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YIELD AND ECONOMICS OF MONOCROP COTTON VS. CROP DIVERSIFICATION

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Abstract

Changes in commodity prices from year to year and the proven benefits of crop diversification suggest that selected multi-cropping practices may enhance overall farm profitability. Rotational crop sequences often increase the yields of the rotated crops, an effect that may be more pronounced when yields are limited by specific problems that are ameliorated 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. The advent of high yielding early maturing wheat varieties, insect-resistant cotton varieties and boll weevil eradication has opened up new possibilities for diversifying crop selection while implementing Best Management Practices (BMPs) in the Mid-South. A wheat winter cover crop grown as a green manure increases the yield of the following cotton crop and is an important component of BMPs that will likely become part of nutrient management plans of farms in the Mid-South. Wheat residue is beneficial because it reduces erosion, conserves soil water, improves soil quality and protects cotton seedlings from abiotic damage. Used as a green manure, wheat growth is terminated before grain fill *(Zodaks Growth Stage 40-59)*, so the summer crop can be planted in a timely manner. The farmer gains no cash benefit from the wheat crop. With new technology, it is increasingly practical to harvest a wheat cash crop and follow with a high-yielding summer crop. High yielding fields are generally well drained and many are irrigated, which further enhances the feasibility of successful double-crop wheat + summer crop production. Other BMP systems in which cotton, corn, soybean and grain sorghum are grown in rotations are beneficial for soil improvement and disease, nematode and weed control.

Profitability of alternative cropping systems versus continuous monocropping is determined by the magnitude of crop responses and, perhaps more importantly, by commodity prices of the included crops. Multicrop sequences can have significant yield benefits but may be no more profitable than monocropping if alternative crops have low profitability. When returns from alternative crops are lower than for cotton, the yield increases gained from diversified systems must be large enough to offset the reduced income from the alternative crop. The objective of this paper is to use ongoing rotation and cropping systems experiments with emphasis placed on BMPs (minimum tillage and crop and cover crop residues for water quality protection) to compare continuous monocrop cotton with multicrop sequences to determine if diversification increases yields and profitability

Methods

Two cropping systems studies in Louisiana situated on soils that are widely representative of soils in the mid-South were selected for analyses. The studies are ongoing rotation studies in which continuous monocrop 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 monocropping 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 doublecropping with wheat (wheat and a summer crop harvested in the same year). In Study 2, all cropping systems are produced using practical BMPs, that is, combinations of year-round ground cover of winter wheat and/or crop residues with no-tillage. Study 2 is planted on a Gigger silt loam in a randomized complete block design with five blocks.

Results

In Study 1, rotation of cotton with corn, grain sorghum or soybean has consistently increased the annual yield of cotton 15 percent or more and increased yield of grain crops 30% or more. In recent years, yield increases have been as large as 32% for cotton and 50% for soybean, possibly due to elevated weed pressure and nematode and disease increases in monoculture. 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 monocrop 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. 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 (Figure 1). This emphasizes the importance of rotations for long-term benefits and when specific problems (nematodes, weeds, diseases) reduce the yield of continuous monocrop cotton.

