ECONOMICS OF COVER CROP AND SUPPLEMENTAL FERTILIZER IN STRIP-TILLAGE COTTON

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Abstract

Cover crop selection plays an important role in strip-tillage cotton production in Georgia. Some benefits of growing a cover crop in row crop systems include reduced soil erosion and the possibility for reduced fertilizer inputs. An economic analysis was conducted using a partial budget approach to determine how cover crops and supplemental nitrogen application impact profitability. Field research was conducted in Tifton, GA, in 2012 where cotton was grown under strip-tillage management following a crimson clover, vetch, rye, or wheat cover crop, or with no cover control, and fertilizer applications of zero, 30, 60, or 90 pounds of nitrogen per acre on cotton. There were a total of 80 plots (five cover crop treatments × four fertilizer treatments × four replications) in a randomized complete block design. Yield data were collected to determine gross revenue. Revenue was based on the Southeast average base price for November 2012. Gross revenue was highest when cotton followed the leguminous cover crops crimson clover and vetch. Gross revenue was also higher at 60 and 90 pounds of nitrogen per acre. Systems costs were calculated for cover crop and nitrogen fertilizer. Adjusted revenue, defined as revenue adjusted for yield, cover crop cost, and nitrogen fertilizer cost was calculated to determine the most profitable combination of cover crop and nitrogen fertilizer. Results indicate that plots following hairy vetch appeared to be the most profitable. Cotton following hairy vetch had higher average adjusted revenues ($80 per acre higher) when averaged across all supplemental nitrogen rates. Additionally, supplemental nitrogen appeared to boost profitability of strip-tillage cotton compared to zero supplemental nitrogen when averaged across all cover crops. Average adjusted revenues were $53 per acre higher at 30 lbs/acre of nitrogen, $69 per acre higher at 60 lbs/acre of nitrogen, and $103 per acre higher at 90 lbs/acre of nitrogen than the adjusted revenue for zero nitrogen. Results by cover and fertilizer treatment indicate that cotton following rye, wheat and no cover appeared more profitable with supplemental nitrogen fertilizer. Adjusted revenue from using a traditional wheat or rye cover crop and higher amounts (60 or 90 pounds) of nitrogen on cotton was similar but slightly lower than the hairy vetch cover crop. Having no cover crop resulted in the lowest adjusted revenue of any of the systems in the study. Reduced soil and wind erosion and improved soil quality are considered benefits of a cover crop but were not considered in this study.

Introduction and Objective

Cover crop selection plays an important role in strip-tillage cotton production in Georgia. Some benefits of growing a cover crop in row crop systems include reduced soil erosion and the possibility for reduced fertilizer inputs. These cover crop benefits come at a cost to growers via the seed, its planting, and consequent burn down prior to planting the cotton. The question is whether these costs are outweighed by the benefits. Supplemental fertilizer application can increase cotton yield, but that supplemental fertilizer application is only economically rational when the value of the yield is greater than the cost of the supplemental fertilizer and its application. The objective of this research was to determine how cover crops and supplemental nitrogen application on cotton impact profitability.

Data and Methods

Field research was conducted in Tifton, GA, in 2012 where cotton was grown under strip-tillage management following a crimson clover, vetch, rye, or wheat cover crop, or no cover crop (the control treatment), and supplemental applications of zero, 30, 60 or 90 pounds of nitrogen per acre on cotton. The cover crops were planted at recommended seeding rates as follows: crimson clover at 18 lbs/acre, hairy vetch at 20 lbs/acre, rye at 90 lbs/acre, and wheat at 90 lbs/acre. There were a total of 80 plots (five cover crop treatments × four fertilizer treatments × four replications) in a randomized complete block design.

An economic analysis was conducted using a partial budget approach. Yield data were collected to determine gross revenue. Revenue was based on the Southeast average price for base quality cotton (Color 41, Leaf 4, Staple 34) for November 2012 (USDA-AMS). Fiber quality differences were not considered in this study. Costs were calculated for cover crop and fertilizer expenses. Adjusted revenue, defined as gross revenue minus cover crop and fertilizer costs, was calculated for each treatment to determine the most profitable combination of cover crop and supplemental nitrogen fertilizer.

