DRYLAND COTTON LINT YIELD AND QUALITY RESPONSE IN LONG-TERM CONVENTIONAL AND NO-TILL SYSTEMS IN SOUTHWEST OKLAHOMA

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Abstract

Profitability of dryland cotton production continues to be a major producer concern in southwestern Oklahoma. Many production factors influence profitability, and one of these can be tillage system. The objective of this project was to compare long-term no-till and conventional tillage practices and determine their impact on cotton lint yield and quality under dryland conditions. A long-term dryland project was initiated at the OSU Southwest Research and Extension Center near Altus, OK in 2003. The study is a split-plot experimental design with three replicates. Tillage types are considered main plots (conventional tillage and no-tillage) with various monocrops (cotton, wheat and grain sorghum) and crop rotations (cotton-wheat-grain sorghum, cotton-wheat, cotton-grain sorghum, and wheat-double crop grain sorghum-cotton) as sub-plots. One of the sub-plot treatments is continuous cotton, and lint yield and quality data from 2003-2015 for the conventional tillage and no-tillage continuous cotton were analyzed. Seedbed preparation for the conventional tilled plots includes primary tillage using a chisel plow and disking in the spring. Cotton stalks are rotary mowed each year after harvest. No-till plots receive no tillage operations. Results from the 9-year combined analysis of this project indicate that tillage system had minimal effect on fiber properties, but both lint yield and net returns above agronomic inputs were statistically increased under the no-till management system when compared to the conventional system.

Introduction

Profitability of dryland cotton production continues to be a major producer concern in southwestern Oklahoma, as well as across the entire Cotton Belt. Many production factors influence profitability, and one of these can be tillage system. The objective of this project was to compare long-term no-till and conventional tillage practices and determine their impact on cotton lint yield and quality under dryland conditions.

Materials and Methods

A long-term dryland project was initiated at the OSU Southwest Research and Extension Center near Altus, OK in 2003 on a fine, mixed, superactive, thermic Vertic Paleustolls soil. It is currently one of the longest continuous no-till projects in the state. The study is a split-plot experimental design with three replicates. Tillage types are considered main plots (conventional tillage and no-tillage) with various monocrops (cotton, wheat and grain sorghum) and crop rotations (cotton-wheat-grain sorghum, cotton-wheat, cotton-grain sorghum, and wheat-double crop grain sorghum-cotton) as sub-plots. In 2014, the experimental focus was changed and some crops were omitted and others added. However, one of the sub-plot treatments is continuous cotton, and lint yield and quality data from 2003-2015 for the conventional tillage and no-tillage continuous cotton will be reported. Experimental unit size is 30 ft wide by 75 ft long with 40-inch row spacing. Seedbed preparation for the conventional tilled plots includes primary tillage using a chisel plow and disking in the spring. Cotton stalks are rotary mowed each year after harvest. No-till plots receive no tillage operations. Seeding rate has been 3 seeds/row-ft or about 40,000 seed per acre. Herbicide applications included trifluralin (preplant, 1 qt./acre); Roundup (post-emergence, 1 or 2 applications, typically 22 or 32 oz/acre); and Dual Magnum (post-emergence, 1 pt/acre as needed). Nitrogen application has been 60 lb N/acre, the recommendation for about 1 bale/acre yield goal. Phosphorus and potassium fertilizer additions were based on soil testing and applied as needed.

Cotton data from 2006 were lost due to drought. Unfortunately, due to persistent Extreme to Exceptional Drought (D3 and D4 categories as defined by the U.S. Drought Monitor), various crops including cotton failed in 2011, 2012, and 2013. From 2003 through 2010, 1/1000th of an acre was hand harvested from each of the center two rows of each plot. Beginning in 2014, harvested area was the center two rows by entire plot length (75 ft) and a modified John Deere 482 plot stripper harvester was used.

Samples were taken from each plot and were ginned on a plot gin. Lint turnout for each plot was used to convert plot bur cotton weights to lint per acre. Ginned lint was submitted to the Texas Tech University Fiber and Biopolymer Research Institute for High Volume Instrument (HVI) analyses. Loan value for all years was determined using HVI data and the 2015 Upland Cotton Loan Valuation Model (Falconer, 2015). With respect to net returns above agronomic inputs, the crop lint value was not based on Commodity Credit Corporation Loan rate, but average crop prices received in the area for each year of the project. Net returns above agronomic inputs were based on custom rates provided by OSU Extension agricultural economists. Agronomic inputs include various tillage or other operations based on average prices provided in the Oklahoma Farm and Ranch Custom Rates Publication, CR-205 in each respective year (Doye and Sahs, 2014).

The GLM procedure was used for by-year analysis and data were combined across years using the Mixed procedure in SAS 9.4 for Windows. Year and Replicate(Year) were considered random effects. Planting and harvesting dates and varieties planted in each year are provided in Table 1.

Table 1. Planting date, variety planted and harvest dates.

