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COTTON YIELD RESPONSE TO N AND K MANAGEMENT IN ROTATIONS WITH CORN IN THE MISSISSIPPI DELTA

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Abstract

Long-term rotation 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 associated with corn/cotton rotations in the Mississippi Delta. 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 the better drained sandy loam soils (Bosket) that are more suited to optimum corn and cotton production. The most recent farm legislation has allowed producers the opportunity to look into alternative crops and cropping sequences to replace some of their cotton acres in certain years. These studies are 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; b) determining 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. Areas were defined at both locations that could be rotated over a 3-year period with two years planted to cotton and one year planted to corn. Within each area, each of the three sections would have a factorial arrangement of nitrogen (N) and potassium (K) treatments. The corn and cotton sections consisted of four-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 different N rates established as a sidedress application 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. 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. Soil moisture sensors were installed to measure soil water tension and used to initiate and schedule irrigations for both corn and cotton. Both crops were harvested with commercial harvesters modified for plot harvest with grad samples taken for laboratory analyses and ginning. Stand counts were taken in the corn studies by counting the stalks in one of the two remaining border rows. 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).

Corn yields have been increased by 8 to 24% at DREC and 27 to 38% at TSF in the last four years by increasing N rates above 120 lb/acre. On the sandy loam soil at DREC, corn yields have been optimized with 200 to 240 lb N/acre in most years. On the more poorly drained soils at TSF, at least 240 lb N/acre has been required to optimize corn yields. There has been no significant interaction between N rates and K rates at either location over the years. There has been no significant response to increasing K rates even though the lower K rate areas have had no fertilizer K applied in five years. Cotton lint yields have been affected by rainfall patterns in four of the last five 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 9 inches of rainfall occurring during the month. Cotton yields were impacted by cloudy weather that led to increased boll rot and subsequent yield loss. The 2002 harvest season was also affected by adverse weather conditions during the harvest season that delayed the harvest for many producers and eliminated the possibility for any second harvest. The 2004 growing season found more than 20 days of cloudy weather and rainfall in the month of June that impacted vegetative growth. These weather variations aid in the interpretation of results for cotton following corn and cotton following cotton in rotations.

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 have probably been higher in 2002 if the second harvest could have been made. Remotely sensed images in 2003 showed a pronounced difference between cotton following cotton and cotton following corn at the DREC location. These visual differences in June and July translated into a 19.3% increase in lint yield for cotton following corn (1416 lb/acre) compared to cotton following cotton (1187 lb/acre). However, in 2004, cotton following corn had lint yields that were 8.1% lower than cotton following cotton. On the silty clay loam soils at Tribbett (TSF) in 2000, cotton lint yield was 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 that can be directly related to the rotation 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 was related to the size of the plants and the amount of boll rot and subsequent yield loss. On the silty clay loam soils, with excess rainfall, cotton following corn was negatively impacted 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. In both 2003 and 2004, there has been no difference in lint yields for cotton following cotton compared to cotton following corn. In these years both johnsongarss and bermudagrass have been contributors to additional costs and reduced yields. When comparing cotton following corn verses cotton following cotton, the largest yield advantage has come in the dry years. When excess cloudy weather and rainfall has been a problem cotton following corn has been hampered by excess vegetative growth and increased boll rot, especially when the rainfall has come later in the growing season.

After the first three years or one cycle of the rotation study, cotton yield response had ranged from -5.1% to +45.6% at TSF and +4.3% to +10.3% at DREC when averaged across all N and K fertility treatments. After five years, that range is the same on the silty clay loam soils at TSF. However, the range in response on the sandy loam soil is now -8.1 to +19.3%. Years have been quite different and may actually reflect a largest range in weather conditions than originally thought possible. General observations have indicated that at least 30 more lb N/acre is required to optimize yields on the Dundee/Forestdale soils. Johnsongrass and bermudagrass have both presented problems on the TSF and play an important role in the decision making process. Biotechnology offers some solutions for the problems that have been identified and are being incorporated into the study. The economic implications have to 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.