Results

Gross revenue was calculated by multiplying yield per acre by the November 2012 Southeast average base price of cotton ($0.6942 per pound). Yields for the plots planted to hairy vetch and crimson clover cover crops were higher than those planted to rye and wheat as well as the no cover control (Table 1). As a result, gross revenue was highest when cotton followed the leguminous cover crops: crimson clover and vetch.

Table 1. Average Yield and Gross Revenue by Cover Crop

Cover Crop	Yield (lbs/acre)	Gross Revenue ($/acre)
Crimson Clover	1,450	$1,007
Hairy Vetch	1,566	$1,087
Rye	1,396	$ 969
Wheat	1,414	$ 982
No Cover	1,294	$ 898

A similar result occurred in the plots receiving supplemental nitrogen (Table 2). Yields were higher for plots that received supplemental nitrogen than the plots that received zero nitrogen. As a result, gross revenues were higher for the plots that received supplemental nitrogen.

Table 2. Average Yield and Gross Revenue by Supplemental Fertilizer

Supplemental Nitrogen Rate (lbs N/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)
Zero	1,285	$ 892
30	1,406	$ 976
60	1,469	$1,020
90	1,536	$1,066

Yield and gross revenue also varied as a result of the interaction of cover crop and level of fertilizer applied on cotton (Table 3). Cotton planted after leguminous cover crops (hairy vetch and crimson clover), showed relatively high yield and gross revenue across all levels of

nitrogen. With a crimson clover cover crop, the highest cotton yield was achieved with 90 lbs/acre of nitrogen but yield was only 112 lbs/acre more than with no nitrogen. With the hairy vetch cover crop, cotton yield was highest with 30 lbs/acre of nitrogen, but yield was less than 100 lbs/acre higher than with no nitrogen.

Cotton planted after non-leguminous cover crops (rye and wheat) generally showed higher yields and gross revenues as the amount of nitrogen increased. With a rye cover crop, the highest cotton yield and gross revenue was achieved with 60 lbs/acre of nitrogen. With a wheat cover crop, highest cotton yield and gross revenue was achieved with 90 lbs/acre of nitrogen.

Cotton planted with no cover crop achieved the highest yield with 90 lbs/acre of nitrogen. Cotton with no nitrogen applied and planted after crimson clover or hairy vetch resulted in the same yield as cotton with no cover crop and 90 lbs/acre of nitrogen. The highest yields and gross returns were achieved with hairy vetch and 30 lbs/acre of nitrogen (1,640 lbs/acre) and wheat and 90 lbs/acre of nitrogen (1,604 lbs/acre).

Table 3. Average Yield and Gross Revenue by Cover Crop and Supplemental Fertilizer

Supplemental Fertilizer / Cover Crop	Zero N		30 lbs N		60 lbs N		90 lbs N	
	Yield (lbs/acre)	Gross Revenue ($/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)	Yield (lbs/acre)	Gross Revenue ($/acre)
Crimson Clover	1,438	$ 998	1,358	$ 943	1,454	$1,009	1,550	$1,076
Hairy Vetch	1,564	$1,086	1,640	$1,138	1,468	$1,019	1,590	$1,104
Rye	1,122	$ 779	1,318	$ 915	1,613	$1,120	1,531	$1,063
Wheat	1,122	$ 779	1,426	$ 990	1,506	$1,045	1,604	$1,113
No Cover	1,181	$ 820	1,287	$ 893	1,303	$ 905	1,405	$ 975

Table 3 presents yield and gross revenue for each cover crop and nitrogen combination; costs are not yet considered. Costs considered in the study were the costs associated with the cover crop and the cost of supplemental fertilizer (nitrogen). All other inputs and costs were the same for each treatment and thus need not be considered for comparison. Costs associated with the cover crop include seed, planting (fuel, labor, and repairs and maintenance of tractor and equipment), and the cost of herbicide and spraying for terminating the cover crop. Costs associated with nitrogen fertilizer include the cost of the fertilizer and the application of the fertilizer (fuel, labor, and repairs and maintenance of tractor and equipment). No fertilizer, herbicides, fungicides, or other inputs and costs were applied to the cover crops. Table 4 shows the estimated cost of each cover crop and nitrogen combination.

