FACTORS INFLUENCING COTTON YIELDS FOLLOWING CORN IN THE MID-SOUTH

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Abstract

Cotton/corn rotation studies have been underway in the Mississippi Delta since the mid-1990's and continue to gain in acceptance as corn and soybean grow in importance and profitability. Cotton producers had left rotations in favor of mono-culture (continuous cotton) due to the profitability of cotton. Current studies 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]) were initiated in 2000. These original studies were designed 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 and 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 intended to examine both the benefits and problems associated with corn/cotton rotations in the Mississippi Delta. In the last two decades, changes in 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. As commodity prices rose for grain crops (corn and soybean), shifts in traditional cotton acres occurred. In 2007, corn acreage increased from 340,000 acres the previous year to 960,000 acres with an average yield of 148 bu/acre (a record yield for Mississippi at that time). At the same time cotton acres decreased from 1.23 million to 660,000 acres in 2007, with an average yield of 975 lb lint/acre and then dropped further to a low of 290,000 acres harvested in 2009 and a yield of 687 lb lint/acre. In 2012, the harvested cotton acreage was 470,000 with a yield of 970 lb lint/acre (NASS). 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 and is the basis for this discussion.

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. The three sections at each location had a factorial arrangement of nitrogen (N) and potassium (K) rates. 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. These cultivars changed over the year as new technologies were introduced and older cultivars disappeared. Crops were harvested with commercial equipment 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 973 lb/acre/yr where cotton followed cotton from 2000 through 2011. Lint yield for cotton following corn was 1063 lb/acre/yr for the same period. This translated to a 9.2% yield increase (90 lb/acre/yr) for cotton following corn with no additional fertilizer inputs. The DREC location had eleven years (2001 through 2011) of data and an average lint cotton yield of 816 lb/acre/yr where cotton followed cotton. When cotton followed corn the average lint yield was 955 lb/acre/yr. This reflected a 17.1% difference (139 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 65.4% increase in 2009. In five of the eleven years, the rotation response has exceeded 230 lb lint/acre with the highest in 2009, at 334 lb lint/acre.

Several factors have been identified that could impact the rotational response and can be divided into four major areas 1) climate/weather related phenomena (rainfall total and distribution, solar radiation and cloudiness, humidity and air movement, and physical limitations such as drainage or irrigation); 2) production related problems (planting date as related to harvest window, weed competition, antagonistic pesticides, pesticide drift and residuals); 3) nematodes or other insect pests; and 4) disease pressure. The primary influence comes 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. During the time of these studies, rainfall in August 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. Rainfall distribution also affects roots development especially where rainfall early in the growing season results in a relatively shallow rooted crop. In 2004 at the DREC location, lint yield was 8.1% lower where cotton followed corn as compared to cotton following cotton. Rainfall in May (7.25 in) and June (12.45 in) caused greater growth and more shading. July through September rainfall totaled just over five inches. The same year at TSF, May (4.27 in) and June (8.35 in) was much lower and the reduction in yield less severe. The biggest yield reductions as related to rotation occurred in 2007 (14.9% decrease). In this year rainfall was low early in the growing season and also low in February, March, and April going into the planting season. These conditions tend to favor a better root system and in rotations, the root development is better following corn. Above normal rainfall in July (7.74) resulted in rank growth, fruit shed, and boll rot. The biggest advantages have occurred in years where rainfall is limited and irrigation has been heavily relied upon. The silty clay loam soils at TSF have higher available water and tend to have a better rooted crop than the sandy loam soils. Unfortunately, many of the weather-related factors that influence plant growth are not predictable.

In 2007, emphasis was shifted to examine the effect of the corn/cotton rotation on reniform and root-knot nematode. Very few root-knot nematodes were found and the populations did not increase. Reniform nematode numbers were not significantly influenced by N or K rate but were influenced by the crop being grown. In general, the reniform numbers were lower following corn and tended to build up in the second year of cotton following corn. Those numbers were high headed into corn but decreased during the season and were generally lower at the end of the growing season than in the spring. The reniform numbers increased during the growing season and mushroomed at the end of the second cotton season. This would indicate a need for a1:1 corn/cotton rotation if reniform nematode numbers continue to increase. Other alternatives are available, such as chemical control, but are more expensive. 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.