to determine effects of conservation tillage on lint yields under two nitrogen (N) fertilization regimes in a rainfed production system. The study was conducted with two cotton cultivars of varying maturities.

Materials and Methods

A field study was conducted from 1991 to 1996 at the Texas A&M Agricultural Research and Extension Center at Corpus Christi, TX on an Orelia sandy clay loam (Hyperthermic Typic Ochraqualf). Some characteristics of the surface horizon include: Sand content-60.2%, Silt content-14.1%,Clay content-25.7%, Moisture retention at .1 bar-24.7%, and at .33 bar-18.2% (Stearman, Matocha, and Crenshaw, 1995).

Twenty four treatments were selected from a larger study of 32 treatments arranged in a randomized complete block design with four replications. Plot dimensions were 12.75 feet by 40 feet with 4 rows spaced 38 inches apart. The inside two rows were used for yield determinations utilizing a small plot stripper or hand picking.

Fertilizer was applied preplant in 1991 thru 1995. In 1996, the fertilizer was sidedressed in May due to a severe drought. The fertilizer was banded four inches to the side and four inches below the seed zone. In 1991 thru 1995, the two fertilizer rates used were 60-20-0 and 30-20-0. In 1996, the rates were 60-0-0 and 30-0-0. The fertilizer sources were 34-0-0 and 0-46-0 for all six years of the study.

The two cotton cultivars used were Cab CS (earlier maturing) and D&PL50 (10 day later maturing). The cotton was planted between March 15 and April 15, depending on moisture and weather conditions during the six year period. Monthly rainfall during the growing season is presented for the duration of the study (Table 1).

Six different tillage treatments were used as follows: CT-Conventional, MB-12 inch Moldboard, CH-12 inch Chisel, MT-Minimum Till, MTC-Minimum Till Chisel, and NT-No Till (Table 2).

Cotton was grown on the same plots for the six-year period and row identification was maintained continuously throughout the study.

Results and Discussion

Lint yields varied substantially over the 6-year period of the study due to varying amounts of rainfall during the growing season. Over the six year period, Cab CS yielded the most lint with the MTC tillage treatment and the least with the NT treatment. The differences among CT, MB, CH, MT, and MTC were not statistically significant with LSD at .05 (Fig.1).

D&PL yielded the most lint with the MB tillage treatment and the least with the NT. Again, the differences among CT, MB, CH, MT, and MTC were not statistically significant (Fig. 2). During the six year period, Cab CS yielded 595 lbs. lint per acre with the MTC and D&PL yielded 552lbs. with the MB. The largest difference between the two cultivars was in the NT treatment, where D&PL yielded a 6-year average of 442 lbs. of lint per acre and Cab CS yielded 388 lbs. of lint.

Even though yield differences were not statistically significant among the 5 tillage treatments, cost of production data comparing the CT, MB, and CH treatments with the MT and MTC systems should favor the latter since fewer trips over the field were required (cost data not shown).

Yield values averaged for the CT, MB, and CH treatments (which required 10 trips over the field) and compared to MT and MTC systems (which required 6 trips), show

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differences for years with below average precipitation. Cab CS and D&PL produced an additional 63 and 69 lb lint/A respectively, with the reduced till treatments. The NT system produced lower yields but compared favorably with the CT, MB, and CH systems. The D&PL cultivar with NT produced an additional 53 lb lint/A compared to Cab CS, (Fig. 3).

During the years of average rainfall, (1992 and 1995), yields from MT and MTC compared favorably with CT, MB, CH (Cab CS, 846 lb/A versus 803 lb/A and D&PL, 788 lb/A versus 810 lb/A). No till cotton showed a yield of 503 lb/A for Cab CS and 584 lb/A for D&PL (Fig. 4).

When data is averaged over cultivars and years (Fig. 5) to compare tillage systems, yields rank in the following order: MTC (574 lb/A), MT (558 lb/A NT (415 lb/A), 12-inch MB (555 lb/A) and NT (415 lb/A). Yields increased by 143 lb/A when zero tillage was changed to MT but only 16 lb/A when in-row chiseling at 16-inch depth was included with the MT system (MTC). At the same time yields decreased by 19 lb/A when the primary tillage was moldboarding at 12-inch depth (Fig. 5). The relatively small increase in yield from performing the deep chiseling as part of the primary tillage operation would not be cost effective.

