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THE ROLE OF ROTATIONS IN COTTON PRODUCTION: COMPARISONS OF CONTINUOUS COTTON WITH TWO-YEAR ROTATIONS AND THREE CROPS IN TWO YEARS

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Abstract

Crop rotations often increase the yields of the rotated crops, an effect which may be more pronounced when yields are limited by specific problems that are affected by the cropping sequences. Profitability of rotations versus continuous mono-cropping is determined by the magnitude of crop responses and, perhaps more importantly, by commodity prices of the included crops. The objective of this study was to compare continuous mono-crop cotton with selected rotations to determine if rotations increased yields and profitability. Rotation-crop sequence studies from four locations were analyzed for both yield benefits and for economic benefits (net returns above variable costs). Rotation sequences included cotton, corn, soybean, grain sorghum and double-crop wheat in two and three-year cycles. In all studies, cotton lint yields were higher in rotations than in continuous mono-cropping. Yield increases ranged from 10 percent to 30 percent. Cotton yield increases were not affected by the choice of alternative crop. Corn, grain sorghum and soybean all provided similar yield benefits to cotton yield. Yield increases did not always result in increases in annual net returns per acre because alternative crops were usually less profitable than cotton. Long-term yield increases and economic benefits were larger than initial yield and economic benefits, emphasizing the importance of long-term productivity goals. Double-crop cotton following wheat had lower yields than mono-crop cotton. Returns above variable costs, however, were higher for the cotton-wheat double-crop system. We conclude that rotations of cotton with corn, soybean or grain sorghum will increase cotton yield and will usually also increase profitability.

Introduction

Rotational crop sequences often increase the yields of the rotated crops, sometimes only a small amount but potentially by large percentages when yields are limited by specific problems that are affected by the cropping sequences. Nematode infestations, soil-borne diseases and weed infestations are examples of specific yield limiting problems that require rotations with alternative crops to maintain or increase cotton yield. Profitability of rotations versus continuous mono-cropping is determined by the magnitude of crop responses and, perhaps more importantly, by commodity prices of the included crops. Thus rotations can have significant yield benefits but may be no more profitable than mono-cropping depending upon the cost of production and returns for each crop. When returns from alternative crops are lower than for cotton, the yield increases from rotations must be large enough to offset the reduced income from the alternative crop. Large yield increases will usually occur when specific problems are present but lacking these problems, rotation benefits are smaller. The magnitude of yield increases needed to ensure that rotations increase profitability have not been documented. The objective of this paper was to use ongoing rotation experiments to compare continuous mono-crop cotton with rotations to determine if rotations increase yields and profitability

Materials and Methods

Four rotation studies in Louisiana and Mississippi situated on soils that are widely representative of soils in the mid-South were selected for analyses. All of the studies are ongoing rotation studies in which continuous mono-crop cotton is directly compared with selected rotational sequences. Study number 1 is a long-term continuing rotation begun in 1982 at the LSU AgCenter Northeast Research Station in St. Joseph, LA. This study compares continuous mono-cropping of the summer crops of cotton, corn, soybean and grain sorghum to various two- and three-year rotations of these crops. The experiment is

on a Commerce silt loam and is planted in a randomized complete block design with four blocks. Study number 2 is a continuing multi-year study initiated at the LSU AgCenter Macon Ridge Research Station in Winnsboro, LA in 2001. Similar to Study 1, continuous mono-crop cotton is compared with various crop sequences of cotton, corn, soybean, grain sorghum and double-cropping with wheat (wheat and a summer crop harvested in the same year). In, Study 2, however, all cropping systems are produced using practical Best Management Practices (BMPs), that is a combination of year-round ground cover of winter wheat and crop residues with no-tillage. Study 2 is planted on a Gigger silt loam in a randomized complete block design with five blocks. Studies 3 and 4 are comparisons of 2-year cotton-corn rotations with continuous mono-crop cotton. These studies are located at the Mississippi State University Delta Research and Extension Center in Stoneville, MS. Study 3 is on a Bosket very fine sandy loam and Study 4 is on a Forestdale/Dundee silty clay loam.

