ROTATIONS IN COTTON PRODUCTION FOR THE MISSISSIPPI DELTA -- 2000-2017

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Abstract

Crop rotation is not a new concept and has actually been around for centuries. Some of the earliest research at the oldest experiment station in Rothamsted (England) founded in 1843 dealt with crop rotations and green manures. Early research at the Delta Branch Experiment Station (Delta Research and Extension Center) dating back to 1904 dealt with crop rotations. Before the discovery of synthetic nitrogen fertilizer, legumes were the primary nitrogen source for other crops that followed. Crop rotation fell by the wayside in the 1960's to 1990's as mono-crop culture was the most economical crop while corn and soybean were secondary even though soybean production reached 4 million acres in the early 1980's. The current research on crop rotations began in the mid-to-late 1990's. As irrigation expanded and early soybean production systems were developed, soybean became a profitable crop and gained in importance and average yields grew from a meager 10-15 bu/acre to more than 75-80 bu/acre with some field topping 100 bu/acre in some parts of the South. In 1980, there were far less than 100,000 acres that yielded less than 100 bu/acre. For the last 35 years, average corn yields have increased at an average of 3 bu/acre/year bringing average yield to nearly 190 bu/acre. With these type of advances in yields, crop rotations with grain crops has become an accepted practice and bring profitability to farming operations.

Long-term crop rotation research at the Delta Research and Experiment Station (DREC) originated in 2000 with trials on the station at Stoneville and at the satellite farm 9TSF) near Tribbett, MS. The initial research project was designed to evaluate a factorial arrangement of potassium (K) rates and nitrogen (N) rates for corn, cotton following corn, and cotton following corn. The DREC location was planted on a Bosket very fine sandy loam (Mollic Hapludalfs) and the TSF study planted on a Forestdale and Dundee silty clay loam (Typic Endoaqualfs). Remote imagery taken in June of 2003 showed a distinct line between the two sections planted to cotton one of which followed corn while the other followed cotton. By season's end, lint yields (averaged across N rates, K rates, and replications) were 230 lb lint/acre different in favor of cotton following corn. This difference has been termed the rotation effect since all inputs were the same except one followed corn and the other followed cotton. The rotation effect became the focus of the long-term studies at each location. The rotation effect at DREC has ranged from -14.9% to + 65.4% with an overall average of 17.1% (139.2 lb lint/acre/year). Negative rotation effects were observed in two of twelve years but can be explained by examining rainfall data for the growing season. One of the negative response (-8.1%) was observed in 2004 where rainfall totals surpassed 29.0 inches in April through September and 12.45 inches were measured in June alone. Better growing plants following corn can lead to boll rot when plants get too big. Overall lint yields were lower at TSF as expected and the rotation effect was smaller. The response ranged from -5.1 to +50.1 with a 14-year average of 8.9% increase (90.2 lb lint/acre/year). The silty clay loam soils have a higher available water content and can actually hold up better under drought conditions.

The second major rotation effort originated at the DREC in 2004 with the establishment of the Centennial Rotation to commemorate the founding of the experiment station in 1904. The Centennial Rotation was quite different from many of the other long-term systems around the country in that it had every crop in the rotation grown each year an every system was replicated four times. At the time of the initial experiment design, cotton was still king and the only continuous crop was cotton. The rotations are various combinations of cotton, corn, and soybean with 2-yr, 3-yr, and 4-yr rotations compared to continuous cotton. After twelve years, the 2-yr systems have cycle six time, the 3-yr systems have cycled four time and the 4-yr systems have cycled three times. In the 13th year all systems are back to the beginning. With the design just describe, direct comparisons of cotton following corn can be made with continuous cotton. In the first twelve years, the rotation effect has average 22.0% (222 lb lint/acre/year) with no negative response years. The range of rotation response was +8.8 to 39.5%. In one of the highest cotton yielding season, 2013, continuous cotton yield was 1452 lb/acre which surpassed any other continuous cotton yield. However, in that same year, cotton following corn had lint yields of 1952 lb/acre, an increase of 500 lb/acre. A major emphasis in the Centennial Rotation has been the estimation and summation of nutrient (N, P, K, and S) uptake and removal. Including grain crop in a rotation results in greater uptake and greater removal. With soybean, most of the removal comes from symbiotic fixation rather than fertilizer applications. In comparing a corn/soybean rotation (all grain crops) to continuous cotton, after twelve years the grains had removed 225% more N, 151% more P, 78% more K, and 82%

more S than the continuous cotton system. In comparing continuous cotton to a cotton/corn rotation, 91% more N, 111% more P, 28% more K and 81% more S was removed with the corn/cotton rotation system. The take home point to be made is that the rotation effects are real and that soil testing to monitor soil nutrient levels are critical for optimizing yields when grains are part of the system.