IMPACT OF CONSERVATION SYSTEMS ON NET RETURNS TO COTTON PRODUCTION IN ALABAMA

Leah M. Duzy
Kipling S. Balkcom
National Soil Dynamics Laboratory
Agricultural Research Service, USDA
Auburn, AL

Abstract

With lower commodity prices and higher production expenses, cotton (*Gossypium hirsutum* L.) producers are concerned with maximizing yields, while minimizing production expenses. The adoption of a conservation system, including a winter cover crop, may be a viable option for cotton producers in Alabama. The objective of this research is to evaluate the economic impact of different tillage systems and cover crops on cotton production in Alabama. The data are from an experiment conducted during crop years 2004 - 2009 at the Prattville Agricultural Research Unit in Prattville, Alabama. The experiment included four tillage systems and three cover crops. The tillage systems were: 1) no tillage; 2) spring strip till; 3) spring paratill; and 4) fall paratill. The three cover crop treatments were: 1) cereal rye (*Secale cereale* L.); 2) winter wheat (*Triticum aestivum* L.); and 3) corn (*Zea mays* L.) residue. In five out of six years the use of cover crops produced yields statistically greater than yields following corn residue. In four out of six years, planting cotton after a cover crop produced NRAVTC that were either statistically greater than or not statistically different from NRAVTC for cotton following corn residue. In conclusion, the use of conservation tillage and a cover crop provides producers with a production system to help reach conservation goals, as well as maintain or exceed yields and NRAVTC from using conservation tillage alone.

Introduction

With lower commodity prices and higher production expenses, cotton producers are concerned with maximizing yields, while minimizing production expenses. The adoption of a conservation system, including a winter cover crop, may be a viable option for cotton producers in Alabama. The objective of this research is to evaluate the economic impact of different tillage systems and cover crops on cotton production in Alabama.

Materials and Methods

The data for this study were from a field experiment at the Prattville Agricultural Research Unit in Prattville, AL from fall of 2003 to 2009. The experiment was conducted on a field that had been in continuous cotton using conventional tillage practices for at least 10 years. Cotton was grown as part of a cotton/corn rotation with each crop present each year; however, only cotton will be discussed in this analysis. The experiment was a 4x3 factorial treatment in randomized complete block design with four replications established on Lucedale fine sandy loam. The treatments were four conservation tillage systems (no-till [NT], fall paratill [FP], spring paratill [SP], and spring strip till [ST]) and three winter cover crops (cereal rye, winter wheat, and corn residue).

The rye and wheat cover crops were seeded at a rate of 90 lb ac^{-1} and fertilized in the fall with 30 lb N ac^{-1} as ammonium nitrate. Both cover crops were terminated using chemical and mechanical termination. Glyphosate was applied in the spring, followed by one pass with a roller (Kornecki et al., 2006) to facilitate spring tillage and planting. The FP operation was performed after cover crop planting. Table 1 outlines the planting, termination, and harvest dates for the cover crops and cotton by year and is adapted from Table 1 in Balkcom et al (2013). Additional information regarding the materials and methods is found in Balkcom et al (2013).

Table 1. Planting, termination, and harvest dates for the cover crops and cotton by year.

Cover Crop		Cotton	
Planting Date	Termination Date	Planting Date	Harvest Date
23 Nov. 2003	16 Apr. 2004	5 May 2004	8 Oct. 2004
26 Oct. 2004	21 Apr. 2005	13 May 2005	12 Oct. 2005
17 Nov. 2005	21 Apr. 2006	4 May 2006	23 Oct. 2006
14 Nov. 2006	12 Apr. 2007	14 Apr. 2007	13 Nov. 2007
29 Nov. 2007	25 Apr. 2008	12 May 2008	15 Nov. 2008
19 Nov. 2008	24 Apr. 2009	11 May 2009	5 Nov. 2009

The economic analysis was performed using a partial budgeting approach. Net returns above variable treatment costs (net returns) were defined as the difference between revenues and cotton production costs (US\$ lb^{-1}) associated with each treatment. Revenues were calculated based on cotton lint and cottonseed yields and prices. The ginning percentage was specific to each treatment, and the average across all treatments and years was 41.84%. Cotton lint price was set at 0.60 US\$ lb^{-1} and cottonseed price was set at 220 US\$ ton^{-1}. Prices were assumed constant across all six years of the analysis. Cotton fiber quality was not considered in this analysis.

