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Cotton Incorporated

Arkansas ROW CROP VERIFICATION

Economics and Sustainability Overview of Arkansas Cotton Research and Sustainability Program

Amanda Free,[1] Bill Robertson,[1] Breana Watkins,[2] Mike Daniels,[3]
Steve Stevens,[4] Joe Whittenton,[5] David Wildy[6]

Abstract

Practices that lead to improved soil health often improves profitability and sustainability as well as having a positive impact on field's environmental footprint. The objectives of this project is to: improve efficiency specifically regarding irrigation water use, increase soil health, and document differences in farmer standard tillage fields to that of a modified production system no-till cover through utilization of the Fieldprint Calculator. The University of Arkansas Cotton Research Verification Sustainability program conducted research along with Discovery Farms in two fields in Southeast Arkansas in 2015-2017. Each field was composed of two irrigation sets allowing for evaluation of farmer standard practices, till no-cover to that of a modified production system no-till cover. In 2016, an additional three new fields was added with first time cover crops. All fields were monitored for inputs and entered into the Fieldprint Calculator and used to calculate expenses. Yield on no-till cover increased an average of 9.30% and was $0.05 per pound cheaper to produce than Farmer Standard tillage no-cover in 2015-2017. The metrics from the Fieldprint Calculator all favored no-till cover with regards to improving sustainability. Soil conservation or erosion was reduced by 77.85% and greenhouse gas emissions decreased by 11.48%. Through the use of no-till and cover crops in this study several improvements were observed, resulting in increased yield, decreased footprint size, and increased profitability.

Introduction

As cost of production continues to increase, producers are striving to increase profitability, the key to remaining profitable is to continuously introduce technologies that will improve efficiency. Cotton producers utilize many different production practices to improve efficiency and profitability as not any one practice will benefit all producers. Producers are often hesitant when it comes to adopting new technology not only due to the associated costs, but also having concern about irrigation efficiency when converting to no-till with cover. The University of Arkansas, Division of Agriculture, has been conducting the Cotton Research Verification Program (CRVP) since 1980 with the objective of demonstrating the profitability of University production recommendations. The Cotton Research Verification Sustainability Program (CRVSP) conducted research in three Arkansas counties in 2017: Desha, Mississippi, and St. Francis. In Desha County, the

[1] Cotton Research Verification Sustainability Program Coordinator and Professor/Cotton Agronomist, respectively, University of Arkansas System Division of Agriculture, Newport Extension Center, Newport.
[2] Program Associate- Economics, University of Arkansas System Division of Agriculture, Craighead County Extension Office, Jonesboro.
[3] Professor, Extension Water Quality, University of Arkansas System Division of Agriculture, Department of Crop, Soils, and Environmental Sciences, Little Rock.
[4]Producer, Discovery Farms, Dumas
[5]Producer, Forrest City
[6]Producer, Manila

CRVSP conducted research along with Discovery Farms in Southeast Arkansas for two fields Shopcot and Weaver fields. Discovery farms main focus is on Edge of Field water quality, where they trace irrigation efficiency and nutrient and sediment losses. All fields in Desha County were composed of two irrigation sets allowing for evaluation of farmer standard practice to that of a modified production system. Allowing for comparisons to be made on how each impacted edge of field water quality and ultimately profitability and sustainability of each fields system. Fields located in Mississippi and St. Francis counties are not composed of two irrigation sets, fields still remain split in half for observation of farmer standard to that of a modified production system no-till cover.

All fields are monitored for inputs and were entered into the Fieldprint Calculator. The Fieldprint Calculator is a relatively new tool developed by Field to Market: The Alliance for Sustainable Agriculture. The Fieldprint Calculator was designed in an effort to help educate producers on how adjustments in management could affect environmental factors. Utilization of the calculator assists producers by making estimates over seven sustainability factors: land use, soil conservation, soil carbon, irrigation water use, water quality, and greenhouse gas emissions. Fieldprint Calculator estimates fields' performance and compares results to national and state averages. Calculated summaries give producers insight to the ability areas for improved management on their farm.

The objectives of this project are to:

1. Improve efficiency: specifically regarding irrigation water use.
2. Increase Soil Health
3. Document differences in farmer standard tillage fields to that of a modified production system no-till cover through utilization of the Fieldprint Calculator.

