INFLUENCE OF SOIL TEST PARAMETERS ON YIELDS AS DETERMINED THROUGH GPS/GIS TECHNOLOGY

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Abstract

Producers are continually being exposed to new technologies and the Computer Age. Site specific management or precision farming has been used to describe one aspect of the new technologies that offers promise for use in agricultural operations. Global positioning systems (GPS) make it possible to geo-reference fields which become the framework for multi-layered data that can be used to describe events taking place in the field. Yield monitors developed for grain harvest are making it possible to measure yield variations in the field while on the move and then relate all of the data back to the original framework. Since GPS sets a land-based reference system, the logical point to begin is the soil and soil nutrient analysis. The first objective of this research project was to examine the relationship between soil testing parameters (pH, phosphorus [P], potassium [K], exchangeable acidity, exchangeable cations [K, Ca, Mg, Na], cation exchange capacity [CEC], organic matter [OM], an estimate of sulfur [S], and zinc [Zn]) and yields of corn (1998) and cotton (1999). The second objective was to build yield maps and soil characteristics maps in an effort to explain spatial yield variability in both corn and cotton. The research area was a 15-acre field on the Delta Research and Extension Center at Stoneville, MS containing three soil classification units. The general soil type was a Dundee (Aeric Ochraqualfs) classed into very fine sandy loam, silt loam, or silty clay loam textural classes. Each plot (cell) consisted of four 40-in rows 82 feet in length (0.025 acres). The field was divided into 496 cells arranged in eight tiers and 62 ranges with alleys between tiers. All plots were planted to corn (variety: Pioneer 32K61) and maintained uniformly during the entire season with all cultural practices consistent across all cells. The center two rows of each plot was harvested, weighed, and a moisture sample taken so that the yield could be adjusted to a constant moisture. In 1999, cotton (variety: STV-474) was planted and maintained uniformly as in the previous growing season. The two center rows were again harvested with a commercial spindle picker modified for plot harvest. Grab samples were taken at each of two harvest to determine lint yields. All cells were geo-referenced prior to harvest in 1998 with an ATV-mounted GPS equipped with differential correction. Soil samples were taken from each cell following harvest in 1998. Eight to ten subsamples were taken and composited from each cell. The 12-in core was divided into topsoil (0 to 6 in) and subsoil (6 to 12 in) samples. All samples were dried, ground, and mixed prior to leaving the experiment station and were then analyzed through the Soil Testing Laboratory at Mississippi State University and operated by the Extension Service. Additional soil samples were taken following the 1999 harvest but only to a depth of six inches. Tools used in the summary and explanation of data included Lotus 123 and Freelance Graphics, ArcView Geographical Information System (GIS, Environmental Systems Research Institute, Inc.), Statistical Analysis Systems (SAS), and TableCurve 2D (Jandel Scientific). Corn yields in 1998 ranged from a low of 132 bu/A to a high of 186 bu/A. The 54 bu/A range translates into a 40% yield range. Regression analysis was used to examine the soil characteristics with respect to corn yields. When including a single factor in the model, the highest correlation was between yield and subsoil P (R^2 = 0.246) followed by topsoil P (R^2 = 0.239). When two factors were included in the model, the highest correlation occurred between subsoil P + subsoil K (R^2 = 0.272) Adding the second factor did not greatly increase the correlation. Both subsoil P and subsoil K were positively correlated to corn yield. At the time of presentation, 1999 lint yields and soil analyses data had not been completed, thus correlations were made for seedcotton yields and 1998 soils data. First harvest seedcotton yields ranged from 2366 to 3835 lb/A with second harvest yields ranging from 98 to 581 lb/A. Total seedcotton yields ranged from a low of 2583 lb/A to a high of 4099 lb/A. Seedcotton yields were not nearly as highly correlated to soil nutrients as had been observed in the 1998 corn crop. The highest single- factor correlation was to subsoil acidity (R^2 = 0.0668) followed closely by topsoil acidity (R^2 = 0.0640). TableCurve was used to look at the slope of the relationship between cotton yield and subsoil acidity and also to look at how well the data fit the regression line. Normally one would expect cotton yields to decrease with increase acidity. However, yield data in 1999 actually showed an increasing yield with increasing acidity and no apparent relationship with pH. As indicated early, none of the soil characteristics alone explained much variability. When two factors were examined in the regression model, the top factors that correlated to yield were topsoil exchangeable Mg + topsoil CEC (R^2 = 0.185). These two factors, while having the highest correlation to cotton yield, are not factors which can be manipulated through normal farming operations. Delta soils tend to be high in Mg and often have a negative correlation to yield. As one would expect, cotton tends to do better on sandier soils which would be indicative of lower CEC soils. This discussion only touches the tip of the data collected to date but does show how complicated the systems are. When looking at corn and cotton rotation systems, the factors which were most correlated to corn yield were not correlated to cotton yield. These data suggest that factors

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other than soil characteristics are more strongly influencing yields. The new technologies do provide helpful tools to explain some of the yield variation actually occurring in the field.