# COTTON/CORN ROTATIONS – TEN YEARS OF YIELDS ACROSS N AND K LEVELS

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## Abstract

Long-term rotation studies with cotton following corn were initiated in 2000 at the Delta Research and Extension Center (DREC) on a Bosket very fine sandy loam (Mollic Hapludalfs) and at the Tribbett Satellite Farm (TSF) on a Forestdale/Dundee silty clay loam (Typic Endoaqualfs). The studies were designed to examine the rotational benefits and problems associated with crop rotations in the Mississippi Delta on both 'poorly' drained to 'somewhat-poorly' drained soils (Forestdale /Dundee) as well as better drained soils (Bosket). The selected sites are characteristic of soils suited for corn and cotton production. Producers now have the opportunity to shift plantings and crop mix within their farm enterprise and evaluate alternative crops or cropping sequences to replace some of their mono-crop cotton acreage. The objectives of the studies included, a) determining the effects of N and K nutrition on cotton lint yields and corn grain yields for different soil types; b) determining rotational effects of corn on cotton production and the implications of these rotations on whole farm economics; and c) evaluating the effects of nitrogen (N) and potassium (K) rates and rotational effects on nematode dynamics. The third objective was added in 2007 and will continue as an area of interest in the future. Areas were defined at both locations that could be rotated over a 3-year period with corn followed by one or two years of cotton. Within each location (soil type), each section had a factorial arrangement of N and K treatments. The sections consisted of 4-row (40-in spacing) plots, 90 to 100 feet in length, with either four (TSF) or five (DREC) replications. Annual N 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 different N rates established as a sidedress application at early square formation for cotton and at the 5- to 6-leaf stage of corn. 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. The K solution (muriate of potash, KCl) was chosen for ease of application with available equipment and does not imply that granular muriate of potash could not be used with incorporation. High-yield potential corn and cotton cultivars were planted at each location and maintained throughout the growing season and have been adjusted as new cultivars become available or as the cultivar of choice has been removed or replaced. Soil moisture sensors were installed to measure soil water relations and used to initiate, schedule, and terminate irrigations for both corn and cotton. The crops were harvested with commercial harvesters modified for plot harvest with cotton grab-samples taken for ginning and corn samples taken at harvest for determination of harvest moisture, bushel test weight, and seed weight. Seedcotton samples taken at harvest were ginned through a 10-saw micro-gin for calculation of the lint percentage. 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).

On the sandy loam soil at DREC, corn yields have ranged from 167 to 244 bu/acre (excludes 2000 data due to herbicide injury in corn following many years of continuous cotton) when averaged across all N and K levels. Between 2001 and 2009, yields have been optimized with 200 to 240 lb N/acre in most years. The average corn yields at DREC are 204 bu/acre/yr. On the more poorly drained soils at TSF, a minimum of 240 lb N/acre has been required to optimize corn yields for most years. Corn yields have ranged from 141 to 221 bu/acre with an overall average of 182 bu/acre/yr (excludes 2000 data for comparison). There has been no significant response to increasing K rates even though the lower K rate areas have had no fertilizer K applied in ten years and there has been no interaction between K rates or N rates. The highest corn yields have occurred with early planting at this location. Corn yields have topped 200 bu/acre in three of the ten years of the study.

Cotton lint yields have been affected by rainfall patterns throughout the duration of the study and have been quite variable with respect to rainfall during the growing season and annual totals even though some irrigation has been available. In 2000, August became the driest month on record when no rainfall occurred while August 2001 became the

wettest on record with nearly 9 inches of rainfall occurring during the month. At DREC, cotton yields have been as low as 510 lb lint/acre in 2009 where cotton followed cotton to a high of 1416 in 2003 with cotton following corn. When averaged across years, N rates, and K rates, cotton yields have averaged 949 lb lint/acre for cotton following corn compared to 807 lb lint/acre for cotton following corn. The range in response at DREC was -147 to +334 lb lint/acre with an average response of 142 lb lint/acre (17.7% increase) for cotton following corn as compared to cotton following cotton. The largest reductions in yield (2004 and 2007) occurred where excess rainfall and cloudy weather impacted disease and insect problems. Recent research has shown a marked effect of the rotation on reniform nematode numbers with little indication that the N and K treatments make a significant difference. Yield reductions have also been related to excess vegetative growth and the associated problems with getting insecticides into the dense canopy and subsequent insect damage in cotton following corn.

Cotton lint yields following corn at the TSF location ranged from 748 to 1394 lb lint/acre with an overall average of 1044 lb lint/acre/yr when averaged across all N rates and K rates (2000 to 2009). When cotton followed cotton, the lint yield range was 650 to 1276 lb/acre with an average yield of 950 lb/acre/yr. The response to rotation has ranged from a 5.1% (44 lb lint/acre) decrease to a 50.1% (341 lb lint/acre) increase with an average response of 9.9% (94 lb/acre/yr, increase). Irrigation has been more consistent at the TSF location as the irrigation water comes from an underground well. At DREC, surface water is used for irrigation and the availability of pumps is limited. In only one year, the cotton following corn rotation system resulted in a significant yield reduction (5.1% in 2001) where record rainfall was recorded in August. In the other years where no response to rotation was observed, the weed pressure in cotton following corn resulted in competition for nutrients and water. Shifting cultivars has helped to overcome this problem.

Response to N fertilization has been evident in most years while the response to K fertilization has been limited even though no fertilizer K has been supplied to some plots for the duration of the study. In most years, 90 to 120 lb N/acre has been sufficient for optimum cotton yields on the sandy loam soil. At TSF, on the silty clay loam soil, cotton yields have been optimized with 120 to 150 lb N/acre. In some years optimum yields for cotton following cotton have required higher N rates to optimize yields even though that yield does not equal the yield obtained behind a corn crop. The different N rate requirements have not been evident at the DREC location. In summary, the study has shown a range in response to rotations but an overall average increase in lint yields from 10-17% depending on the location and soil type. As grain acreage increases and with the higher prices for fertilizer, the benefits from rotation become more and more important. Also, as the populations of nematodes increase, control through rotation offers an alternative to pesticide applications.