GATHERING REFLECTANCE DATA using a hand-held GreenSeeker unit, Jason Satterfield, Mississippi State University graduate student, is helping compile a database that researchers hope will lead to precisely-timed nitrogen applications.

Precision technology may hold promise of prescription N applications for rice

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If Mid-South rice farmers knew exactly when, and where, to apply nitrogen fertilizer it would lead to greater efficiency, positive environmental impacts, monetary savings and higher yields.

Although there are many questions left to answer, researchers believe precision agriculture will soon offer growers the opportunity to reap such rewards.

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At the forefront of such research, Tim Walker is leading a Rice Foundation-sponsored project being conducted in Mississippi, Arkansas and Louisiana.

In the study that began in 2007, "our objective is to evaluate different tools to assess the nitrogen nutrition status of rice plants at mid-season," says the Mississippi State University associate professor, who is based at the Delta Research and Extension Center at Stoneville, Miss.

The first order of business: find out if any of the commercially available tools will help differentiate between plants receiving varying nitrogen rates.

At first, Walker and colleagues were using an instrument that measured spectral reflectance from 350 nanometers up to 1,050.

"So it covered the visible as well as the near infrared portion of the electromagnetic spectrum. We're continuing that project and have found that, yes, we can use reflectance values to differentiate between plants that have varying nitrogen nutritional status. We have two years of data on that."

In 2008, Walker joined up with Brenda Tubana, an LSU AgCenter assistant professor and researcher who was working with NTech's GreenSeeker technology.

How does a handheld GreenSeeker — which looks much like a metal detector — operate?

According to the NTech Web site, it "calculates NDVI (Normalized Difference Vegetative Index) using red and near infrared light. Red light is absorbed by plant chlorophyll as an energy source during photosynthesis.

Therefore, healthy plants absorb more red light and reflect larger amounts of NIR (near infrared) than those that are unhealthy.

NDVI is an excellent indicator of biomass (amount of living plant tissue), and is used in conjunction with growing degree days greater than zero or days from planting to accurately project yield potential."

While the current project makes use of hand-held devices, others can be attached to an applicator. For example, the technology is available for wheat and corn crops and can be connected to a fertilizer applicator that applies nitrogen on-the-go.

Basically, says Tubana "the GreenSeeker has an 'active' light source. Instead of relying on sunlight, it has its own source of light energy and it measures the crop canopy reflectance all with the same instrument."

From the 2007 and 2008 studies, Walker says "we found something like the GreenSeeker will probably be our best bet for bringing such a technology to the production level. That's because, for example, the technology that involves just the sun's energy can be adversely affected by cloud cover."

Last summer, Jason Satterfield — a graduate student Walker has been working with — spent a week at the Rice Research Station at Crowley, La.

Although he worked diligently, the student was unable to bring in data because of near-constant cloudy conditions.

With a rice crop, "we don't have time to wait on the clouds to break — when it gets to the point when a top-dress decision must be made, it needs to be done in a few days, not weeks."

With GreenSeeker's active light source that isn't an issue. "You can take the instru-

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ment out at night, under clouds or in the rain," says Tubana.

Having found a reliable sensor, another set of issues still must be addressed.

"We're using the crop canopy reflectance (measured as NDVI readings) to estimate crop yield potential. The predicted yield potential would provide an idea of the crop's actual yield level at harvest."

Tubana — who is also looking at the system in sugarcane — is creating a database by taking measurements across different sugarcane sites in Louisiana. "We're also collecting sensor data at different growth stages of the crop. It's a big job."

Those readings will be used to establish the equation for crop yield potential. In turn, that information will help estimate, or project, the nitrogen requirements of the crop.

"Say, we go to the field and start collecting sensor data when the rice begins tillering," says Tubana. "Every week, for the next five weeks, we'll collect sensor readings. At harvest, from each of those data dates, we will determine the relationship between the sensor reading and actual yield.

"Whichever amongst those dates earns the best correlation (sensor readings versus actual yield) is an indication that's the best time to collect the sensor data to be able to predict yield potential.

"From our findings so far, the date where we obtained the best correlation … is actually the timeframe when the mid-season nitrogen fertilizer application is done."

That's just the first step for the researchers and requires continuous refinement.

"Every year, you can still incorporate new data until you have a solid database. When the predictive yield potential equation is established, farmers will be able to use the system to project the nitrogen requirement of their crop. That will be based on the nitrogen removal rate of the predicted yield potential."

If a grower can estimate the yield potential of the crop, he'll "have an idea of the amount of nitrogen that'll be removed by the crop and, hence, the crop nitrogen fertilizer requirement.

"So, basically the yield potential predictive equation constitutes the sensor-based nitrogen decision tool that we want to develop for crops like rice and sugarcane."

Getting a rice sensor system up and running will be "a go or no-go, in my opinion, in the next five years," says Walker. "By then, we should know enough about it."

By collecting so much preliminary data, "it allows the precision agriculture tool companies to make better decisions.

"We can take our data in and say 'Look at what we can do in rice.' Even if it's modification or construction of new sensors — for instance, something to mount on the bottom of an airplane, or whatever — the company would be more prone to move forward.

"Hopefully, by working with these handheld instruments, we're gathering a body of information that should be beneficial in helping companies to commercialize their products for rice. We feel good that we're onto something with this research."

How easy would it be for farmers to use such a system?

The technology is "very user-friendly, especially for growers who have already made the move to things like auto-steer and variable-rate fertilizer and spray applications," says Walker. "This technology interfaces well."

For a grower unfamiliar with precision agriculture tools and technology, there will be a learning curve. However, for those already working with yield monitors and the like, "this will be just another day at the office."

The major goal of the use and application of the remote sensor is to come up with an easy-to-use nitrogen decision tool for farmers, says Tubana.

"By using a sort of pocket calculator, farmers could just plug in information and they'd be provided the optimum rate of nitrogen they need to apply. An Excel-format calculator could be installed in the pocket computer that also holds the programs needed to operate the sensor."

To use the sensor-based nitrogen decision tool, it will be necessary for farmers to have "reference strips" in their fields.

One set of strips would not have any nitrogen applied. Another set would have very high rates of nitrogen. The farmer would collect data from those strips and feed that into an equation personalized for his operation.

Walker likens the GreenSeeker work in rice to a "sort of a missing link in terms of being more precise with nitrogen. Another study we're all jointly working on — being led by the University of Arkansas — deals with taking a soil sample and determining how much nitrogen that soil can supply to the plant."

If a soil test could be married with a plant test like the GreenSeeker, "We'll have really ramped up precision nitrogen application to a very high level. Right now, we feel very confident with recommendations — we do the best we can.

"But those are based on a small scale with respect to production. Something like this would help take the guess work out and be more efficient with the dollars being spent."

It's important to remember that, just last year, growers were looking at nitrogen prices of $800 per ton. Input prices continue to be high.

"There was a time when people said 'nitrogen will never be $800 per ton.' Well, it has been that price. What's to keep it from rising to that level, or higher, again? It's best to do this work in preparation for that time."

HAVING SETTLED ON the GreenSeeker technology for her rice and sugarcane studies, Brenda Tubana, LSU AgCenter assistant professor, is now busy taking readings and building a database. The readings will be used to establish the equation for crop yield potential. In turn, that information will help estimate, or project, the nitrogen requirements of the crop.