Table 4. Average Systems Costs per Acre by Cover Crop and Supplemental Fertilizer

Fertilizer / Cover Crop	Zero N	30 lbs N	60 lbs N	90 lbs N
Crimson Clover	$58.26	$88.50	$108.90	$129.30
Hairy Vetch	$68.06	$98.30	$118.70	$139.10
Rye	$65.37	$95.61	$116.01	$136.41
Wheat	$52.86	$83.10	$103.50	$123.90
No Cover	$ 8.47*	$38.71	$ 59.11	$ 79.51

* The No Cover, Zero N plots had a cost (herbicide and application) to terminate winter weeds.

Profitability of the cover crop and supplemental fertilizer systems was determined by calculating and comparing adjusted revenue. Adjusted revenue was calculated by subtracting the costs

associated with the various cover crops and supplemental fertilizer systems (Table 4) from gross revenue (Table 3).

When averaged across all fertilizer levels (Figure 1), cotton planted after hairy vetch appeared to be the most profitable followed by crimson clover and wheat. Cotton planted after no cover crop and after rye gave the lowest adjusted revenue.

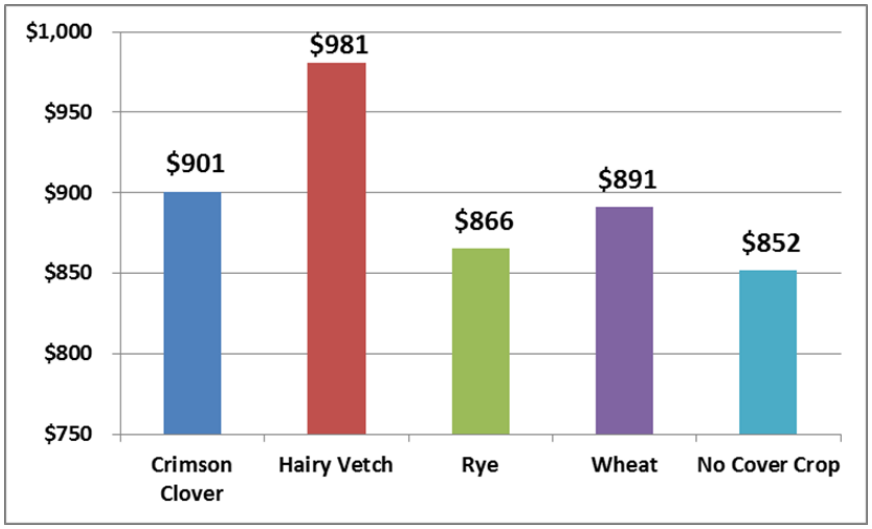

Figure 1. Average Adjusted Revenue by Cover Crop ($/acre)

When averaged across all cover crops (Figure 2), plots that received the most supplemental fertilizer (nitrogen) resulted in the highest average adjusted revenue. Adjusted revenue increased as the amount of nitrogen increased. Rates of 30, 60, and 90 lpounds of nitrogen per acre resulted in an increase in adjusted revenue of $53, $69, and $103 per acre, respectively, compared to zero nitrogen.

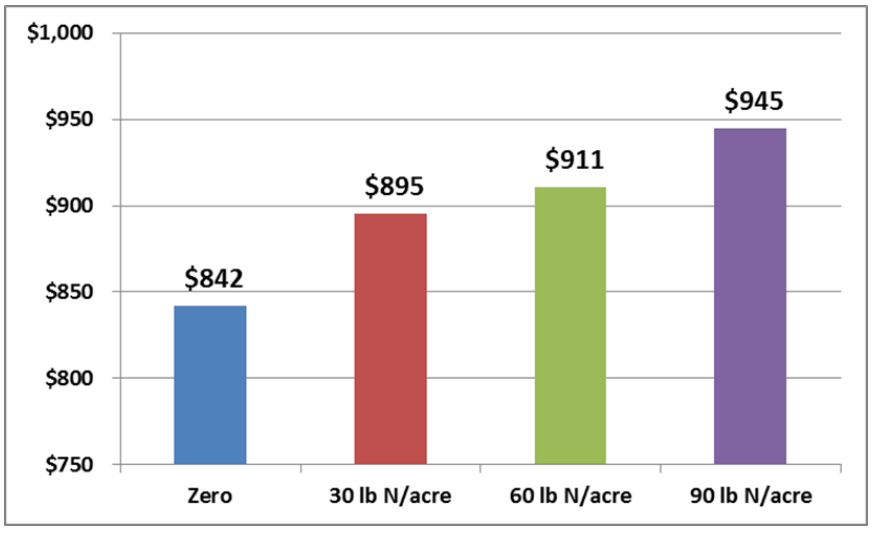

Figure 2. Average Adjusted Revenue by Supplemental Nitrogen Rate ($/acre)