With adequate precipitation (1992 and 1995), MT substantially increased yields (247 lb/A) over NT (Fig. 6). An additional yield of 53 lb/A was measured from adding in-row chisel to the MT treatment. At the same time, 12-inch MB decreased yields by 57 lb/A as compared to MTC.

In the years with below average precipitation, the yield advantage from MT over NT was 49 lb/A while yields for MT and MTC were equal (Fig. 7). Again, inverting the soil or moldboarding (MB) decreased yields by 61 lb/A which ranked lower than the NT treatment. Corn and sorghum plots were grown on either side of the cotton plots and most modern herbicide technology could not be used on the NT cotton plots due to risk of chemical drift. The authors believe that the NT yields were reduced due to this small plot arrangement.

Summary

In seasons with adequate precipitation, cotton grown under minimum tillage produced equivalent yields to that produced with conventional tillage. With below average rainfall, minimum tillage yielded more lint per acre than conventional tillage. Yields averaged over the 6-year period for minimum till compared favorably with the conventional tillage for both cultivars. No statistically significant yield response to fertilizer nitrogen was measured for either cultivar. The no-till system produced the lowest lint yields in most yields. This was largely attributed to weed pressure resulting from limitations in use of new herbicide technology in the small confined, multi crop specie, split-plot experimental test site.

In summary, the results indicate that the minimum till form of conservation tillage is feasible in the production of cotton in south Texas. However, additional research on factors affecting conservation tillage such as weed control, possibly insect control, increased disease possibility and fertilizer nutrient availability is needed. Also, additional work is needed on the NT tillage practice (fertilizer placement, seed treatment, weed control) etc. in order to produce yields more competitive with minimum till systems developed for south Texas.

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Table 1. Monthly rainfall in inches at Corpus Christi, TX, 1991-1996.

	96	95	94	93	92	91
January	0.00	0.63	0.79	0.40	3.03	1.78
February	0.06	2.38	0.85	1.58	3.40	1.43
March	0.05	3.51	2.23	2.76	4.11	0.91
April	1.31	0.3	2.26	2.13	2.29	3.23
May	0.93	3.18	1.55	6.80	7.67	3.59
June	2.33	2.25	3.20	8.49	2.26	8.56
July	0.04	0.64	0.70	0.00	0.77	1.43
Totals	*4.72*	*12.89*	*11.58*	*22.16*	*23.53*	*20.93*

Table 2. Description of tillage treatments.

CT (Conventional)	MB (12"Moldboard)	CH (12" Chisel)
Shred Stalks	Shred Stalks	Shred Stalks
Disk	Disk	Disk
Bed out Stalks	Moldboard 12"	Chisel 12"
Rebed	Bed	Bed
Run Middles (2X)	Run Middles (2X)	Run Middles (2X)
Plant	Plant	Plant
Cultivate (3X)	Cultivate (3X)	Cultivate (3X)
MT (Minimum till)	MTC (Min. Till Chisel)	NT (No-Till)
Shred	Shred	Shred
Root Plow & Bed	I.R. Chisel, Bed	Spray (2X)
Run Middles	Run Middles	Plant
Herbicide	Herbicide	Spray
Plant	Plant	Post Emerg. Spray
Cultivate	Cultivate	

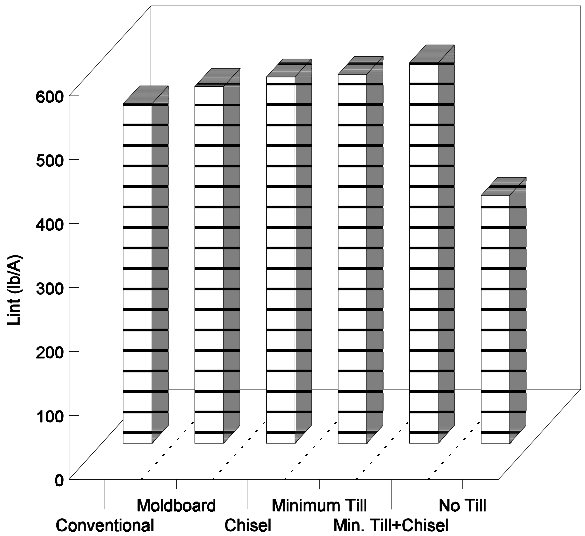

Figure 1. Comparison of six tillage systems on 6-year average yields from early maturing cultivar (CABCS).

