COTTON YIELDS AS INFLUENCED BY COTTON FERTILIZATION OF CORN IN A COTTON/CORN ROTATION SYSTEM

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Abstract

Corn acreage has increased from 140,000 acres for grain in 1990 to a high of 940,000 in 2007 with yields reaching 150 bu/acre across the state. In the Mississippi Delta, yields have been reported in excess of 250 bu/acre. In just the last three years cotton production has decreased from 1.62 million acres in 2001 to 360,000 acres harvested in 2008. The 2004 crop produced an all-time record yield of 1,024 lb lint/acre on 1.1 million acres. The 2005 and 2006 yields averaged around 850 lb/acre and were down due to hurricane damage and drought in the respective years. In 2007, cotton acreage dropped dramatically as grain crop acreage increased due to excellent prices for those crops while cotton prices declined along with world demand. As the corn acreage increases, the opportunity for rotations rises significantly. Cotton yield increases due to rotation have averaged 10 to 15% with higher benefits observed in drier years. The cotton yield advantage in multi-crop systems has been attributed to several factors including better soil tilth, improved water infiltration, increased organic matter content, depressed nematode populations following corn, as well as benefits due to rotation of herbicides. Some yield decreases following corn in rotation have been documented and have generally been weather related where excess growth has been detrimental and affected both yields and quality. In most cases, cotton yields have been maintained following corn with less total fertilizer N required. However, little information is available on how much N rates could be reduced for cotton following corn, how much residual N is available to the subsequent cotton crop, and what effect rainfall totals and distribution have on residual N. Excess N has led to increased vegetative growth and reduced both lint yield and lint quality. Efficient utilization of available N can reduce the overall cost of production while reducing the potential release of nutrients from the field into waterways and streams.

In order to address these issues, a multi-year study was established in 2004 at the Delta Research and Extension Center with one-half of the research area planted to corn each year and the remaining half planted to cotton. Fertilizer N rates for corn ranged from 120 to 300 lb N/acre in 30-lb increments and were applied as urea-ammonium nitrate (32% N) with 120 lb N/acre applied prior to planting (PP) and the remainder applied as a sidedress (SD) application. Potassium was applied at rates of 0, 30, 60, and 90 lb K/acre with liquid muriate of potash as the K source. The N and K rates were only applied to the area when it was planted to corn. The following year, a uniform N rate, 90 lb N/acre, was applied to the cotton with no additional K. The 7x4 factorial arrangement of treatments was laid up in randomized complete block design with eight replications. All cultural practices and pesticide applications were maintained uniformly across the corn or cotton study. Plots were harvested with commercial harvesters adapted for plot harvest and samples collected for determination of harvest moisture, bushel test weight, and seed weight for corn and lint percentage on cotton.

There was no significant interaction between N rates and K rates, so only the main effects were examined for both crops. In the initial year of the study (2004) corn yields ranged from 154 to 165 bu/acre with no significant yield increase achieved with N rates above 180 to 210 lb N/acre. These yields are lower than expected for the soil types included in the study. Yields in subsequent years were significantly higher and more in line with yields potentials for the area. Since 2004 was the establishment year, no cotton following corn was evaluated. In 2005, cotton yields following the previous corn crop ranged in yield from 864 to 903 lb lint/acre with no significant difference in yields as they related to the previous year's N rates. Corn yields of 165 bu/acre removed about 150 lb N/acre from the field as harvested grain. Thus at the 300 lb N/acre application rate, 150 lb N/acre was not removed in the grain and should be left in the field as residue, organic matter, or as inorganic N remaining in the soil. Some of the cotton yield effects could have been masked due to losses from the hurricane-related wind and rain in 2005. However, visual observations did not lead to that conclusion. Corn yields in 2005, harvested before the hurricanes, ranged from 197 to 207 bu/acre. While yields were significantly higher than the previous year, there was still no large range in yields associated with N rates. Grain yields were not significantly increased with N rates above 180 lb N/acre. As with the previous year, grain yields were probably limited due to the limited availability of supplemental irrigation.

The 2006 cotton yields following corn in 2005 ranged from 1,316 to 1,373 lb lint/acre. There was no significant difference in yield as related to residual N levels but there was a slight trend. Lint yields were excellent in 2006 compared to the previous year and were more indicative of yield potential in the area. Corn yields in 2006 ranged from 206 to 227 bu/acre with no significant response above 210 lb N/acre. In both 2005 and 2006 there was no apparent cotton yield response to residual N from the previous corn crop. Rainfall totals and distribution can be used to shed some light of the potential for N loss from the systems. After the 2004 growing season, rainfall totals for October to the next April were 39.92 inches. Actual rainfall in 2004 was 68.00 inches (14.71 inches above normal) nearly 20 inches falling in May and June after the initial N application. High rainfall and prolonged saturated conditions can lead to nitrification and denitrification and loss of available N. October through December rainfall in 2005 was just over 5 inches, however August and September rainfall was over 12 inches. January through April rainfall totaled more than 26 inches again leading to the potential for decreases in the available N pool. September 2006 to April 2007 rainfall was lower than in previous seasons at 33.05 inches with little rainfall occurring after January. Cotton yields in 2007 were significantly influenced by residual N from the 2006 corn crop. Lint yields with 120 lb N/acre applied to corn were 1164 lb/acre compared to a high of 1258 lb lint/acre where 270 lb N/acre had been applied to the corn. While the differences are not great they are significant and 2007 was the only year where differences occurred. In 2008, there was no response to residual N with lint yields ranging from 1351 to 1383 lb/acre. Rainfall totals for the September to April period were 34.43 inches 23.65 inches falling in February through May 2008. The excess rainfall in the spring along with warmer temperatures should be indicators of the potential for N loss from the residual pool. After four years, cotton response to residual N was only evident in one of the four years. In that year rainfall was lower compared to other years. From this study, 90 lb N/acre was sufficient to optimize yields in three of four years. The normal recommendations would call for 110 to 120 lb N/acre for optimum production. Based on cotton yields, there appeared to be little buildup on residual N from higher N applications on corn. Corn yields improved after the first season with yields limited by the supply of water from either rainfall or irrigation.