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FOUR-YEAR SUMMARY OF THE SPATIAL VARIABILITY OF COTTON AND CORN YIELDS IN THE MISSISSIPPI DELTA

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Abstract

In the Mississippi Delta, producers continue to look for the tools to increase net returns. Precision agriculture and site specific management have been gaining in acceptance in some areas of the country and are being evaluated throughout the Cotton Belt. Global Positioning Systems (GPS) along with Geographic Information Systems (GIS) have become the framework for multi-layered data that may be used to describe the spatial variability found in many fields in the Delta. A study being conducted in a 15-acre field on the Delta Research and Extension Center located at Stoneville, MS, was established to examine the spatial variability of both corn and cotton yields in a rotational system. The study, initiated in 1998, had corn grown in 1998 and 2000 while cotton was grown in 1999 and 2001. The 496-cell field was geo-referenced in 1998 with plots (cells) maintained in the same area in subsequent years. Each individual cell consisted of four 40-in rows 82 feet in length and arranged as eight tiers with 62 strips. Soil samples were taken after each crop was removed. The samples were collected by compositing 6-8 soil cores from each plot. The samples were air-dried, ground, mixed, boxed, then shipped to Mississippi State University Extension Service for routine soil analyses. The original objectives of the study were to 1) build yield maps and soil characteristic maps in an effort to visually explain spatial variability in both cotton and corn; and 2) to examine the relationship between soil test parameters and yields of cotton and corn utilizing GPS/GIS technology. Several tools have been used to accomplish the objectives including, ArcView GIS, TableCurve 2D, Statistical Analysis Systems (SAS), and a graphics package to illustrate the results (Lotus Freelance Graphics). A spreadsheet (Lotus 123) system was set up to handle the data prior to inclusion in the database.

The research area contained three soil types as determined from the Washington County Soil Survey Report issued in 1961. The soils were Dundee very fine sandy loam, Dundee silt loam, and Dundee silty clay loam, all with varying levels of productivity. In 1998, corn yields ranged from 132 to 186 bu/acre with an average yield of 156 bu/acre. The area had been planted to continuous cotton for many years prior to the shift to corn in 1998. Soil pH in the area averaged 6.4 with phosphorus (P) at 114 lb/acre and potassium (K) at 305 lb/acre. Organic matter ranged from 0.40% to 2.11% with an average of 0.97%. The cation exchange capacity (CEC) ranged from 8.18 to 22.30 meq/100g with an average of 13.81 meq/100g. The range in CEC would be expected based on the soil texture outlined in the soil survey report. At the time of harvest, samples were extracted to determine the grain moisture content, bushel test weight, and seed weight. The area rotated to corn again in 2000 following the 1999 cotton crop. Grain yields ranged from 153 to 210 bu/acre with the average yield established at 182 bu/acre. This average was 17% (26 bu/acre) higher than the average in 1998. Bushel test weights ranged from 56.3 lb/bushel to 59.8 lb/bushel with an average of 58.2 lb/bushel. Seed weights ranged from 31.59 g/100 seed to a high of 37.15 g/100 seed. In 1998, there appeared to be some difference in harvest plant stands even though the field had been planted at a uniform seeding rate based on planter calibration prior to planting. In 2000, harvest population was determined by counting the stalks in the two rows adjoining the harvest rows. The stand ranged from a low of 18,327 plants/acre to a high of 28,766 plants/acre with an average of 23,024 plants/acre.

In 1999, the area rotated to cotton and was harvested twice to determine ranges in yields and maturity as measured by the percent first harvest (PFH). Seedcotton yields were determined by harvesting the center two rows of the 4-row plot. Grab samples were taken from each plot at harvest and used to determine the lint percent by ginning the samples through a 10-saw micro-gin. First harvest lint yields ranged from 900 to 1439 lb/acre with second harvest lint yields ranging from 33 to 208 lb/acre. The first harvest yields reflected a difference of greater than a bale per acre. Total lint yields ranged from 949 to 1508 lb/acre with an average of 1163 lb/acre. In examining the yield maps from the different crops, it became obvious that the yields maps were different depending on the crop being grown. The two corn yield maps had been somewhat similar in distribution but were quite different with respect to actual yields. These maps were again quite different from the cotton yield map. As expected from visual observations, the lower yielding cotton areas at the first harvest were the higher yielding areas at the second harvest. This was reflected also in a map of PFH. Even after the two harvests were added together, there were still obvious differences in yields related to the location in the field. What had been the lower yielding corn areas in 1998 and 2000 were not always the lower yielding areas with respect to cotton. The 2001 lint yields have not been completed so only seedcotton yields could be reported. First harvest seedcotton yields ranged from 769 to 2920 lb/acre with an average of 2151 lb/acre. The 2001 yields were greatly influenced by boll rot and fruit shed resulting from nearly three weeks of cloudy weather and heavy rainfall late in the season. Second harvest yields ranged from 88 to 311 lb/acre and averaged 223 lb/acre. This led to total seedcotton yields which ranged

from 880 to 2232 lb/acre with an average of 2403 lb/acre. The PFH ranged from 80.4% to 96.5% and 91.5% when averaged across all 496 cells.

In summary, the yield maps provided an indication of the high and low yielding areas in a field. However, multiple years will be needed to better define the reasons for the variability that was evident in the field. Contrary to some reports, the better yielding areas in the field for one crop were not the better yielding areas for another crop. Therefore, yield maps are needed for individual crops and should be collected for several different years. In most cases, several factors are involved in spatial variability in fields. While there is a tendency to ascribe much of the variation to soil differences, it may actually only explain a small portion of the inherent differences. The new technologies do provide a means for examining layer upon layer of geo-referenced data. Large databases can be generated but the difficulty comes in the interpretation of the data.