Results and Discussion

In Study 1, rotation of cotton with corn, grain sorghum or soybean has consistently increased the annual yield of cotton 15 percent or more (Figures 1, 2 and 3). In recent years, yield increases have been as large as 32 percent, possibly due to elevated weed pressure and nematode increases in continuous mono-crop cotton. Rotation has also increased the yields of soybean and corn 20 percent to 30 percent (Figure 4). Grain sorghum has been particularly effective in increasing cotton yields, but grain sorghum yields have been low and unrepresentative of yield potential because of bird feeding. With yield increases of 15 percent, as occurred in the early years of this study, continuous mono-crop cotton was economically competitive with rotations. There was no difference in annual net returns between continuous cotton and 2-and 3-year rotations of cotton-corn, cotton-soybean or cotton-corn-soybean, which averaged 241 dollars per acre (Figures 5 and 6). When yield increases were greater than 15 percent, as has occurred since 1995, rotations were 60 to 99 dollars per acre more profitable each year than growing continuous cotton (Figures 7 and 8). This emphasizes the importance of rotations for long-term benefits and when specific problems (nematodes, weeds, diseases) reduce the yield of continuous mono-crop cotton.

In Study 2, BMP multi-crop sequences of cotton rotated with corn, soybean or grain sorghum and double-crop wheat, although not increasing yield, have been as profitable or more profitable than growing continuous cotton or crop sequences with grain crops only. Continuous cotton yielded 1213 pounds per acre and other crop sequences averaged 1245 pounds per acre. Annual net returns from continuous cotton averaged 231 dollars per acre. Double-crop cotton following winter wheat yielded lower than mono-crop cotton but net returns at 259 dollars per acre were higher with the double–crop system because of the extra income from wheat. An exception was that, in the initial 2-year cycle, continuous cotton had 22 dollars per acre greater returns above variable costs than the 2-year corn-wheat-cotton rotation due primarily to lower returns from the corn crop. Economic analyses have not yet been done that include payments that are likely to be available in the future to support the environmental benefits of planting a winter wheat crop and using conservation tillage as BMPs.

In Studies 3 and 4, rotation of cotton with corn increased cotton yield about 10 percent. Lint yield of continuous mono-crop cotton averaged over the 4 years of the study was 905 pounds per acre on Bosket very fine sandy loam and 988 pounds per acre on Forestdale/Dundee silty clay loam. Average annual lint yield increases in rotations were 89 pounds acre on Bosket and 79 pounds per acre on Forestdale/Dundee. The profitability of rotations was greater than mono-crop cotton primarily because of high corn yields that averaged 204 bushels per acre on Bosket and 165 bushels per acre on Forestdale/Dundee. Also, cotton yields in 2002 were reduced by extended wet weather associated with tropical systems. The wet conditions impacted the yields and profitability of the cotton in both crop sequences, but may have been more detrimental in continuous cotton.

Summary

Rotations of cotton with corn, soybean or grain sorghum usually increased crop yields in the short term and long term in all four of the ongoing studies. Overall, rotations of cotton with alternative crops increased yield 10 percent to 30 percent. Effects of rotations on profitability were less consistent than on yields because profitability of rotations was determined not only by yields but also by inputs and prices of all crops, including the alternative crops. In Study 1 at St. Joseph, for example, yields were increased each year by all of the rotations, but rotations required about 12 years to increase profitability. Reduced returns from alternative crops compared with returns from cotton initially limited the profitability of rotations. Producers should maintain flexibility in making crop sequence decisions. In some years, production problems or commodity prices may be such that continuous cotton is more profitable than rotations whereas, in other years, rotations with alternative crops will provide opportunities for increased productivity.