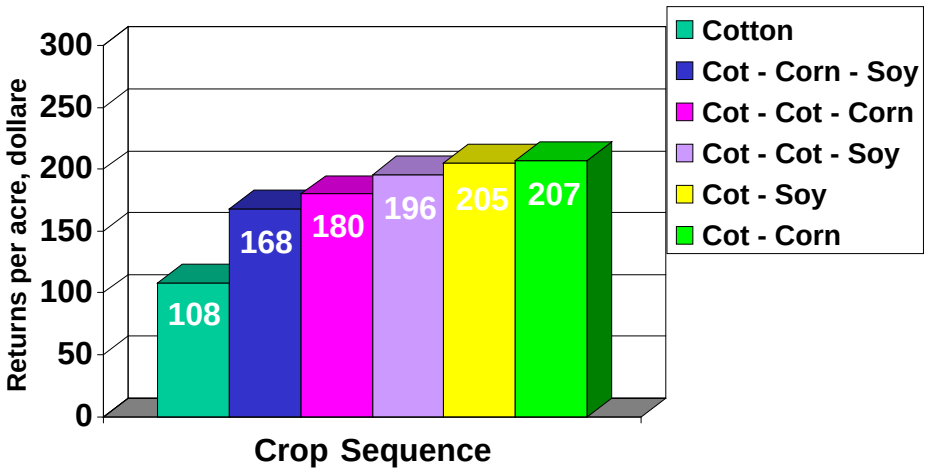

Figure 1. Annual net returns above expenses from 1995 through 2003 in continuous cotton and in selected crop sequences in a 23-yr. rotation study.

In the initial four years of Study 2, average yields among BMP multi-crop sequences using cotton, corn, soybean, grain sorghum and double-crop wheat have been similar and not different from monoculture. Continuous cotton averaged 1112 pounds per acre; cotton following wheat green manure averaged 1133 pounds per acre and doublecrop cotton following wheat averaged 1094 pounds per acre. Although not increasing yield, BMP systems have been as profitable or more profitable than growing continuous cotton or crop sequences with grain crops only (Figure 2). Annual net returns from continuous cotton averaged 143 dollars per acre. Several BMP systems had higher returns, especially doublecrop wheat and cotton, which averaged 234 dollars per acre in net returns because of the increased income from the wheat crop. In the initial crop cycle, continuous cotton had greater returns above variable costs than the 2-year BMP system of corn-wheat-cotton sequence, due primarily to lower returns from the corn crop but, after completing the second cycle, net returns were about the same. Double-crop cotton following winter wheat yielded lower than mono-crop cotton in 2002 and 2003 but higher in 2004, suggesting the possibility of increased yield variability (risk) for doublecrop cotton compared with monocropping or rotations.

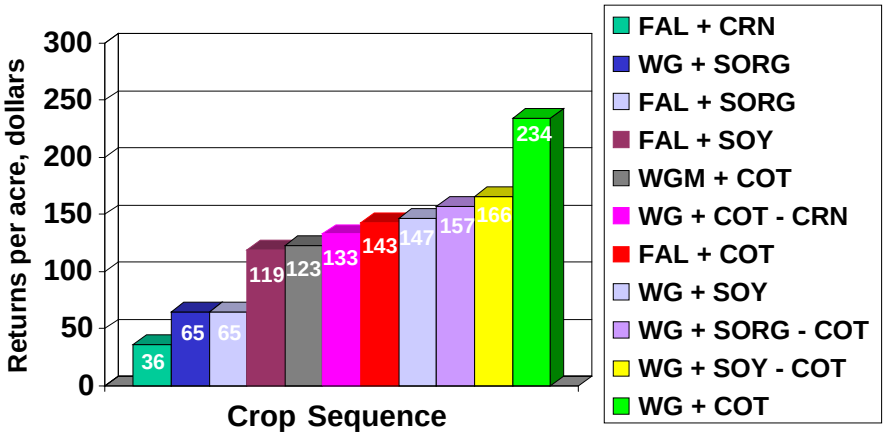

Figure 2. Annual net returns above variable expenses for cropping sequence in a 4-yr BMP study – 2001-2004. *(FAL, winter fallow; CRN, corn; WG, wheat grain; WGM, wheat green manure; SORG, grain sorghum; SOY, soybean; COT, cotton)*

Summary

Rotations of cotton with corn, soybean or grain sorghum usually increased crop yields in the short term and long term in both of the ongoing studies. Overall, rotations of cotton with alternative crops increased yield 15 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. Because rotations are not necessarily the most profitable system in the short term, 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. Several of the BMP systems that utilized rotations, conservation tillage and winter wheat grain or green manure crops were more profitable than monoculture, demonstrating that use of these BMPs to protect water quality does not reduce farm income and, in fact, may increase farm profitability.

Acknowledgement

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