Production costs associated with tillage and cover crop establishment and termination (Table 2) were adapted from machinery cost estimates (Lazarus 2014) and cotton enterprise budgets (ACES 2014; MSU 2014). Input prices were assumed to represent prices paid by producers in 2013. Two types of production costs were considered: 1) costs that differed by tillage and cover crop, and 2) yield varying costs. Aside from production expenses related to treatments, all other production expenses were assumed constant across the experimental plots. Costs associated with tillage, cover crop management, and interest on operating capital varied by treatment and year. Machinery costs included only variable costs (fuel, labor, and repairs and maintenance). Yield varying costs included a ginning and warehousing fee and a classing and promotion fee. Land rent, crop insurance, and fixed expenses, such as depreciation and management costs, can differ substantially between producers. Therefore, these expenses were not included in this analysis.

Table 2. Production costs (US\$ ac^{-1}) for cotton production by year.

Production Item	Production Cost US\$ ac^{-1}
Production costs differing by treatment	
Tillage[a]	
No-till (NT)	0
Fall Para-till/Spring Para-till (FP/SP)	8.82
Spring Strip-till (ST)	4.66
Cover crop[b]	
Corn Residue (Fallow)	0
Cereal Rye	88.37
Winter Wheat	65.84
Production costs based on yield	
Ginning and warehousing (US\$ lb^{-1})	0.10
Classing and Promotion Fee (US\$ lb^{-1})	0.0032

Data were analyzed using PROC GLIMMIX (SAS Institute 2012). Dependent variables were cotton lint yield (measured in lb ac^{-1}) and net returns (measured in US\$ lb^{-1}). Year, tillage, cover crop, and their interactions were considered fixed effects. Replication and the interaction between replication and tillage were considered the random effects. For yield and net returns, year, year by tillage, and year by cover crop were significant at P=.01 (not shown). Therefore, data were analyzed by year in the final analysis. Fisher's protected least significant difference (LSD) test at the $P = 0.05$ level of significance was used to separate treatment means.

Results and Discussion

Cotton lint yields averaged across all treatments were the highest in 2005 (1327 lb ac^{-1}), followed by 2008 (1124 lb ac^{-1}) and 2009 (987 lb ac^{-1}). Due to drought conditions in 2006 and 2007, average lint yields, regardless of treatment, were 551 lb ac^{-1} in 2006 and 366 lb ac^{-1} in 2007. Net returns followed the same pattern, with the highest net returns in 2005, 2008, and 2009 (810 US$ ac^{-1}, 655 US$ ac^{-1}, and 570 US$ ac^{-1}, respectively), and with the lowest net returns in 2004, 2006, and 2007 (372 US$ ac^{-1}, 305 US$ ac^{-1}, and 187 US$ ac^{-1} respectively).

For cotton lint yield and net returns, year, year by tillage, and year by cover were all statistically significant at *P=0.01*. Therefore, the data were analyzed by year for both dependent variables. For each year, tillage by cover was not statistically significant at a conventional level of significance for both cotton lint yield and net returns. The following discussion for cotton lint yield and net returns will focus on tillage and cover crop treatments separately.

Cotton Lint Yield

There was no significant difference between yields by tillage treatment in 2004, 2007, and 2008. In 2005, the highest yielding treatment was ST; however, it was not significantly different from SP. 2005 was the only year where the NT treatment produced yields significantly lower than yields from all of the other tillage treatments. In 2006, the highest yielding treatment was NT, which was statistically greater than the three other treatments. As noted above, 2006 was one of the driest years in the study. In 2009, FP and SP were the highest yielding treatments and were not statistically different.