Year	Planting Date	Variety	Harvest Date
2003	5/22/2003	PM2266RR	12/5/2003
2004	5/19/2004	PM2266RR	11/7/2004
2005	5/20/2005	PM2266RR	11/23/2005
2006	6/6/2006	PM2266RR	Crop Failure - Drought
2007	5/30/2007	PM2266RR	11/7/2007
2008	5/21/2008	FM9058F	11/20/2008
2009	5/26/2009	DP 174RF	11/20/2009
2010	5/12/2010	DP 174RF	11/10/2010
2011	6/8/2011	DP 1044 B2RF	Crop Failure - Drought
2012	6/15/2012	DP 1044 B2RF	Crop Failure - Drought
2013	6/5/2013	DP 1044 B2RF	Crop Failure - Drought
2014	6/20/2014	DP 1044 B2RF	11/18/2014
2015	6/11/2015	DP 1044 B2RF	10/21/2015

Results and Discussion

Results are presented in Table 2. Tillage system effects on lint yields indicated somewhat mixed results. Early yield data were variable. However, results from later years indicated a more favorable yield response to no-till compared to conventional. When combined across years, the no-till system averaged 49 lb/acre higher lint yield when compared to conventional. The combined analysis also indicated that net returns above agronomic inputs favored the no-till system by $69/acre over conventional, and this difference was highly significant. No consistent tillage system effects were observed for any fiber properties including Loan value in the by-year analysis, and the combined analysis indicated that no statistically significant effects were noted across the 9 years reported.

Summary and Conclusions

Results from the 9-year combined analysis of this project indicate that tillage system had minimal effect on fiber properties, but both lint yield and net returns above agronomic inputs were statistically increased under the no-till management system when compared to the conventional system.

Table 2. Lint yield, net returns, HVI fiber properties, and 2015 Loan value.

Year	System	Lint yield	Net returns above agronomic inputs	Micronaire	Length	Uniformity	Strength	2015 Loan
		lb/acre	$/acre	units	100ths inch	%	g/tex	$/lb
2003	Conventional	282	25	4.7	0.97	81.1	30.5	0.4960
	No-till	194	107	4.7	0.99	82.6	31.3	0.4916
	CV, %	7.3	17.2	2.6	1.2	1.4	3.5	1.3
	Pr>F	0.0245	0.0126	1.0000	0.1835	0.2541	0.4771	0.4851
2004	Conventional	317	50	4.2	1.02	83.3	30.2	0.5195
	No-till	271	76	4.2	0.99	82.1	31.6	0.5040
	CV, %	30.9	74.7	3.4	1.9	1.1	0.7	1.9
	Pr>F	0.6031	0.5685	1.0000	0.1885	0.2567	0.0127	0.1858
2005	Conventional	664	221	3.5	1.01	80.3	30.2	0.4930
	No-till	617	226	3.5	0.99	81.3	29.3	0.4872
	CV, %	10.3	15.4	5.3	3.5	2.2	3.8	3.2
	Pr>F	0.4781	0.8834	1.0000	0.5601	0.5549	0.4069	0.6904
2007	Conventional	623	190	4.5	1.01	81.1	29.2	0.5030
	No-till	740	303	4.2	1.02	81.8	31.2	0.5150
	CV, %	15.7	23.9	4.9	2.4	0.7	2.0	2.2
	Pr>F	0.3151	0.1439	0.2254	0.6667	0.2421	0.0579	0.3170
2008	Conventional	193	-45	4.6	1.00	78.5	26.7	0.4955
	No-till	275	21	4.6	1.07	78.2	29.5	0.5371
	CV, %	14.0	141.8	3.9	4.7	1.8	5.3	5.9
	Pr>F	0.0913	0.0416	0.8399	0.2030	0.8229	0.1490	0.2346
2009	Conventional	328	34	3.9	1.08	80.3	27.1	0.5453
	No-till	298	67	4.0	1.06	79.7	26.4	0.5365
	CV, %	17.2	61.5	7.2	1.7	0.8	2.8	3.6
	Pr>F	0.5695	0.3229	0.5492	0.3701	0.3628	0.3897	0.6372
2010	Conventional	280	336	3.8	1.05	79.0	25.4	0.5085
	No-till	401	482	4.0	1.05	78.9	25.9	0.5263
	CV, %	22.5	22.5	4.5	3.3	1.9	7.3	6.2
	Pr>F	0.1909	0.1922	0.2495	0.9175	0.9426	0.7607	0.5675
2014	Conventional	417	95	4.8	1.11	82.7	33.0	0.5500
	No-till	475	155	4.7	1.11	81.9	33.2	0.5553
	CV, %	26.0	56.8	2.3	2.3	0.4	3.8	1.6
	Pr>F	0.5983	0.4068	0.2697	1.0000	0.1093	0.9086	0.5452
2015	Conventional	392	80	4.0	1.08	81.6	29.2	0.5628
	No-till	486	175	4.2	1.08	81.5	28.6	0.5576
	CV, %	4.3	9.0	5.2	2.0	0.3	7.2	2.5
	Pr>F	0.0257	0.0096	0.3169	1.0000	0.7072	0.7584	0.6950
All years	Conventional	378	110	4.2	1.03	80.9	29.1	0.5193
	No-till	427	179	4.2	1.04	80.9	29.7	0.5234
	Pr>|t|	0.0186	<0.0001	0.6305	0.6067	0.9501	0.1204	0.4447

Acknowledgements

This project was supported by the Oklahoma State Support Committee – Cotton Incorporated, and the OSU Integrated Pest Management Program. The authors also thank Larry Bull, Rocky Thacker and the staff at the Southwest Research and Extension Center at Altus for their excellent cooperation.

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