Procedures

The 2017 CRVSP was comprised of five fields which allowed for observation of two systems farmer standard tillage was compared to a modified production system no-till cover in an effort to improve efficiency, profitability, sustainability and soil health. Elbon Cereal Rye was the cover crop used in all no-till cover fields, and it was broadcast at a rate of 56 pounds per acre. The fields in this project averaged approximately 40 acres in size with each practice comprised half of the field. Throughout the study all producers' inputs were recorded providing the information needed to calculate both fixed and variable costs. Field data was collected through utilization of soil penetrometers, soil moisture sensors, rain gauges, Et gauges, flow meters and trapezoidal flumes. Soil penetrometers were used to measure soil compaction throughout the season in both no-till with cover and farmer standard tillage. A set of three soil Watermark soil moisture sensors were also placed in both no-till with cover and farmer standard tillage at 6, 12, and 18 inches. Et gauges wereadjusted after each rainfall or irrigation event at all fields and was used to trigger irrigations. We had a unique opportunity to determine exactly how efficient each rainfall or irrigation event was through the use of trapezoidal flumes at the Discovery farm fields. Being able to calculate both rainfall and irrigation efficiency of those two fields allowed us to set the Et gauges accurately. In the other three fields an estimate was made on how efficient each irrigation or rainfall event was believed to have been and adjusted

accordingly. Flow meter readings allowed for documentation for how much water was applied across furrow irrigated fields. Periodically throughout the growing season holes were dug, and several earthworms were spotted. Visually across all fields soil structure seemed to be improving with several noticeable earthworm channels. Plots were machine harvested.

Results and Discussion

Soil compaction was consistently lower in no-till with cover, soil moisture was consistently higher in no-till with cover, and irrigation water flow rates down the row was slower in no-till with cover. There was concern initially that water flow rates down the row would be a problem in no-till with cover fields. After the first irrigation this was no longer a concern and actually resulted in a benefit. After large rain events we observed that no-till with cover infiltrates water quicker which allows for decreased runoff when compared to that of a stale seedbed re-hipped with a cover crop. Across all fields, no-till with cover had one tillage operation FurrowRunner vs. multiple tillage operation in farmer standard tillage. The FurrowRunner allowed for a narrow trench in the furrow to help with water movement while leaving all cover crop residue on the sides of the furrow and top of the row, only having minimal disturbance. Water movement slowed as water worked its way through stubble allowing for better water infiltration and less runoff. The fields had an increased yield primarily as a result of increased soil health, with no-till cover producing 1236 lb. lint/A when compared to farmer standard tillage producing 1121 lb. lint/A. Improvements were also observed with regard to sustainability measures with an established no-till cover crop production system when compared to farmer standard tillage practice (Table 1). The environmental footprint calculated by Fieldprint Calculator, showed a smaller or more sustainable footprint in no-till with cover.

Practical Applications

In this study no-till with cover increased water use efficiency. Although water movement through the field is slower than till no-cover, better water infiltration and less runoff was seen. No significant differences were observed for lint yield with 1236 lb. lint/A for no-till with cover and 1121 lb. lint/A for the farmer standard practice. Additional research is needed to further evaluate how profitability, irrigation water use efficiency, size of environmental footprint, soil health and continuous improvement are related.

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Table 1: 2017 Sustainability Measures: Improvements with No-till vs. Farmer Standard Tillage

Parameters	No-till Cover	Till No-cover	% Change No-till vs. Till
Yield (lb. lint har./A)	1236	1121	9.30%
Operating Expenses ($/A)	564.07	547.24	2.98%
Operating Expenses ($/lb. lint/har.)	0.457	0.507	-10.94%
Land Use (A/lb. lint eq.)	0.00068	0.00075	-10.29%
Soil Conservation (Tons/lb. lint eq./yr.)	0.00066	0.00298	-77.85%
Irrigation Water Use (A-in./lb. lint eq. above dryland lint eq.)	0.024	0.025	-4.17%
Energy Use (BTU/lb. lint eq.)	5304	5923	-11.67%
Greenhouse Gas Emissions (lb. CO_2eq./lb. lint eq.)	1.22	1.36	-11.48%

Table 2. Summary of revenue and expenses per acre for 2017 Cotton Research Verification Sustainability Program fields comparing farmer standard tillage (FS) with or without cover crop to no-till (NT) with cover crop.