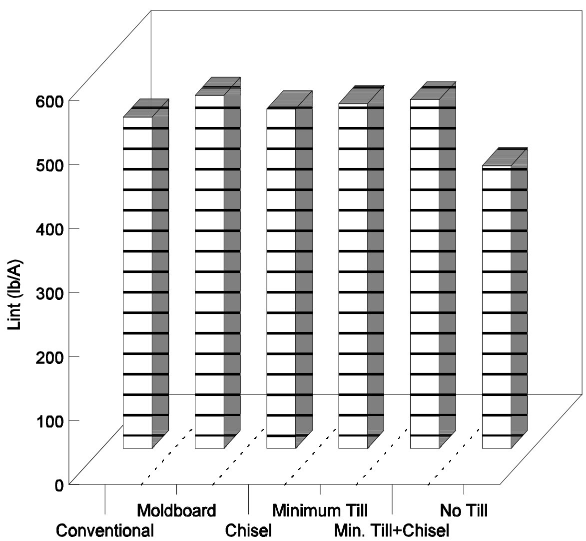

Figure 2. Comparison of six tillage systems on 6-year average yields from slightly later maturing cultivar (D&PL).

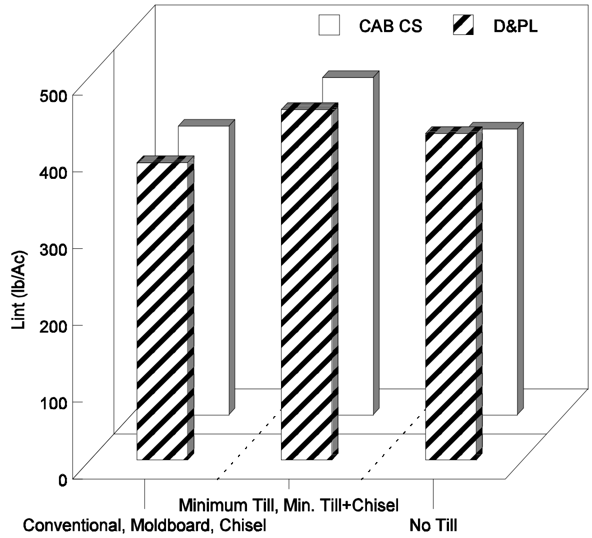

Figure 3. Comparison of conservation tillage systems with conventional and deep plow systems on average lint yields for two cultivars in seasons with below average rainfall.

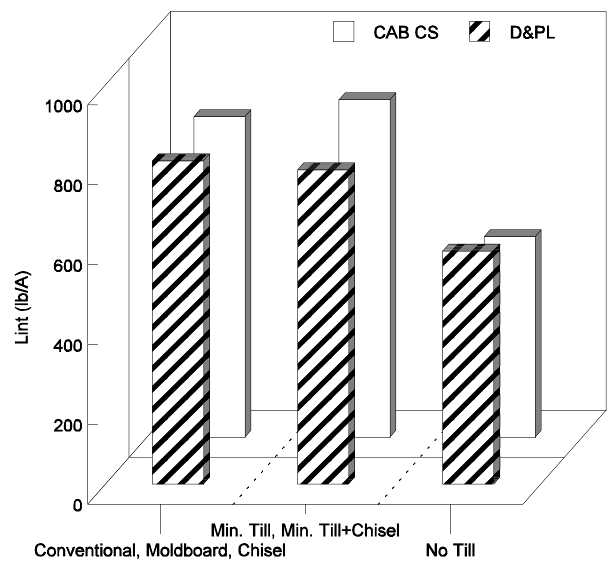

Figure 4. Comparison of conservation tillage systems with conventional and deep plow systems on average lint yields for two cultivars in seasons with adequate rainfall (1992, 1995).

