ARKANSAS

Assessment of Rice Yield and Fertility Using Site-Specific Technologies

By W.H. Baker and S.D. Carroll

Considerable yield variability occurs in many rice fields in the Midsouth area of the U.S. If field variability can be reasonably illustrated, then decisions could be formulated to improve management in the areas exhibiting suboptimal production. The key is to begin to identify and better comprehend the factors and conditions causing this variability. Recent advances in navigation systems, yield sensors, and data analysis software have dramatically increased the effectiveness of collecting field production information. The combined result of these tools is to allow production decisions to shift from field-sized areas to much smaller units. Subsequently, the uncertainty and error associated with large block decisions are also reduced.

This investigation was designed to assess the value of using global positioning system (GPS) and geographic information system (GIS) technologies to determine field production variability. The objective was to assess the differences between site-specific yield and soil information compared to field average or composite information.

Arkansas research is providing an understanding of the value of yield monitors and intensive soil sampling in rice management.

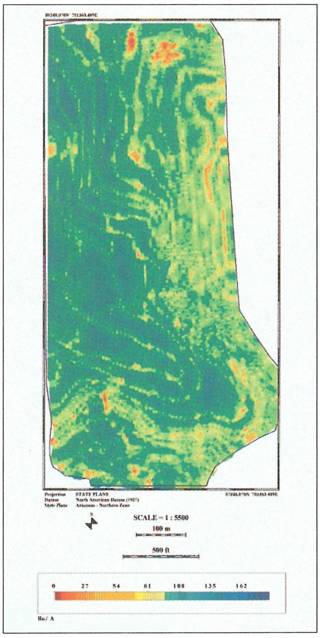

Figure 1. Continuous surface map of the yield monitoring information.

Arkansas Study

Yield information was generated using an AL2000 yield monitor coupled to a GPS receiver using the U.S. Coast Guard for differential correction. This equipment was placed on a Case IH 2188 combine. Soil test data were collected on a 2.5 acre grid using a differential GPS receiver to locate the cell centers. Each sample point consisted of a composite of five cores collected from the top 6 inches of soil on a 30 ft. radius around the center of the cell. Soil pH was measured on a 2:1 water to soil basis. Mehlich 3 extractable soil potassium (K) and phosphorus (P) were determined by ICP emission spectroscopy. The GIS used to assess the yield and soil test data was the professional version of the Rockwell Vision System software. Yield and soil test maps are presented as continuous surfaces derived from an inverse distance model. These surfaces are analogous to contour intervals. The farm production system investigated was a rice and soybean rotation located on a clay pan silt loam soil in the mid-Arkansas Delta region. Eight soybean and rice fields consisting of 1,200 acres were yield monitored and grid soil sampled. The data discussed in this article were from one of these fields (110 acres), that had been cropped to rice for the last three years.

Production Observations Based on Yield Monitoring

The yields from some of the first fields to be harvested were disappointingly low. This field was no exception. The yield ranged from 20 to 139 bu/A with an average yield of 32 bu/A, nearly 35 bu/A off the expected yield.

Yield monitoring data are presented in **Figure 1**. One interesting feature observed from this surface map is the appearance of the levees at the lower end of the production scale. The yield data indicated nearly 40 percent of the field was below the mean of 32 bu/A. This low production level was largely associated with one end of the field that was poorly drained. Some seedling stress probably occurred from early season cold and wet weather. A large strip of this low yielding area had been filled and the fill material may have restricted soil drainage. Clearly, a soil physical problem was associated with the low yielding areas in this field.

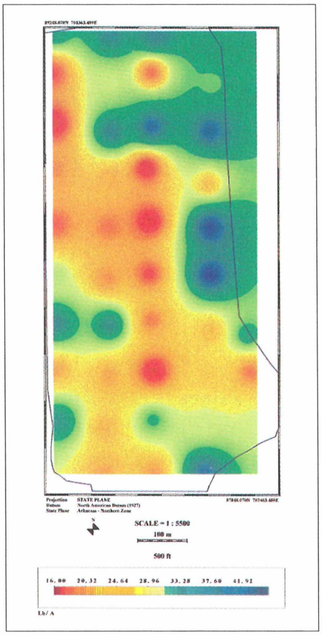

Figure 2. Continuous surface map of the grid sampled soil test P information.