Figure 3 shows the adjusted revenue by cover crop and supplemental fertilizer (nitrogen) combination. The highest adjusted revenue was achieved with cotton produced with 30 lbs/acre of nitrogen after a hairy vetch cover crop. This was followed by hairy vetch and zero nitrogen then by a rye cover crop and 60 lbs/acre of nitrogen. Cotton following traditional grass/small grain cover crops (rye and wheat) resulted in lower but similar adjusted revenue—with rye and 60 lbs/acre of nitrogen and wheat and 90 lbs/acre of nitrogen. On average, cotton produced with no cover crop resulted in lower adjusted revenue.

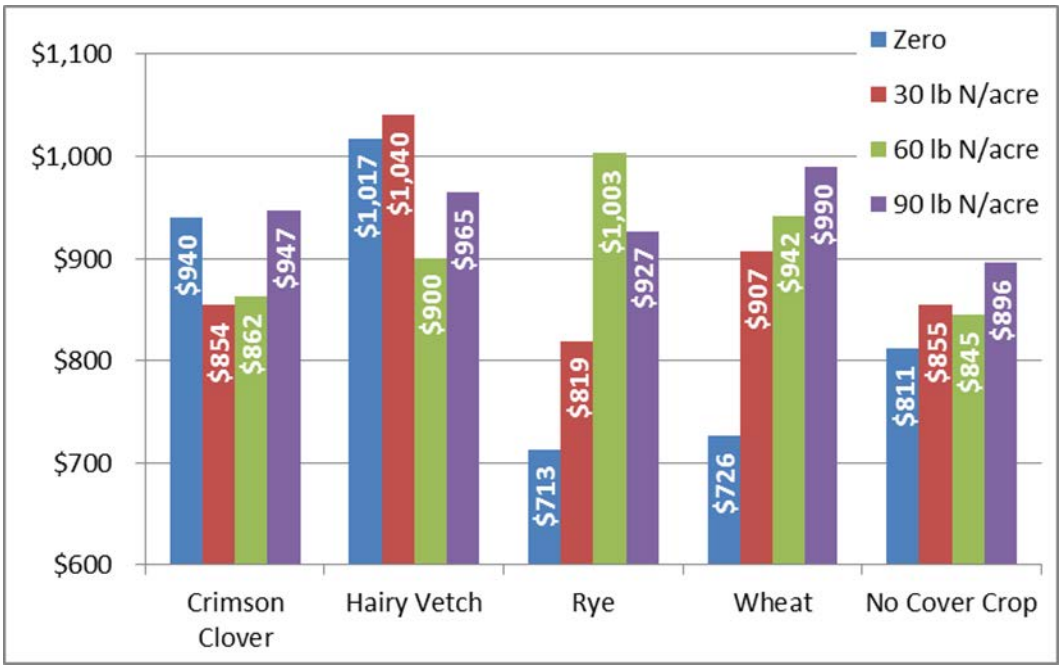

Figure 3. Average Adjusted Revenue by Cover Crop and Supplemental Fertilizer ($/acre)

Conclusions

Adjusted revenues were calculated to determine the impact of cover crop and the application of supplemental nitrogen fertilizer on cotton yield. Cotton following hairy vetch appeared to have the most profit potential. Averaged over all levels of N, it had the highest average adjusted revenue by $80 per acre. A hairy vetch cover crop with zero or 30 lbs of N applied to cotton offered the highest adjusted revenue. Adjusted revenue from using a traditional wheat or rye cover crop and higher amounts (60 or 90 lbs) of N on cotton was similar but slightly lower than the hairy vetch cover crop. Having no cover crop resulted in the lowest adjusted revenue of any of the systems in the study. Compared to having no cover crop, having a cover crop resulted in higher adjusted revenue when averaged across all N levels considered. Cotton following leguminous cover crops (crimson clover or hairy vetch) may allow for reduced side dress nitrogen applications. Hairy vetch resulted in higher adjusted revenue than crimson clover.

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