UPDATE ON COTTON/CORN ROTATIONS IN MISSISSIPPI

M. Wayne Ebelhar
Davis R. Clark
H. C. Pringle
Mississippi State University
Stoneville, MS

Abstract

Long-term cotton/corn rotation studies 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) to examine the rotational benefits and problems associated with crop rotations in the Mississippi Delta. The studies were designed to evaluate rotational effects on both 'poorly' drained to 'somewhat-poorly' drained soils (Forestdale/Dundee) as well as better drained soils (Bosket) that are characteristic of soils suited for corn as well as cotton. Recent farm legislation has allowed producers the opportunity to shift their plantings and evaluate alternative crops and cropping sequences to replace some of their cotton acreage. 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; 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 be the area of interest for future years. 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 of the three sections had a factorial arrangement of N and K treatments. 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. 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 6- to 8-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. Stand counts were taken in the corn studies by counting the stalks in one of the two remaining border rows. The 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, average (across and N and K rates), corn yields have ranged from 167 to 244 bu/acre (excludes 2000 data due to herbicide injury) between 2001 and 2007 and been optimized with 200 to 240 lb N/acre in most years. The average corn yields at DREC are 212 bu/acre/yr. The only year where 280 lb N/acre was significantly greater than 240 lb N/acre was 2004 and that year had the lowest corn yields. Heavy rainfall in May and June (nearly 20 inches total) contributed to severe disease pressure and soil N loss. On the more poorly drained soils at TSF, at least 240 lb N/acre has been required to optimize corn yields in most years. Corn yields have ranged from 141 to 221 bu/acre with an overall average of 186 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 eight years and there has been no interaction between K rates or N rates.

Cotton lint yields have been affected by rainfall patterns throughout the study and have been quite variable with respect to rainfall during the growing season and annual totals. 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. 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 do aid in the interpretation of results for cotton following corn and cotton following cotton in rotations. The 2006 growing season resulted in some of the lowest yields in several years. The rainfall patterns were different at the two locations in 2007 with the TSF location receiving less rainfall than the DREC location. Heavy rainfall in June led to fruit shed and excess vegetative growth that confounded attempts to control plant bugs. From 11 to 13 insect sprays were applied during the growing season in an effort to control insect pests.

Lint yields for cotton following corn, at the DREC location, ranged from 631 lb/acre to 1416 lb/acre with an overall average of 988 lb/acre (averaged across all N rates and K rates). When cotton followed cotton, the range was 521 to 1187 lb lint/acre with an average of 890 lb/acre/yr. The response to rotation has ranged from a 14.9% (147 lb lint/acre) decrease to a 51.7 % (270 lb lint/acre) increase with the average response at 11.1% (98 lb/acre/yr, increase). The overall average had been higher prior to 2007 but severe plant bug infestations and damage reduced yields in cotton following corn more than cotton following cotton. However, both areas had heavy infestations and poor fruit set in the lower portions of the plants. This reduction has been related to excess vegetative growth and the associated problems with getting insecticides into the dense canopy.

Cotton lint yields following corn at the TSF location ranged from 748 to 1394 lb lint/acre with an overall average of 1047 lb lint/acre/yr when averaged across all N rates and K rates. When cotton followed cotton, the lint yield range was 681 to 1276 lb/acre with an average yield of 939 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 11.4% (107 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.

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.

These studies will continue with the emphasis shifted to examine the effects of N and K nutrition on nematode dynamics within the systems. In summary, the study has shown a range in response to rotations but an overall average increase in lint yields of 11%. As grain acreage increases and with the extremely high 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.