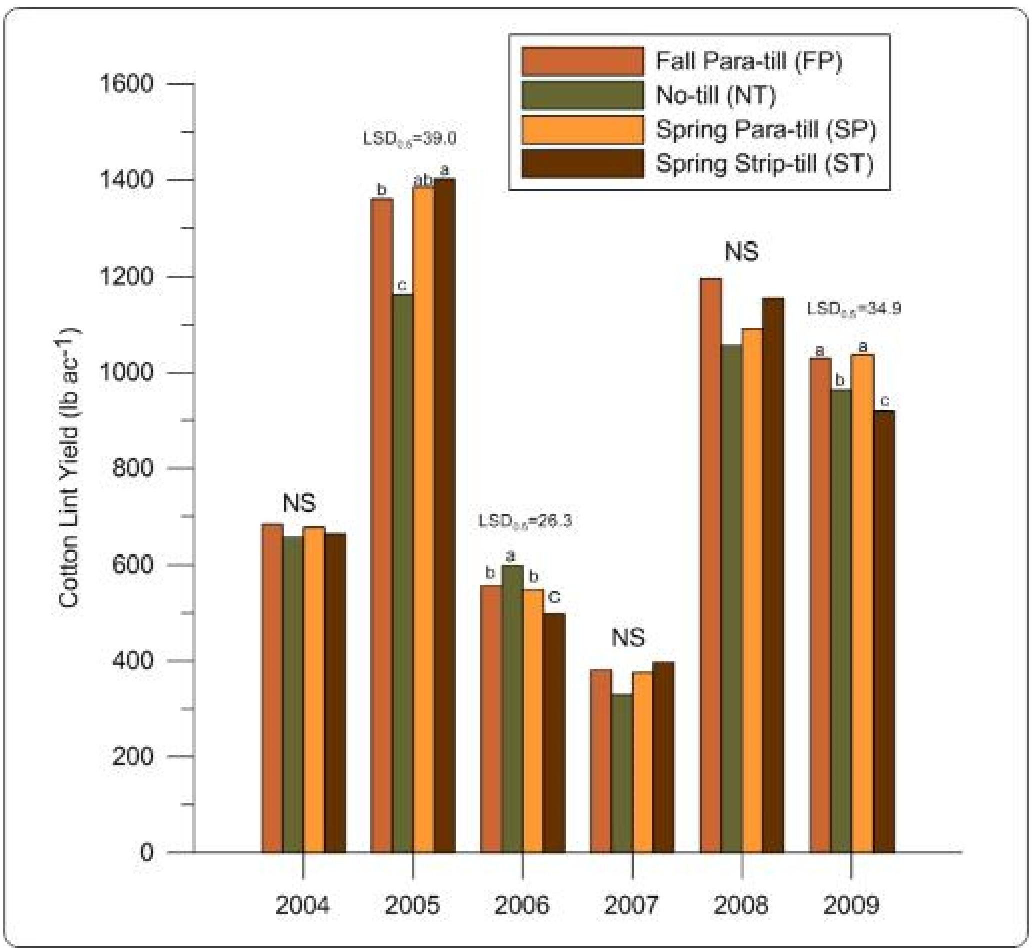

Figure 1. Cotton lint yield (lb ac^{-1}) by year and tillage treatment.

As shown in figure 2, across all years, there was a significant difference between cover crop treatments. In five out of six years, lint yields following either rye, wheat, or both rye and wheat were significantly greater than yields following corn residue. In 2004 and 2009, lint yields following rye were statistically greater than wheat and corn residue. In 2005, lint yields following wheat were statistically greater than those following rye and corn residue. There was no statistical difference and very little numerical difference between cotton lint yields in 2006 and 2007, which were the two driest years in the study; however, there was a statistical difference between the cover crops and the corn residue treatment. The only year where cotton lint yields following corn residue were statistically greater than the cover crop treatments was in 2008.

