INTERPRETATION OF GRID SAMPLING TECHNIQUES FOR SOIL NUTRIENT STATUS

M. W. Ebelhar, Agronomist
Mississippi Agricultural and Forestry Experiment Station
Delta Research and Extension Center
Stoneville, MS

Abstract

The need for agricultural producers in the Mississippi Delta to improve their management practices and become more cost efficient has fueled the pursuit of technology-based approaches to farming. The emergence of satellite and computer-based technology has expanded the imagination of the agriculture-related community with anticipation of significant gains in production efficiency based on the potential for improved management capabilities. The rapid development of Global Positioning Systems (GPS), Geographic Information Systems (GIS), and variable rate technology (VRT) has resulted in the need to identify the factors that most influence yield and are potentially controllable. Soil physical and chemical properties greatly influence yield and have a high level of inherent natural spatial variability. In order to assess this spatial variability, a grid system was set up on 100-ft x 100-ft (100-ft cell) intervals at the Tribbett Satellite Farm of the Delta Research and Extension Center. The experimental area consisted of a 45.92-acre block (1000 x 2000 ft) with 200 cells. A composite soil sample was taken from around the center point of each cell of the grid area. The soil samples were then processed and analyzed through the Soil Testing and Plant Analysis Laboratory at Mississippi State University operated by the Mississippi Cooperative Extension Service. The objectives of the investigation were to 1) examine the effects of grid size for soil sampling in order to determine fertilizer phosphorus (P) and potassium (K) needs on a field basis and 2) to evaluate the variations within larger cells and their influence on cell means, and thus fertilizer use. Soil analysis results were first summarized for the 100-ft grid (0.23 acres) system. Means were then determined for cell sizes of 200-ft (0.92 acres, four 100-ft cells), 300-ft (2.07 acres, nine 100-ft cells), 400-ft (3.67 acres, sixteen 100-ft cells), 500-ft (5.74 acres, twenty five 100-ft cells), and 1000-ft (22.96 acres, one hundred 100-ft cells). The soil test value for each larger cell was calculated as a mean value for the 100-ft cells contained in each larger cell. Fertilizer P and K requirements were then determined based on recommendations from the soil testing laboratory for individual cells and summed across cells for the 45-acre field. The total P requirements ranged from 1103 lb P (5490 lb 0-46-0) with 100-ft grid sampling to a low of 770 lb P (3833 lb 0-46-0) for the 400-ft grid . The average P requirement for the entire area across grid sizes was 860 lb P (4278 lb 0-46-0). The difference represents a 43% increase in P requirements for the 0.23-acre cell compared to the 3.67-acre cell. With respect to K, total K requirements for the area ranged from 2367 lb K (4752 lb 0-0-60) with the 100-ft to a low of 2184 lb K (4385 lb 0-0-60) for the 300-ft grid, with an overall average of 2287 lb K (4592 lb 0-0-60). The range represents an 8% increase in fertilizer requirements for the whole farm compared to the low rate. The variability in K needs were not as drastic as the variability in P needs. In general, smaller grid size sampling does not suggest higher fertilizer requirements but does allow for the detection of more spatial variability, and thus delineates areas which could require higher fertilizer rates or lower fertilizer rates than what could be determined from a single sample from a large area. Composite samples can give false indications if one cell sample has extremely high or low test levels which could bias the entire composite. If this scenario occurs, then the majority of the area could receive either too little or too much fertilizer. By having detailed maps of the spatial variability and variable rate applicators, it is possible to apply the fertilizer more efficiently, keeping the high-testing areas from being over-fertilized and the low-testing areas from being under-fertilized. This investigation was made using non-GPS/GIS technology to establish grids and calculate fertilizer needs. The data is also being analyzed using current GPS/GIS technology to determine fertilizer needs based on the capabilities of variable-rate applicators. Comparisons of total fertilizer needs will be made between non-GPS/GIS technology and the new GPS/GIS technology systems. The level of sampling will be limited by cost and must be weighed against the benefits gained from more precise fertilizer application. The goal is to increase the overall productivity and profitability of the field.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:592-592 (1997)
National Cotton Council, Memphis TN