COTTON RESEARCH VERIFICATION SUSTAINABILITY PROGRAM: SUSTAINABILITY REPORT

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Abstract

Practices that lead to improved soil health often improve profitability and sustainability, having a positive impact on a field's environmental footprint. The objectives of this project were to 1) improve efficiency specifically regarding irrigation water use, 2) increase soil health, and 3) document differences in farmer standard tillage fields from that of a modified production system no-till cover through the utilization of the Fieldprint Calculator. The University of Arkansas System Division of Agriculture's Cotton Research Verification Sustainability program conducted research in ten fields in 2020. Each field included different irrigation sets, which allowed for comparison of farmer standard practices (till no-cover) to that of a modified production system (no-till cover), with the exception of the USTP/BCI dryland fields and the St. Francis County pivot irrigated fields. All fields were monitored for inputs, entered in the Fieldprint Calculator, and used to calculate expenses. The yield on no-till cover increased an average of 1.59% and was $0.01/lb lint cheaper to produce than Farmer Standard tillage no-cover in 2020. Most of the metrics from the Fieldprint Calculator favored no-till cover with regards to improving sustainability. Soil conservation or erosion was reduced by 69.57%, and greenhouse gas emissions decreased by 3.95%. Several improvements were observed by using no-till and cover crops in this study resulting in increased yield, decreased footprint size, and increased profitability.

Introduction

As the cost of production continues to increase, producers must be more efficient to be profitable. The key to remaining profitable is to strive for continuous improvement in all aspects of their operation. Cotton producers utilize many different production practices to improve efficiency and profitability. Producers are often hesitant to adopt new no-till with cover technology not only due to the associated costs but also concerns about irrigation efficiency. The University of Arkansas System 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. All field inputs are now entered into the Fieldprint Calculator. The Fieldprint Calculator, https://calculator.fieldtomarket. org/#/, is a 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 eight sustainability factors: land use, soil conservation, soil carbon, irrigation water use, water quality, energy use, biodiversity, and greenhouse gas emissions. Fieldprint Calculator estimates fields' performance and compares results to national and state averages. Calculated summaries give producers insight into the ability areas for improved management on their farm.

Materials and Methods

The Cotton Research Verification Sustainability Program (CRVSP) conducted research in 10 fields in four locations (Clay County (2), Desha County (4), St. Francis County (2), and Agricenter field (2)) in 2020. In Desha County, the CRVSP conducted research in conjunction with Discovery Farms in Southeast Arkansas https://aaes.uark. edu/centers-and-programs/discovery-farm-program/. The Discovery Farm's focus is on edge-of-field water quality, where they trace irrigation efficiency and nutrient and sediment losses. All fields in Desha County included two irrigation sets, farmer standard practice, and a modified irrigation system. Comparisons were made on how each irrigation set impacted edge-of-field water quality and ultimately the profitability and sustainability of each system. Fields located in Clay County, Agricenter, and St. Francis County were not monitored for edge-of-field water quality. However, fields were established for observation of farmer standard practices compared to that of a modified production system using a no-till cover crop. In fall 2019, all no-till cover fields were broadcast seeded with 'Elbon' cereal rye at a target seeding rate of 56 lb/ ac with exception to USTP/BCI field. The USTP/BCI no-till cover field is the only one within the study that had a cover crop blend that consisted of 25 lb/ac cereal rye, 25 lb/ ac black oats, and 2 lb/ac hairy vetch.

Fields in this project averaged approximately 40 ac, with each system comprising 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 were collected by soil moisture sensors, rain gauges, flow meters, and trapezoidal flumes. A set of four soil Watermark soil moisture sensors were also placed in both no-till with cover and farmer standard tillage at 6, 12, 18, and 30 inches. The trapezoidal flumes at the Discovery Farm fields allowed us to determine the exact efficiency of each rainfall or irrigation event. Flow meter readings documented how much water was applied across furrow irrigated fields.

Results and Discussion

Concern that water would not flow well down the row in no-till with cover crop fields was alleviated after the first irrigation. After large rainfall events, we observed that water infiltrated quickly in no-till cover crop system, which decreased runoff when compared to a stale seedbed re-hipped. The producer in Clay County fields elected to run tillage equipment to flatten the top of rows for planting, all other no-till cover fields had no tillage operations compared to multiple tillage operations on most farmer standard tillage fields. The fields had an increased yield primarily as a result of increased soil health, with no-till cover producing 1299 lb lint/ac when compared to farmer standard tillage producing 1279 lb lint/ac. (Table 1) 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. The environmental footprint calculated by the Fieldprint Calculator showed a smaller or more sustainable footprint in no-till with cover.

Table 1. Harvested Lint yield, operating expenses and metrics used to evaluate sustainability as affected by tillage and cover crops.

Parameters	No-till Cover	Till No-Cover	% Change No-till vs. Till
Yield (lb. lint har./A)	1299.24	1278.53	1.59%
Operating Expenses ($/A)	499.00	500.50	-0.30%
Operating Expenses ($/lb lint harvested)	0.388	0.398	-2.58%
Land Use (A/lb lint)	0.00079	0.00081	-2.59%
Soil Conservation (ton/acre/yr.)	2.3	11.1	-382.61%
Irrigation Water Use (acre_in/lb.)	0.018	0.013	28.26%
Energy Use (btu/lb.)	4731	5006	-5.82%
Greenhouse Gas Emissions (lbs. CO_2e/lb.)	1.52	1.58	-3.95%

Summary

In this five-year study (2015 to 2019) to improve soil health, no-till with cover crop practices resulted in a 6% increase in lint yield and increased water use efficiency requiring 22.45% less water to produce a pound of cotton. Irrigation water movement through the field is slower in the no-till cover because of increased water infiltration. Soil conservation or soil erosion was decreased almost 77% using no-till with cover. Additional research is needed to further evaluate how lint yield and profitability are influenced by seasonal rainfall interactions with improved water infiltration which appears to be yield limiting in the Mid-South in wet years. The adoption of practices to improve soil

health will likely be limited until producers become more comfortable in eliminating non-yield limiting practices in a no-till cover crop system to have a more consistent positive impact on profitability.

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