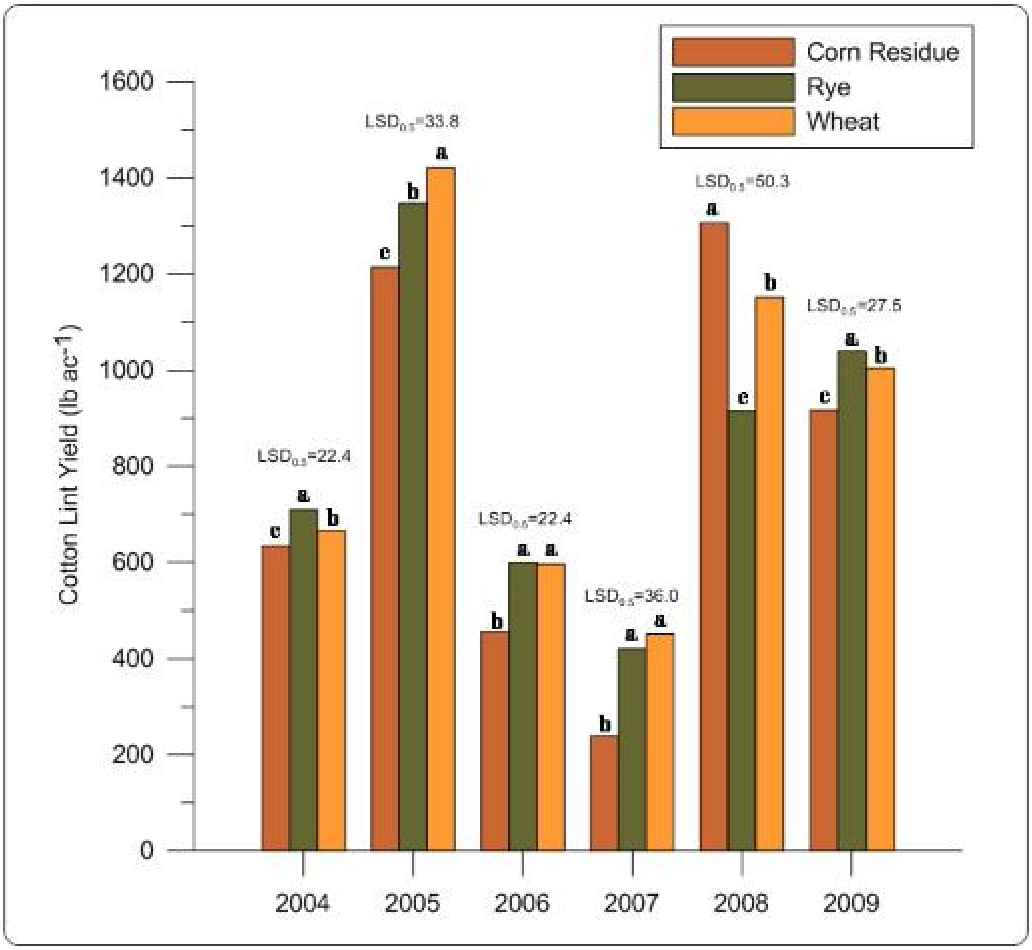

Figure 2. Cotton lint yield (lb ac^{-1}) by year and cover crop treatment.

<u>Net Returns above Variable Treatment Costs</u>

Net returns above variable treatment costs (NRAVTC) by tillage treatment followed the same pattern as cotton lint yields by tillage treatment, as shown in Figure 3. As with cotton lint yield, there was no significant difference in NRAVTC for tillage treatments in 2004, 2007, and 2008. The treatment with the highest NRAVTC in 2005 was ST, and it was not statistically different from FP and SP. In 2006, the NT treatment had the highest NRAVTC and it was statistically different from the other three treatments. In 2009, FP and SP treatments had the highest NRAVTC and there was no statistical difference between the two. Across all six years, none of tillage treatments consistently provided the highest NRAVTC.