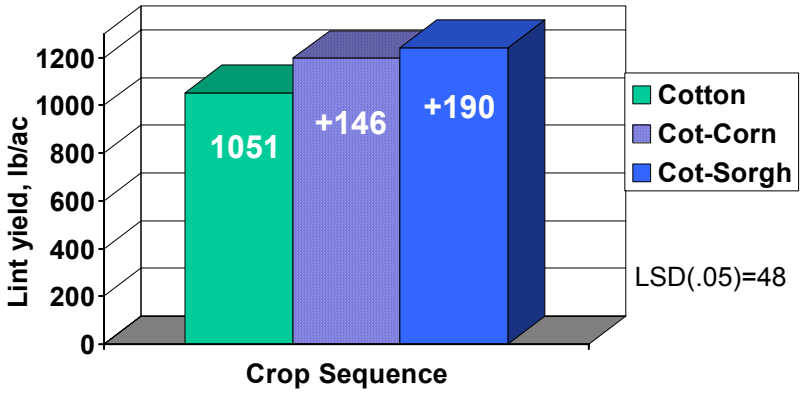

Figure 1. Comparison of yields of continuous mono-crop cotton with cotton yields in 2-year rotations, 1983 through 2003, St. Joseph, LA.

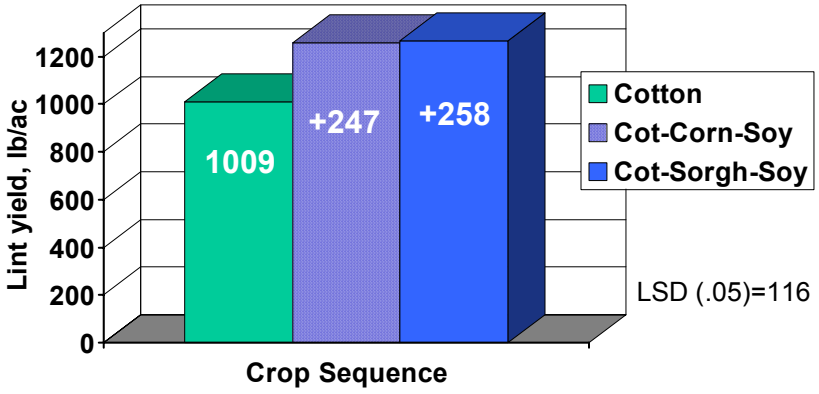

Figure 2. Comparison of yields of continuous mono-crop cotton with cotton yields in 3-year rotations, 1983 through 2003, St. Joseph, LA.

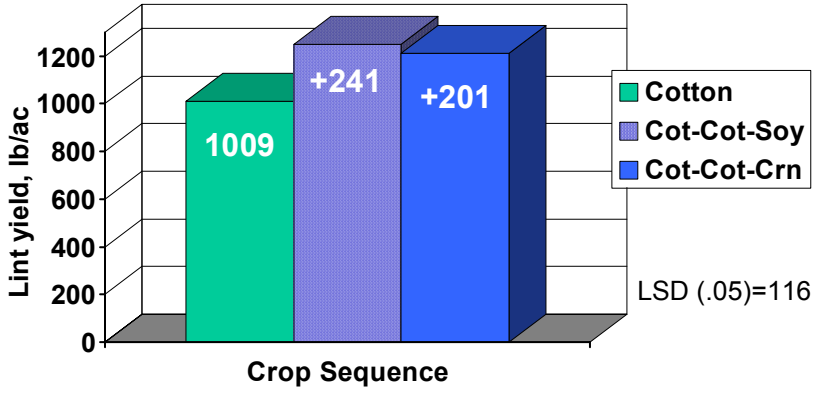

Figure 3. Comparison of yields of continuous mono-crop cotton with cotton yields in 3-year rotations, 1983 through 2003, St. Joseph, LA. First year cotton after grain crop.

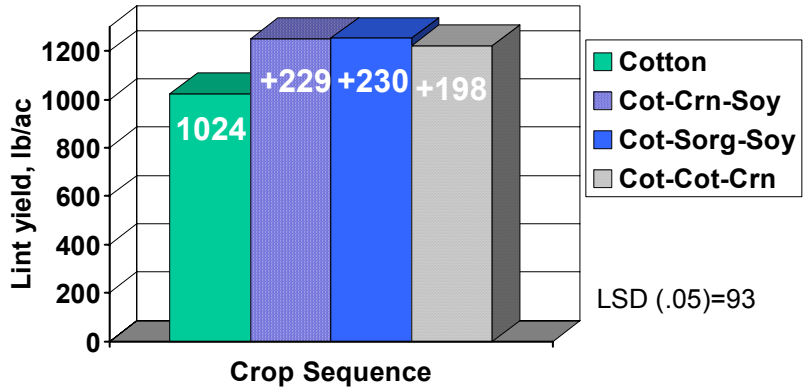

Figure 4. Comparison of yields of continuous mono-crop cotton with cotton yields in 3-yr. rotations on Commerce silt loam, 1995 through 2003, St. Joseph, LA.

