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Influence of Soil Sampling Grid Size on Application Accuracy and Economics of Site-Specific Nutrient Application in Row-Crops

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Abstract

Soil sampling is an important component of site-specific nutrient management in precision agriculture. While precision soil sampling strategies such as grid or zone have been around for a while, the adoption and utilization of these strategies vary considerably among growers, especially in the southeastern United States. Grid-based soil sampling is predominant in the southeastern US and the selection of an optimal grid size is always of interest to both consultants and growers to best capture nutrient spatial variability within the fields while remaining economical. To better understand how some of the commonly used grid sizes influence the depiction of soil nutrient variability and further influence the effectiveness and economics of site-specific nutrient application, a study was conducted across 9 different sites to be planted in cotton in 2022. Soil samples were collected at each site using grid sizes of 0.40, 1.01, 2.02, 3.03, and 4.04 ha. For that purpose, 12-15 samples to a depth of 15 cm were collected within a radius of 9 m from the center point of each grid cell. Spatial nutrient maps (soil pH, P, and K) and the corresponding variable-rate application maps were created based on each grid size and compared to the "actual" nutrient spatial variability within the fields, which was estimated using all the collected soil samples. Difference maps were created by subtracting the map of variability for each grid size from the map of "actual" variability to spatially identify areas of the field where the application rate of nutrients would be correct, excessive (over-application), or deficient (under-application). The total amount of fertilizer required for each grid size along with UGA fertilizer budgets were used to calculate and compare the economics of different grid sizes. The findings of this study suggested that, on average, a fertilizer rate accuracy of 85% or greater can be achieved in a field by using a grid size of 1.01 ha or less. Surprisingly, these smaller grid sizes (0.40- and 1.01-ha) are also economically feasible, even with the increased sampling points due to the large under- or over-application associated with larger grid sizes of 2.02 ha or greater. The overall application costs among different grid sizes were not significantly different whereas the application accuracy decreased considerably (< 60%) for soil sampling on grid sizes of 2.02 ha or greater. These findings implied that the increase in application accuracy may come at a little higher upfront cost to the grower (due to more soil samples); however, the overall application costs are still similar to larger grid size. In conclusion, it can be stated that soil sampling should be conducted on a grid size of 0.40- and 1.01-ha (based on variability in the field) to ensure high application accuracy while still being economical.