41 Yield Variation Across Coastal Plain Soil Mapping Units

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Soil specific crop management is commonly proposed as a means of increasing efficiency of production and reducing environmental damage resulting from overapplication of fertilizers or pesticides to subfield areas prone to leaching or runoff. Large-scale variation in soil characteristics is apparent from soil maps, and small-scale variation has been the subject of geostatistical studies for some time. It is commonly hypothesized that custom-tailoring management to specific soils will result in significant improvement in environmental quality and production efficiency. Clearly, the machinery, sensors, and control technologies are available to implement custom culture. However, it is not clear what adjustments to culture are necessary to achieve such improvements. Experience shows that certain soils need more or less water, seeding rate, fertilizer, or pesticide, but implementation of this experience into control algorithms for intelligent machines requires quantitative knowledge that does not exist at the current time. An initial step was undertaken at the Florence, SC, laboratory to quantify variation, both for soil characteristics and yield. Concurrently, modeling studies have attempted to explain the observed variation. Future work will attempt to propose custom management strategies for the different soils.

Soil specific crop management research at the Coastal Plains Research Center was initiated in 1984 with a detailed soil survey by USDA-SCS personnel. The area was surveyed and flagged on a 15-m grid. The survey team mapped each grid marker, then narrowed the distinctions between different soils down to ~ 3 m. This map was digitized into SAS PROC GMAP. Field studies started in 1985 and include corn (3 yr) (*Zea mays* L.), wheat (3 yr) (*Triticum aestivum* L.), soybean (3 yr) [*Glycine max* (L.) Merr.], and sorghum (1 yr) (*Sorghum* sp). Yield plots were located with surveying equipment and

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superimposed on a soil specific map. From the composite map, databases of soil mapping unit, yield, and other information were generated. Analyses of variation across mapping unit indicated significance in most seasons, although variation within mapping units was surprisingly large. For soils with thicker sandy surface layers, the depth to the clayey subsoil sometimes was correlated with yield. Interactions among water relations, pH of the subsoil, depth to clay, and tillage complicated these relationships.

Modeling studies have been conducted using several daily-time-step models for these crops, including CERES-Maize (V 1 & 2), CERES-Wheat (V 1 & 2), SORKAM, CERES-Sorghum, and SOYGRO. Soil input data was derived from the literature for the typical pedon description of the 1984 survey. Preliminary results indicate that rooting functions must be adjusted for the pH of the subsoil, the strength of the E horizon, and the effect of tillage on the latter. Further studies suggest that the rainfall-runoff partitioning may be critical for these soils. Sensitivity analyses indicate that water stress is much more important than would be assumed in an area with 1100 mm annual rainfall. This appears to be a result of the limited water held in sandy, shallow-rooted soils.

Future work will increase the specificity of the soils input parameters for the models, including changing from typical pedon descriptions and literature values to local measurements of representative soils. Later runs will examine within-mapping unit variation as a result of measured soil variation. The database has been converted into the ARC/INFO Geographic Information System, and further work will integrate the conventional modeling to the GIS.