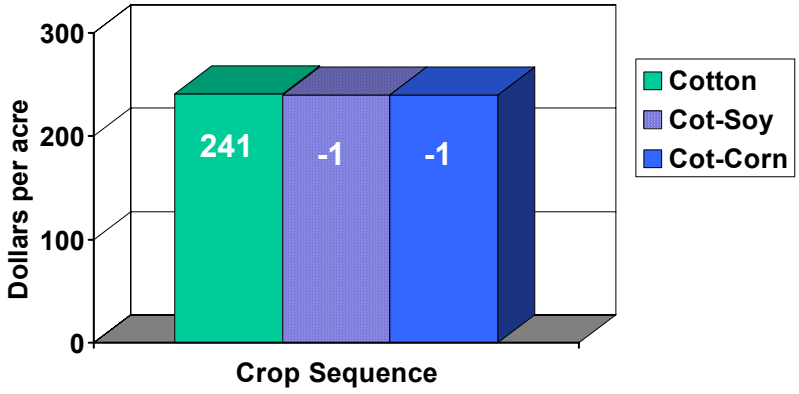

Figure 5. Comparison of net returns above expenses for continuous mono-crop cotton with 2-yr. rotations on Commerce silt loam, 1983 through 2003, St. Joseph, LA.

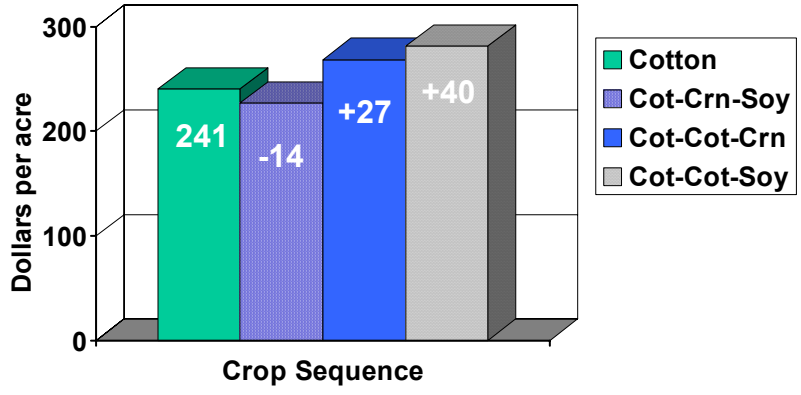

Figure 6. Comparison of net returns above expenses for continuous mono-crop cotton with 3-yr. rotations on Commerce silt loam, 1983 through 2003, St. Joseph, LA.

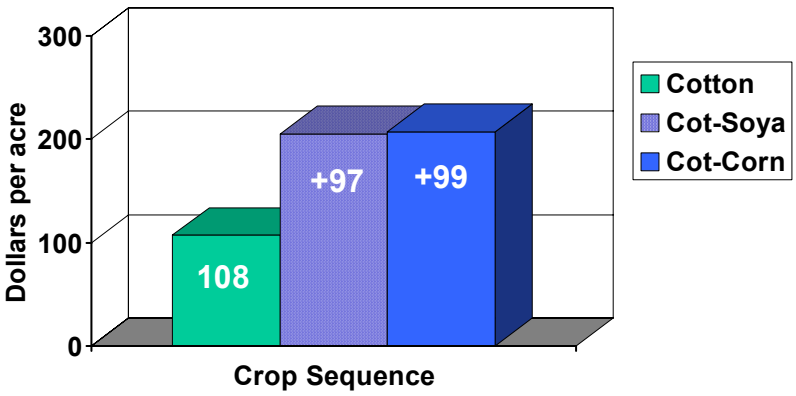

Figure 7. Comparison of net returns above expenses for continuous mono-crop cotton with 2-yr. rotations on Commerce silt loam, 1995 through 2003, St. Joseph, LA.