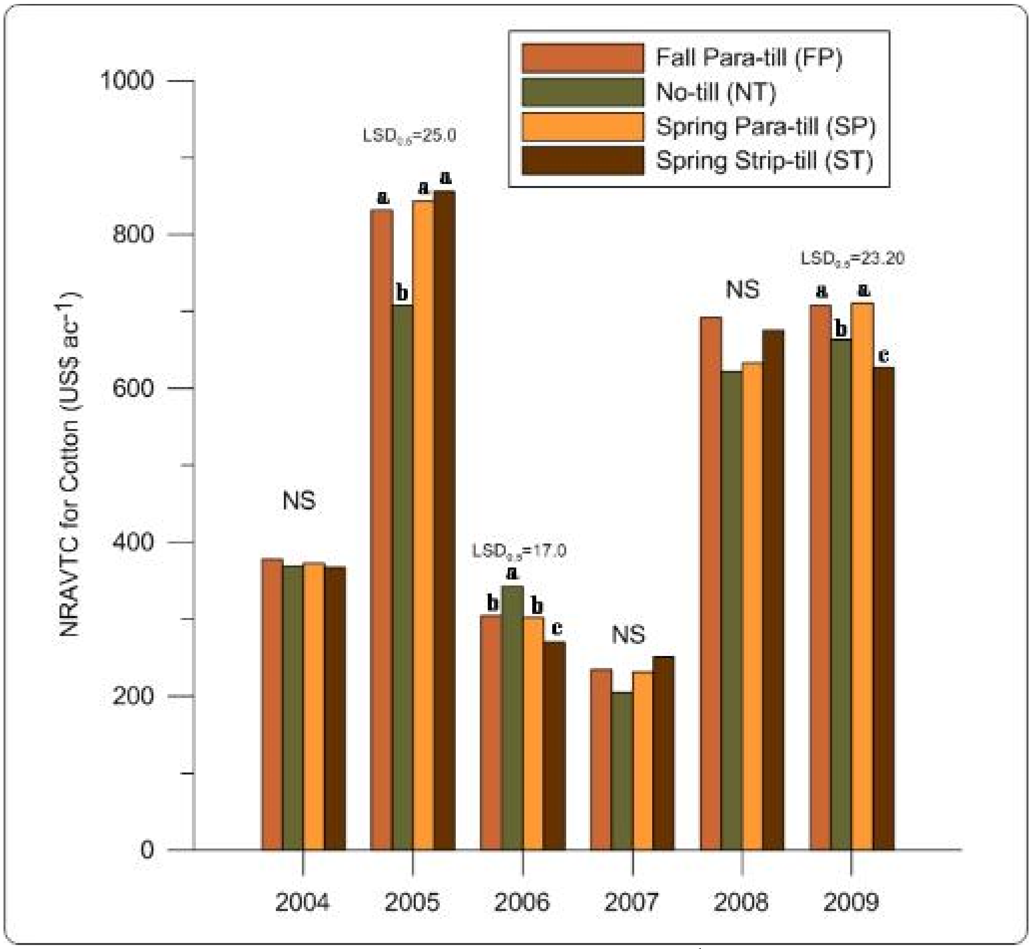

Figure 3. Net returns above variable treatment costs (NRAVTC) in US\$ ac^{-1} by tillage treatment by year.

For NRAVTC by cover crops, the results differed from results for cotton lint yield by cover crop. In 2006 and 2009, there was no significant different between cover crop treatments, with a range of 24.17 US\$ ac^{-1} in 2006 and 6.78 US\$ ac^{-1} in 2009. Corn residue had a statistically higher yield than the other two treatments in 2004 and 2008. In 2005 and 2007, the wheat cover crop treatment had the highest NRAVTC, and was statistically greater than the corn residue and rye cover crop treatment. In four out of six years, the rye and/or wheat cover crop treatments were either significantly higher than the corn residue treatment or not statistically different than the corn residue treatment.