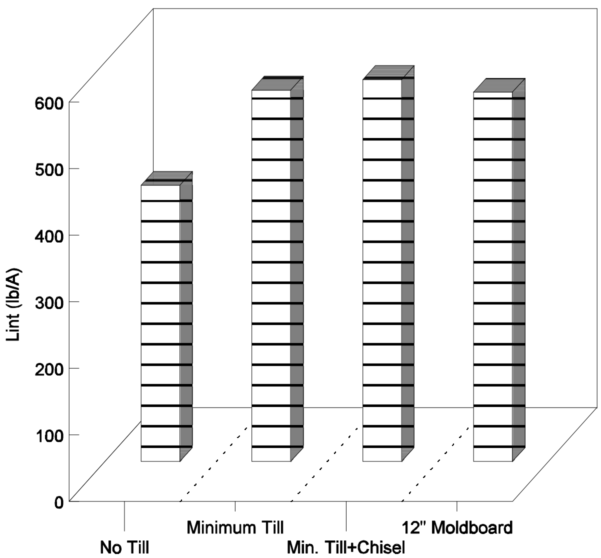

Figure 5. Effects of deep tillage compared to three conservation tillage systems on lint yields averaged over six years and two cultivars.

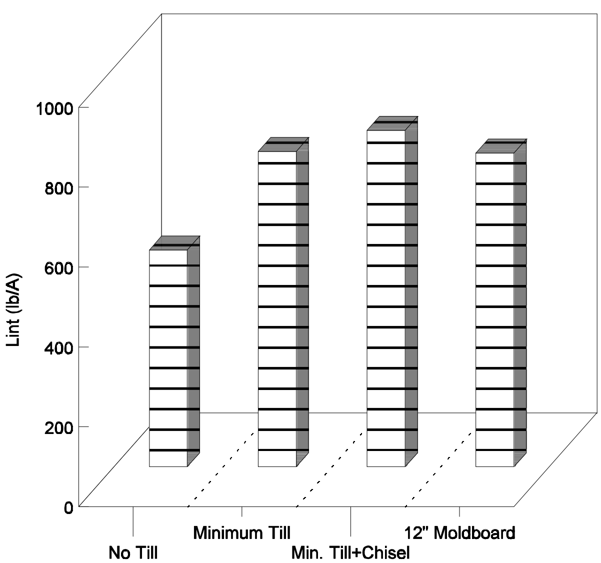

Figure 6. Effects of deep tillage compared to three conservation tillage systems on lint yields averaged over two seasons of adequate rainfall and two cultivars.

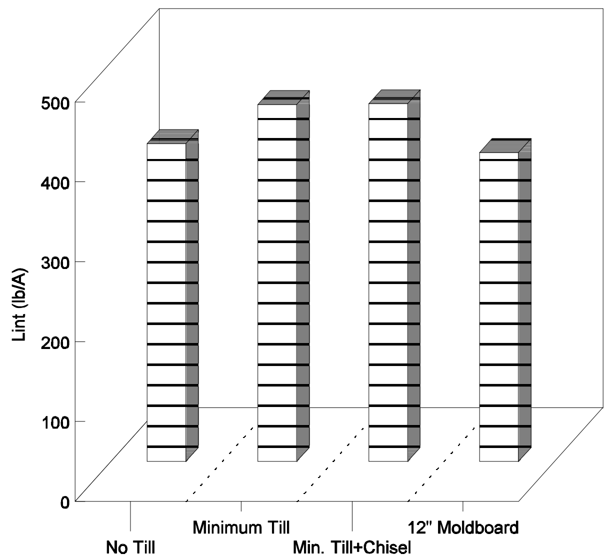

Figure 7. Effects of deep tillage compared to three conservation tillage systems on lint yields averaged over two seasons of below average rainfall and two cultivars.