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IMPROVING COTTON SUSTAINABILITY WITH PRECISION AGRICULTURE

Sustainability of an agricultural system can be simply defined as "meeting the needs of the present while maintaining the ability for future generations to meet their own needs." What sustainability is not, is a sole focus on the environmental impacts of an agricultural operation. There are three pillars of sustainability: economic, environmental, and social, with each one being equally as important as another when developing nutrient management plans. To meet the food, fiber, fuel, and feed needs of the growing population, defining sustainability goals must be a priority for all agricultural systems.

4R Nutrient Stewardship begins with the process of setting sustainability goals. Once the goals for the operation are established, nutrient management practices best suited to achieve the goals are selected. These practices will be a combination of the 4Rs, applying the right nutrient source, at the right rate, at the right time, and in the right place. Incorporating precision agriculture technologies such as grid or zone soil sampling, variable-rate fertilizer application, and automatic section control can enhance the effectiveness of the 4Rs.

Field to Market: The Keystone Alliance for Sustainable Agriculture has an online tool available called the Fieldprint calculator that allows users to compare the sustainability of their particular operation with county, state, and national averages. The Fieldprint calculator also allows growers to evaluate the effect of a change in management practices on various sustainability metrics, such as energy use and greenhouse gas (GHG) emissions.

Switching from single to variable application rates of P and K, reduced energy consumption and GHG emissions 15% and 10%, respectively, for a 72-acre cotton field in Tennessee. Annual application rates for the farm in this example were 30 lb P_2O_5 and 90 lb K_2O/A. Adopting a variable-rate application strategy based on 2.5-acre grid soil sampling dropped the average P_2O_5 rate to 25 lb/A and the average K_2O rate to 51 lb/A (ranging from 0 to 85 lb/A), without reducing lint yield. According to the Fieldprint calculator, these nutrient reductions resulted in energy use dropping from 7,373 to 6,273 BTU/lb and GHG emissions went from 1.849 to 1.655 lb CO_2e/lb. The management change also saved the grower US$24.57/A in input costs and reduced nutrient use by 360 lb of P_2O_5 and 2,808 lb of K_2O.

Variable-rate N application can also have a significant effect on the sustainability of Mid-South cotton production. In another example from Tennessee, a grower had been applying 120 lb N/A to the entire field and began using a variable-rate N application strategy based on soil electrical conductivity-based zone management. The average N rate dropped to 104 lb N/A, ranging from 70 to 123 lb N/A, with no effect on lint yield. This change resulted in a decrease in energy use from 12,966 to 8,875 BTU/lb. Greenhouse gas emissions went from 1.55 to 1.11 lb CO_2e/lb.

Incorporating precision agriculture technologies into 4R Nutrient Stewardship plans can improve the sustainability of cotton production in the Mid-South. Lori Gibson, Row Crop Sustainability Specialist at the University of Tennessee says, "Utilizing precision ag technologies can reduce our impacts on the environment, make you money, and most importantly, keep you farming." For more information on 4R Nutrient Stewardship, visit www.ipni.net/4R and also check out www.fieldtomarket.org to learn more about the Fieldprint calculator.

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Abbreviations: P = phosphorus; K = potassium; CO_2e = carbon dioxide equivalents; BTU = British thermal units.