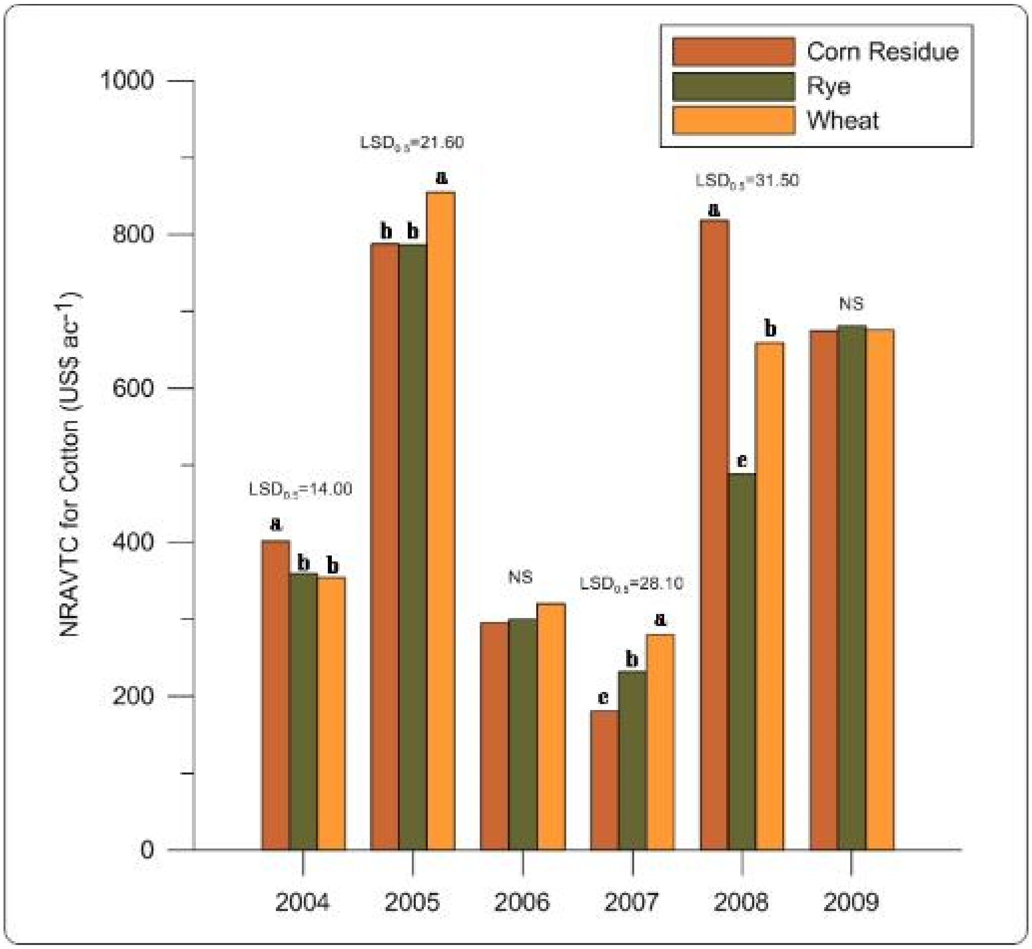

Figure 4. Net returns above variable treatment costs (NRAVTC) in US$ ac^{-1} by cover crop treatment by year.

Summary

There are numerous production options available to producers when they are deciding how to manage their crop. Producers are faced with increasing input costs and pressure to produce a crop using environmentally sustainable methods. While many producers have adopted no-till on their operations, it may not be the best production method for all producers depending on soil type. There are other conservation tillage options, such as fall para-till, that producers may consider in place of no-till. Adding a cover crop into the production system may also provide increased yields, as well as higher net returns.

The results of this analysis demonstrate that one conservation tillage treatment is not superior across all years for cotton. In five out of six years, the yields and NRAVTC were either not significantly different or there was not one statistically higher treatment. The one exception is in 2006 when the NT treatment produced statistically higher yields and NRAVTC as compared to the remaining treatments. Furthermore, in five out of six years the use of cover crops produced yields statistically greater than yields following corn residue. In four out of six years, planting cotton after a cover crop produced NRAVTC that were either statistically greater than or not statistically different from NRAVTC for cotton following corn residue. In conclusion, the use of conservation tillage and a cover crop provides producers with a production system to help reach conservation goals, as well as maintain or exceed yields and NRAVTC from using conservation tillage alone.

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