Sensor Calculates N Needs

Farmers Determine Nitrogen Needs Of Cotton With Sensors

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A trial using sensors to determine amounts of a second application of nitrogen is being conducted by Dr. Brenda Tubaña, Assistant Professor of Soil Fertility and Nutrient Management.

"Our proposed approach is to apply modest amounts of nitrogen early in the season and then at mid-season [around mid-bloom] using a ground-based remote sensor, a second application of nitrogen will be done based on projected needs of cotton," she said. "There are many sources of variability in the field that affect crop yield level and available nitrogen in the soil. Yield level and available nitrogen in the soil are two major factors, among others, that determine crop nitrogen requirement; in this study, we intend to account for these two factors with the aid of a sensor which will allow producers to supply cotton with nitrogen based on needs. The ultimate goal is to increase nitrogen use efficiency through precise management of nitrogen fertilizer."

"GreenSeeker handheld sensor is one of the active sensors that are already commercially available," Tubaña explained. " When you say active, it means a sensor has its own source of light and is not affected by illumination from the sun. Therefore it does not matter what time of the day the data collection will take place. Performance of such sensor is consistent whether it's a cloudy or sunny day. GreenSeeker sensor emits light at two operational wavebands within the red and near infrared regions of the spectrum. "

"The amount of red and near infrared reflectance from the canopy is related to the amount of green biomass of cotton and its overall health status. These reflectance values are expressed either in ratios or normalized forms. GreenSeeker measures crop canopy reflectance as normalized difference vegetation index (NDVI). To utilize these sensor readings to help us project cotton midseason nitrogen requirements, first we need to calibrate NDVI readings with lint yield of cotton grown at varying amounts of nitrogen fertilizer. This is basically what the majority of the research work is focusing on now. What matter most is that, in the end, all these research efforts will generate an N decision tool for producers that is easy-to-use, handy, and capable to provide instant N recommendation. The said tool is like a calculator that can be operated through computer software called Excel, "she explained.

Tubaña said the sensor technology was developed in 1992 at Oklahoma State University.

"The idea was first developed for wheat in 1992 by professors and engineers from Oklahoma State University. A few years later, the technology was tested for corn, and works have recently initiated for cotton, rice and sugarcane," she said. "This technology is pretty much established in wheat but not for other crops like cotton. I would say that this is sort of a new technology in cotton production and there is still more research work to do. As I mentioned earlier, we are in the stage of building a strong database to calibrate sensor readings with cotton lint yield."

The sensors are available to farmers now. Trimble which distributes GreenSeeker handheld sensors has an outlet in Rayville, LA.

"I put out similar studies for corn and sugarcane. Also, researchers from LSU AgCenter and Mississippi State University Delta Research and Extension Center started evaluating this sensor-based technology in rice production."

Tubaña feels that increasing the nitrogen use efficiency of a crop will have a lot of positive implications.

"Application of nitrogen fertilizer based on cotton needs will translate to an increase in profit in two ways: producers can avoid excessive application of nitrogen fertilizer therefore reducing the production cost; or they can apply more nitrogen fertilizer in years and in fields where there is a modest amount of available nitrogen in the soil, especially when cotton is capable of producing exceptionally high lint yield. In other words, tailoring N recommendations based on cotton needs is the way to increase nitrogen use efficiency. From an environmental perspective, increasing nitrogen use efficiency would translate to a reduction of unused nitrogen fertilizer that will go to nearby bodies of water and becomes potential source of pollutants."

The sensor comes with a pocket-size computer where NDVI readings can be stored. Also, the calculator type-N decision tool which Dr. Tubaña and her research team intend to develop can be operated through this pocket-size computer.

"What I perceive in the future is that a producer having this handheld sensor can go out in the field at midseason, collect sensor data, run the calculator and have a N recommendation tailored on the specific requirement of cotton in less than an hour."

"It is important to understand that the adoption of this technology also requires producers to put out an N reference strip. An N reference strip is a small section in the cotton field that gets a large rate of nitrogen fertilizer application and the cotton is established a few days after planting. As the word implies, this serves as a reference to account for year to year variation on available nitrogen in the soil. How does this work? When it is about time for a second application (at midseason) of nitrogen fertilizer, an N reference strip can be monitored and interpreted this way: an N reference strip that can be easily seen and separated from the rest of the cotton field, in a nut shell, tells us that cotton will benefit from N fertilization to some degree, and otherwise if no difference is observed. The sensor comes in handy in a manner that the difference observed between N reference strip and the rest of the cotton field, if there is any, will be translated to a number or absolute value."

Dr. Brenda Tubaña, Assistant Professor of Soil Fertility and Nutrient Management, LSU AgCenter, gives results of a trial using sensors to determine amounts of nitrogen.

Photo by John LaRose, Jr.

With the data available now, Tubaña feels the system could be used by the producers in two years.

"Our presentation in this field day will give us the opportunity to share the results of our study that we conducted to evaluate the performance of the sensor-based calculator as opposed to commonly applied flat nitrogen rates," she said. "Recommended flat nitrogen rates are derived from average values of N rates that produced maximum lint yield from multiple cotton N response trials conducted for many years at different sites."

The system is not perfect yet. The first two-year data showed that sensor-based calculator recommended lower (midseason) N rate compared with the flat N rate and corresponded with lower lint yield as well.

"Although the lower N recommendation made by the sensor-based N calculator resulted in lower lint yield, the nitrogen use efficiency was increased for both years. The sensor-based calculator recommended 25 percent less than the flat rate and that in essence increased nitrogen use efficiency. Obviously, there is still a need to improve the sensor-based N technology in cotton production. We do this by regularly updating our database system and inclusion of other plant information such as height to fine tune the sensor-based calculator. With the technology nowadays, acquisition of cotton plant information may be taken simultaneously without actual measurements or in the absence of physical contact with the plant; this means collection of green biomass using the sensor while measuring plant height using sonar device on-the-go. The current sensor-based calculator is showing potential as a means to improve nitrogen use efficiency in cotton but more work is needed to refine the system." Δ

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