FACTORS INFLUENCING ROTATIONAL EFFECTS IN COTTON/CORN SYSTEMS IN THE MISSISSIPPI DELTA

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Abstract

Cotton/corn rotation studies have been underway in the Mississippi Delta since the mid-1990's. The current studies were initiated at the Delta Research and Extension Center (DREC, Bosket very fine sandy loam [Mollic Hapludalfs]) and at the Tribbett Satellite Farm (TSF, Forestdale/Dundee silty clay loam [Typic Endoaqualfs]) in 2000 to determine the interaction of nitrogen (N) rates and potassium (K) rates in rotations of cotton and corn. The studies evaluated rotation effects on both 'poorly' drained to 'somewhat-poorly' drained silty clay loam soils (Forestdale/Dundee) that are common in the Mississippi Delta as well as better drained sandy loam soils (Bosket) typically grown to either cotton or corn. The studies were meant to examine both the benefits and problems associated with corn/cotton rotations in the Mississippi Delta. In the last decade, modifications to farm legislation have allowed mid-south producers the flexibility to shift from mono-crop cotton to alternative crops and cropping sequences with the decisions on crop mix made annually. Replacement of traditional cotton acres, in certain years, while using rotation to improve soil productivity, offers potential for profitability not available with mono-crop systems including shifts in pesticide chemistry to address resistance problems. As commodity prices escalate for grain crops, shifts in traditional cotton acres have occurred. In 2007, corn acreage increased from 340,000 acres in 2006 to 960,000 acres with an average yield of 150 bu/acre (a record yield for Mississippi). At the same time cotton acreage decreased from 1.23 million in 2006 to 660,000 acres in 2007 with an average yield of 975 lb lint/acre. These studies were intended to examine the impact of cotton corn/rotations on the whole farm enterprise. The objectives included, a) determining the effects of N and K nutrition on cotton lint yields and corn grain yields for different soil types, and b) determining rotational effects of corn on cotton production and the implications of these rotations on whole farm economics. In 2007, a third objective included the determination of N and K fertility effects on nematode dynamics within the rotation. Factors that influence the degree of increase or decrease in lint yield associated with rotation have also been examined.

Research areas were established on each research farm that could be rotated over a 3-year period with one year planted to corn and the two subsequent years planted to cotton. Each of the three sections at each location had a factorial arrangement of N and K rates. The corn and cotton sections consisted of 4-row (40-in spacing) plots, 90 to 100 feet in length, with either four (TSF) or five (DREC) replications. Nitrogen rates were 60, 90, 120, 150, and 180 lb N/acre for cotton and 120, 160, 200, 240, and 280 lb N/acre for corn with the fertilizer N applied as urea-ammonium nitrate solution (32% N). Potassium rates for all rotations were 0, 40, 80, and 120 lb K/acre. Nitrogen was applied at a uniform rate (60 lb N/acre for cotton, 120 lb N/acre for corn) prior to or near planting with the various N rates established as a sidedress application. Potassium applications were made after planting utilizing a 0-0-16 solution (1.3 lb K/gal) applied with the same equipment used for N applications. Corn and cotton cultivars having high yield potential were planted at each location and maintained throughout the growing season. Soil moisture sensors were installed to measure soil water tension and the data used to initiate, schedule, and terminate irrigations for both corn and cotton whenever possible. Crops were harvested with commercial harvesters modified for plot harvest with grab-samples taken for laboratory analyses and ginning. The seedcotton grab-samples taken at harvest were later ginned through a 10-saw micro-gin for calculation of lint percent. Data were summarized and statistically analyzed using SAS (Statistical Analysis Systems) with mean separations by Waller Duncan K-ratio t-tests and Fisher's Protected Least Significant Difference (LSD).

Means across both N rates and K rates were used to measure the benefits from corn in the production systems. Comparisons were made of cotton following cotton and cotton following corn with the latter used to measure the actual benefits from corn in the system. There was no significant interaction between N rates and K rates at either location over the years. Both corn and cotton have shown significant responses to increasing N rates in most years while neither has shown significant increases with increasing K rates in most years. The rotational response has been quite variable with differences ranging from a 5.1% decrease to a 50.1% increase in yield with cotton following corn at TSF. Lint cotton yield has averaged 939 lb/acre/yr where cotton followed cotton from 2000 through 2007. Lint yield for cotton following

corn was 1046.7 lb/acre/yr for the same period. This translated to an 11.4% yield increase (107.6 lb/acre/yr) for cotton following corn with no additional fertilizer inputs. The DREC location had seven years of data and an average lint cotton yield of 889.6 lb/acre/yr where cotton followed cotton. When cotton followed corn the average lint yield was 988.1 lb/acre/yr. This reflected an 11.1% difference (98.5 lb/acre/yr) in favor of cotton following corn. The annual differences due to rotation ranged from a 14.9% decrease in 2007 to a 51.7% increase in 2005.

Several factors have significantly affected the rotational response with the primary influence coming from climate/weather related phenomena that can influence disease pressure and either directly or indirectly affected insect pressure. This was particularly evident in 2007 at the DREC location. Specifics factors included rainfall total and distribution, solar radiation and cloudiness, humidity and air movement, and physical limitations such as drainage or irrigation. During the time of these studies, rainfall in August has set all time records for the least (0.0 in, 2000) and most (8.47 in, 2001) in consecutive years. The largest rotational responses (percent) have occurred in years with severe droughts where irrigation was not timely or sufficient. In other years, excessive rainfall and the associated cloudy days resulted in photosynthetic stress and subsequent fruit shed. Heavy vegetative growth has also resulted in severe boll rot that was more pronounced in cotton following corn compared to cotton following cotton. Severe plant bug pressure reduced yields at DREC even with 11-13 sprays for control. Excess vegetative growth on cotton reduced the efficacy of the pesticides applied, as deep penetration into the canopy was not sufficient. This was more of a problem in cotton following corn compared to cotton following cotton. Other major factors that affect rotational responses deal with production-related problems. These factors have included planting dates as related to harvest windows, weed competition in rotation system, antagonistic pesticides, and pesticide drift, especially with residual herbicides. In rotations, some residual herbicides cannot be used due to the potential for carryover in following crops. Increased pressure from perennial grasses such as bermudagrass and johnsongrass resulted in lower yields for cotton following corn as compared to cotton following cotton at the TSF location. Some of the best responses to rotation have occurred in years where early rainfall is adequate and late season rainfall is limiting. Where corn has been grown, water holding capacity appears to be higher thus carrying the crop farther in dry seasons. Many of the problems with weeds have been cleaned up in the second year of cotton following corn. Biotechnology offers some solutions for the problems that have been identified and have been incorporated into the studies. Unfortunately, many of the weather-related factors that influence plant growth are not predictable. Long-term systems demonstrate the potential for benefits from the rotations. As cash prices for grain continue to rise along with significant increases in fertilizer and seed costs, the potential for crop rotation will remain.