	Field												
Revenue/Expenses	**Shop NT/C**	**Shop FS/ NC**	**Weaver NT/C**	**Weaver FS/NC**	**Grain Bin NT/C**	**Grain Bin FS/NC**	**Homeplace FS/NC**	**Wellcot FS/NC**	**Manila NT/C**	**Manila FS/C**	**Conder NT/C**	**Conder FS/NC**	**Average**
Revenue													
Yield (lb)	1391.0	1228.0	1305.0	1225.0	1202.0	1253.0	1026.0	725.0	1021.0	1717.0	1335.0	1555.0	1248.6
Price ($/lb)	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.70
Total Crop Revenue	**1001.52**	**884.16**	**939.60**	**882.00**	**865.44**	**902.16**	**738.72**	**522.00**	**735.12**	**1236.24**	**961.20**	**1119.60**	**899.00**
Cottonseed Value[a]	208.65	184.20	195.75	183.75	180.30	187.95	153.90	108.75	213.90	257.55	200.25	233.25	192.40
Expenses													
Seed	115.75	96.50	119.01	99.76	144.50	123.50	99.61	93.76	137.46	124.86	141.80	122.20	118.20
Fertilizer & Nutrients	85.18	85.18	85.18	85.18	85.18	85.18	85.18	85.18	47.72	47.72	74.53	74.53	77.20
Herbicides	101.58	80.10	78.02	87.94	124.86	115.58	114.43	116.55	119.32	119.32	98.36	86.18	103.50
Insecticides	96.80	93.50	96.80	96.81	88.68	93.50	93.50	125.70	81.14	81.14	52.71	52.71	87.70
Other Chemicals	26.86	36.75	47.66	35.81	36.46	36.46	36.46	28.49	46.80	46.80	63.78	58.98	41.80
Custom Applications	63.00	56.00	63.00	49.00	60.20	49.00	42.00	49.00	10.92	7.00	42.00	42.00	44.40
Other Inputs	3.88	3.88	3.88	24.29	3.88	3.88	3.88	3.88	27.64	32.49	22.24	25.91	13.30
Diesel Fuel	19.73	23.62	20.12	10.94	19.73	23.85	20.87	22.00	11.38	13.77	10.95	13.77	17.60
Irrigation Energy Costs	15.75	13.66	10.49	14.29	8.92	11.89	12.37	27.88	26.77	26.77	3.21	3.21	14.60
Input Costs	**528.53**	**489.18**	**524.15**	**504.00**	**572.40**	**542.83**	**508.29**	**552.44**	**509.14**	**499.85**	**509.58**	**479.49**	**518.30**
Fees	22.41	22.41	22.41	22.41	22.41	22.41	22.41	22.41	22.41	22.41	22.41	22.41	22.40
Repairs and Maintenance[b]	28.34	30.47	28.03	26.12	27.77	30.62	28.53	31.09	28.50	30.11	27.95	29.70	28.90
Labor, Field Activities	27.82	30.54	28.11	8.64	27.69	30.61	28.42	29.55	7.35	9.09	6.63	8.77	20.30
Production Expenses	**607.10**	**572.61**	**602.69**	**561.17**	**650.27**	**626.46**	**587.65**	**635.49**	**567.40**	**561.46**	**566.56**	**540.37**	**589.90**
Interest	12.75	12.02	12.66	11.78	13.66	13.16	12.34	13.35	11.92	11.79	11.90	11.35	12.40
Post-harvest Expenses	208.65	184.20	195.75	183.75	180.30	187.95	153.90	108.75	213.90	257.55	200.25	233.25	192.40
Operating Expenses	**619.85**	**584.63**	**615.35**	**572.95**	**663.92**	**639.62**	**599.99**	**648.83**	**579.32**	**573.25**	**578.46**	**551.71**	**602.30**
Returns to Op. Expenses	**381.67**	**299.53**	**324.25**	**309.05**	**201.52**	**262.54**	**138.73**	**-126.83**	**155.80**	**662.99**	**382.74**	**567.89**	**296.70**
Cap. Recovery and Fixed Costs	146.65	160.21	145.75	132.39	146.09	163.81	149.01	163.90	150.01	160.33	162.17	168.09	154.00
Total Specified Expenses[c]	**766.50**	**744.85**	**761.10**	**705.35**	**810.02**	**803.43**	**749.00**	**812.73**	**729.33**	**733.59**	**740.63**	**719.80**	**756.40**
Returns to Spec. Expenses	**235.02**	**139.31**	**178.50**	**176.65**	**55.42**	**98.73**	**-10.28**	**-290.73**	**5.79**	**502.65**	**220.57**	**399.80**	**142.60**
Operating Expenses/ lb	0.45	0.48	0.47	0.47	0.55	0.51	0.58	0.89	0.57	0.33	0.43	0.35	0.50
Total Expenses/ lb	0.55	0.61	0.58	0.58	0.67	0.64	0.73	1.12	0.71	0.43	0.55	0.46	0.60

[a] Price includes cottonseed value equal to post-harvest expenses with a $0.05/ lb premium added to lint price.

[b] Includes employee labor allocated to repairs and maintenance.

[c] Does not include land costs, management, or other expenses and fees not associated with production.