On-the-go Crop Sensing

Introduction
The assessment of within-field crop variability can be valuable in maximizing input usage. Technological advances over the past decade have provided producers with variable-rate technology (VRT) that allows the matching of crop fertility needs to local growing conditions. VRT can reduce input costs by applying only what is needed for crop growth while minimizing over-application of inputs in areas with lower yield potential.

Three options exist for implementing VRT: map-based, sensor-based, and manual. This publication addresses “on-the-go” sensor-based VRT. These sensors, typically optical, do not utilize the sun as their light source but rather have an internal source allowing them to operate under different environmental conditions (such as cloudy days). Current commercially available on-the-go sensor systems have only focused on N applications and are used as examples of this technology in this publication.

The GreenSeeker® and CropCircle™ are two commercially available sensor-based systems being used for site-specific application of N. Both sensors indirectly assess the level of chlorophyll (greenness) and amount of biomass by calculating a vegetation index, NDVI (Normalized Difference Vegetation Index). Typically, NDVI values range from -1 to 1 with negative values resulting when the sensor measures bare soil. In contrast, NDVI values close to 0 indicate poor biomass while 1 represents high biomass. By applying an equation, a particular NDVI value can be translated into a site-specific N rate based on the crop needs at the time of application. The equation used by the “on-the-go” VR Nitrogen system is developed through extensive research requiring NDVI measurements from an area with no N limitations, days from planting to NDVI measurements, and the crops yield potential.

How does it work?
Four to six sensors are typically mounted across the boom of an applicator. These sensors are mounted so they are about 2-6 ft above the crop and equally spaced across the width of the applicator. The manner in which the equipment folds for transport can affect spacing. NDVI values (multiple data points per second) are calculated from the visible Red and Near Infrared (NIR) crop reflectance as the applicator traverses the field. As the NDVI readings are measured, they are communicated to a computer which compares the measured NDVI readings to pre-defined ranges with corresponding product rates. The appropriate application rate is selected and subsequently the correct nozzle combination turned ON to meet the desired rate. A producer or consultant has the ability to define these rate brackets so a specific rate is assigned to a NDVI value.

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Nitrogen Application for Grain Crops

For N applications utilizing the Greenseeker®, the concept is that the amount of fertilizer needed at a particular location within the field can be determined by implementing a N-rich strip at planting, or shortly thereafter, and comparing spatial variability of crop growth across the field to crop growth from the N-strip. The N-rich strip provides an area in which N is not the yield limiting factor. An N-rich strip is implemented by selecting one strip that transverses the field (typically one pass of the fertilizer application equipment) to receive a complete N application at planting. Then at sidedress, NDVI readings are collected from the N-rich strip to calibrate the crop sensor system. Subsequently, as the fertilizer applicator covers the field, the sensors read NDVI values, comparing them to the NDVI values from the N-rich strip and applying an adjusted amount of N. For example, if the NDVI value in the N-rich strip was 0.5 but was 0.6 at a particular location within the field, no N would be applied since the sensor determined sufficient N is already available. Conversely, if the N-rich strip had an 0.5 NDVI reading but another location within the field had an 0.4 NDVI, then N would be applied in that area. Recently, the use of a ramped calibration strip has been recommended. Instead of the N-rich strip consisting of one rate across the field; a range of N rates is applied across the field. This provides a benefit in that growers can see actual response to a range of N rates and when they are setting ranges for variable-rate application, they have more information about how to appropriately establish the breaks for the assorted N rates.

A new calibration method called Virtual Reference Strip™ by Holland Scientific Company eliminates the N rich reference strip for calibration of the Crop Circle®. Basic calibration consists of running the sensors over the canopy (three to four passes through the most vigorous crop areas of the field) prior to side-dress N application. A virtual reference NDVI value for the entire field, calculated from the average of the high NDVI values, is then used to normalize the NDVI readings on-the-go.
Uses in Cotton
There is interest in using these type sensor systems for the application of plant growth regulators and defoliant to cotton. The principle behind these applications is that higher NDVI readings reflect higher biomass; areas with higher biomass would require higher rates of both plant growth regulators and defoliants. Research is being conducted across the Cotton Belt to determine the most efficient method of using on-the-go sensors for variable-rate applications of these products. Research is also being conducted to evaluate the potential of this technology for variable-rate N applications to cotton.

Additional Information
These websites provide further information about commercially available systems:

- www.ntechindustries.com
- www.hollandscientific.com

Additional information on VRT can be found on the ACES Website under Timely Info publications; Introduction to Prescriptions for Variable-Rate and Overview of Variable-Rate Technology.

Disclaimer
The mention of trade names and commercial products is for informational purposes and does not necessarily imply endorsement by the Alabama Cooperative Extension System.

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