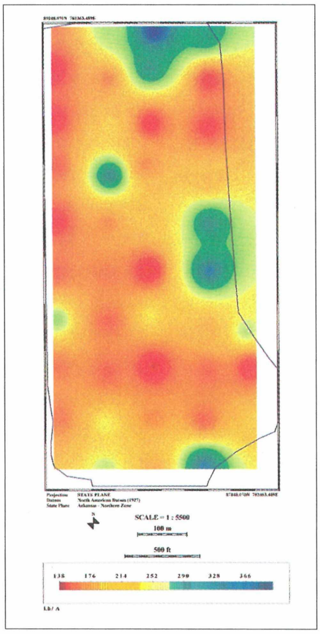

Figure 3. Continuous surface map of the grid sampled soil test K information.

Soil P and K Fertility Assessment

The field composite soil sample represented the average of all 42 of the soil test values from the grid soil samples. Under normal circumstances, a field of this size and appearance would be divided in half and characterized based on two composite samples. Approximately 53 percent of the field was below the mean P value of 28 lb/A, shown in **Figure 2**. The field average, or composite, for soil test P just missed a rice recommendation for P fertilizer based on the current critical level of 25 lb P/A. A large fraction of the low P soil area corresponded to the area where yield monitoring indicated the field was most productive.

The results for soil test K indicated a mean value of 215 lb K/A. The range in these data was from 139 to 400 lb K/A. While the mean soil test was above the critical level of 175 lb K/A for rice, this field

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sampling density which includes distances at which samples are correlated. We wish we could provide guidance to the required sampling density for all fields, but we and others are still researching that question. We have seen cases where it appears that 2.5 acre samples will work, but we have also seen many cases where a far more dense sampling regime must be used. We strongly argue that all fields be given more rigorous geostatistical consideration. We also believe that the best way to make VRT fertilizer application decisions for many fields is to base those decisions upon previous yield maps and nutrient removal calculations. BC

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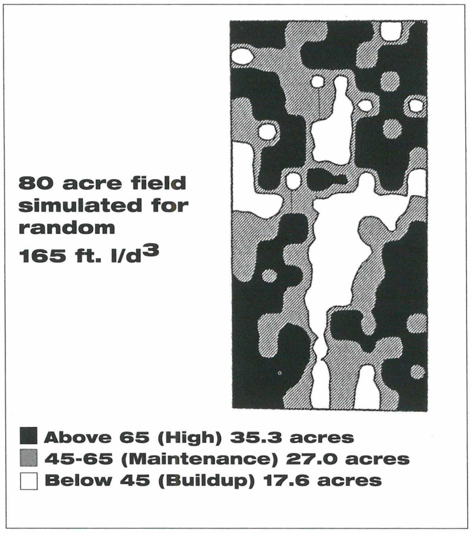

FIGURE 5. Field simulation of soil test P distribution, inverse distance cubed weighting.

Rice Yield... *(continued from page 25)*

would require a moderate addition of K fertilizer based on a composite sample assessment. However, the surface map of soil test K, **Figure 3**, was even more revealing. A large part of the field was shown to have K values at or below the critical level. The grid soil sampling and GIS evaluation plainly illustrated a compelling need for adequate K fertilization.

Summary

Rice production was almost certainly limited by P and K fertility as indicated by yield monitoring and soil test data. The most limited areas of P and K availability corresponded with the high yielding areas. Evidently, larger amounts of soil P and K were being removed where yields were placing the greatest demand. Rice in the less-demanding low-yielding areas was probably restricted by poor soil physical conditions and was not found to be limited by fertility considerations.

The combination of site-specific yield and soil sampling data provided a significant improvement in the quality of information available to make production assessments. While the expense of generating these types of site-specific data is significant, the increased insight and number of yield-improving options offer great promise. BC

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