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INTERACTION OF N AND K FERTILIZATION IN COTTON/CORN ROTATIONS

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Abstract

Long-term studies were established in 2000 at the Delta Research and Extension Center (DREC) and at the Tribbett Satellite Farm (TSF) to examine the rotational benefits and problems in corn/cotton rotations. The studies were designed to evaluate rotation effects on both poorly drained to somewhat poorly drained silty clay loam soils (Forestdale/Dundee) as well as better drained sandy loam soils more characteristic of corn production soils. As a result of changes in the recent farm bill, producers are looking into alternative crops and cropping sequences to replace some of their cotton acres in some years. These studies are intended to examine the impact of 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 both Forestdale/Dundee silty clay loam and Bosket very fine sandy loam; b) determining one- and two-year rotational effects of corn on cotton production and the implications of these rotations on whole farm economics; and c) supplementing the growing knowledge base for site specific management utilizing GPS/GIS technology and grid sampled soil analyses. Three distinct areas were defined at each location and rotated over a 3-year period with two years of cotton and one year of corn. Within each section, a factorial arrangement of nitrogen (N) and potassium (K) rates was established. The corn and cotton sections consist of four-row (40-in spacing) plots, 90 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. Potassium rates for all rotations were 0, 40, 80, and 120 lb K/acre. Nitrogen was applied at a uniform rate prior to planting as urea-ammonium nitrate solution (32% N) with the different rates established as a sidedress application of the same material at early square formation. 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. 'Pioneer 31G98' hybrid corn and 'SureGrow 747' cotton were planted at each location and maintained throughout the growing season. Sensors were installed to measure soil water tension and used to initiate and schedule irrigations for both corn and cotton. Both corn and cotton were harvested with commercial harvesters modified for plot harvest. For corn, samples were taken at harvest for determination of harvest moisture, bushel test weight, and seed weight. Stand counts were also made at this time by counting the stalks in one of the two remaining border rows. Following harvest, the corn stalks were shredded to destroy potential overwintering sites for insects. Soil samples were then taken after the cotton harvest was completed. Seed- cotton grab samples were taken at each harvest and ginned through a 10-saw micro-gin to determine the lint percentage. Soil samples were then taken after the stalks were shred but prior to any tillage. Following soil sampling, the area was disked, subsoiled, and then hipped as soon as possible (only TSF). The data was 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). Where appropriate, main effect means were calculated for each individual study. There was no significant N rate by K rate interaction for any of the studies or years.

Corn yields in 2000 were not significantly increased with increasing N rates but did increase in 2001 and 2002 with N rates up to 240 lb N/acre on the sandy loam at DREC. In 2000, corn was grown for the first time following many years of continuous cotton. Severe residual herbicide injury was observed which hindered crop development. This injury was not evident in 2001 or 2002. In 2001 at DREC, corn yields reached 246 bu/acre with N rates of 240 lb N/acre but dropped to 227 bu/acre for the same N level in 2002. At TSF, corn yields reached 238 bu/acre with 240 lb N/acre in 2001 but dropped to 174 bu/acre for the same N rate in 2002. The drop was primarily due to late planting (April 15) and a severe johnsongrass infestation.

Cotton lint yields have been significantly affected by rainfall patterns in each of the last three years. In 2000, August became the driest month on record when no rainfall occurred while August 2001 became the wettest on record with more than nine inches of rainfall. Cotton yields were impacted by cloudy weather which led to boll rot and yield loss. The 2002 harvest season was also affected by adverse weather conditions which delayed the harvest for many and eliminated the need for any second harvests. At DREC, which was initiated in 2000, there was no cotton following corn to be evaluated. In 2001, cotton lint yield, when averaged across both N rates and K rates, was 10.3% higher where cotton followed corn (730 lb/acre) as compared to continuous cotton (662 lb/acre). In 2002, overall cotton yield was 4.3% higher for cotton following corn (1198 lb/acre) compared to cotton following one year of cotton (1149 lb/acre). This difference would probably have been higher in 2002 if the second harvest could have been made. On the heavier-textured soils at Tribbett (TSF), 2000 saw cotton lint yield of 961 lb/acre for cotton following corn and 660 lb/acre where cotton followed cotton. This difference reflects a 45.6% increase in lint yield which can be related to the rotational effect. However, in 2001, cotton following corn had a lint yield (827 lb/acre) that was 5.1% lower than cotton following cotton (871 lb/acre). The difference seemed to be related to the size of the plants and the amount of boll rot and

subsequent yield loss. On the heavier texture soils, with excess rainfall, cotton following corn was hurt to a larger extent. In 2002, lint yield for cotton following corn (1391 lb/acre) was 9.0% higher than cotton following cotton (1276 lb/acre) when averaged across all N rates and K rates. With respect to cotton, applications of increasing N rates and K rates has produced varying results. There has been no significant increase in lint yields with additions of fertilizer K as a sidedress application at the DREC location for any of the years. In 2000, there was no response to N rates above 60 lb N/acre. In 2001, lint yields tended to show some yield decline with increasing N rates (not significant) for cotton following cotton while cotton following corn had yields which significantly decreased at N rates above 120 lb N/acre. In 2002, with much higher yields observed, there was no difference in yield response to increasing N rates for cotton following cotton. There was some increase in yield where cotton followed corn with 120 lb N/acre producing significantly more cotton than 60 lb N/acre. On the heavier textured soils at TSF, there was no difference in yields where cotton followed cotton but a significant decrease in yields following corn as N rates went above 120 lb N/acre. For 2001, there was no response to N for either cotton following corn or cotton following cotton. In 2001 with cotton following corn, there was a significant decrease in yield with increasing K rates. There was a similar trend for cotton following cotton in 2001 but the differences were not significant. The 2002 cotton yields at TSF were some of the highest observed for these soil types with yields ranging from 1110 lb/acre with 60 lb N/acre to 1384 lb/acre at 180 lb N/acre where cotton followed cotton. This response was significant up to 150 lb N/acre. With cotton following corn, the lint yields were even higher and ranged from 1188 to 1522 lb/acre with the highest yield obtained with 150 lb N/acre.

After three years or one cycle of the rotation study, cotton yield response has ranged from -5.1% to +45.6% at TSF and +4.3% to 10.3% at DREC when averaged across all fertility treatments. Years have been quite different and may actually reflect the largest range in conditions thought possible. The economic implications can now be evaluated and the effects of rotation on the whole farm enterprise examined. This work will be continued through another complete cycle in an effort to better understand the overall effects that years have on the crop rotation.