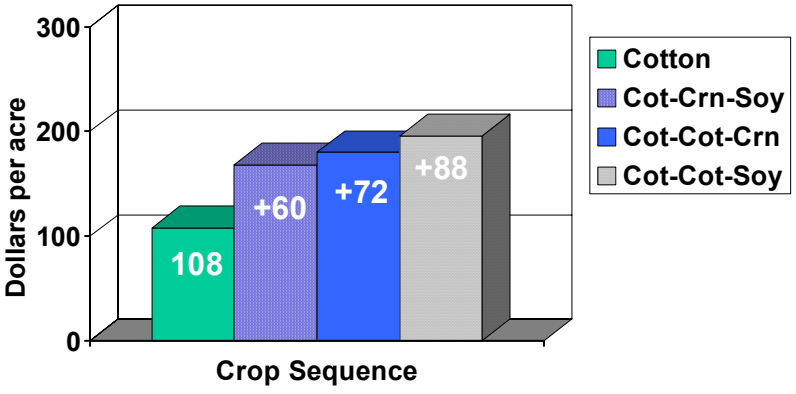

Figure 8. Comparison of net returns above expenses for continuous cotton with 3-yr. rotations on Commerce silt loam, 1995 through 2003, St. Joseph, LA.

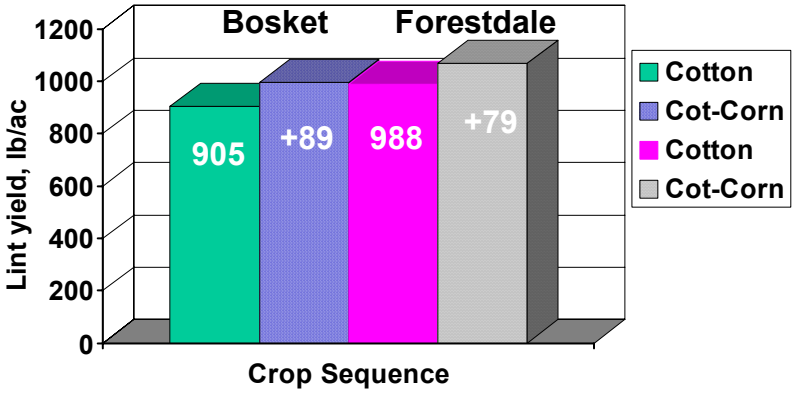

Figure 9. Comparison of yield of continuous cotton with cotton yields in 2-yr cotton-corn rotations on Bosket vfsl and Forestdale/ Dundee scl, 2000-2003, Stoneville, MS. Corn yield averaged 204 bu/ac.

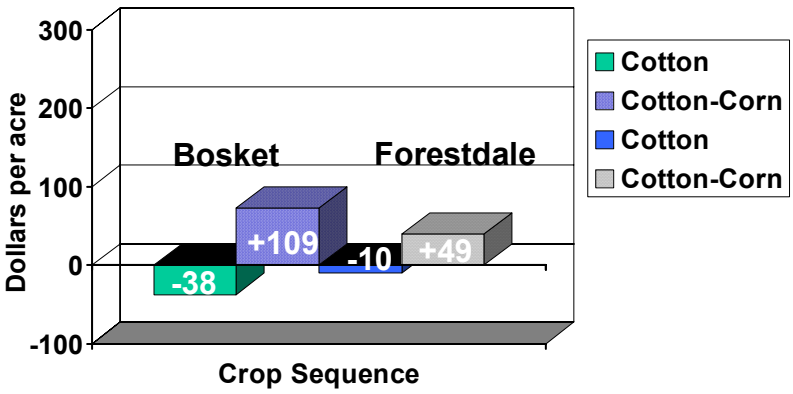

Figure 10. Comparison of net returns above expenses of continuous cotton with 2-yr. cotton-corn rotations on Bosket vfsl and Forestdale/Dundee scl, 2000-2003, Stoneville, MS. Corn yield averaged 204 bu/ac on Bosket and 165 bu/ac on Forestdale.