# APPLY

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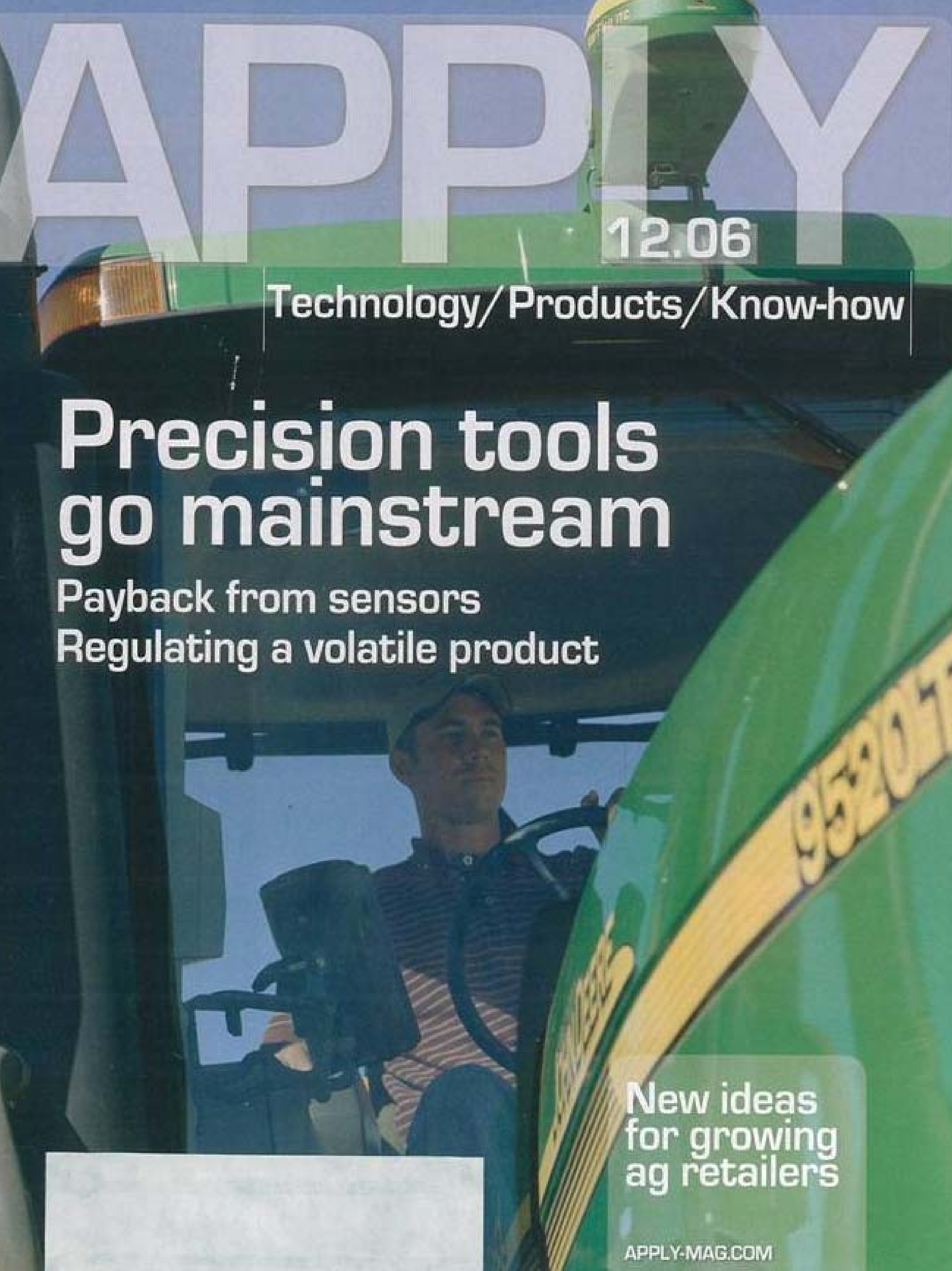

# APPLY

*THE GREENSEEKER from NTech Industries properly applied nitrogen to corn as needed in a recent University of Missouri study.*

# Sensing direction

DRYLAND CORN farmers looking for a way to protect water quality and optimize nitrogen (N) applications can now find help through a variety of commercial precision sensing technologies. However, much of the new equipment is still being perfected. Although it shows great promise, an economic payback isn't always guaranteed.

For example, three years of on-farm trials in Missouri that compared sidedress N applications to corn using a farmer's standard N rate to variable rates dictated by in-field sensors provided mixed results, says Ken Sudduth, USDA Agricultural Research Service (ARS) agricultural engineer, based in Columbia. The research trials were a collaborative effort by the USDA-ARS, the University of Missouri and MFA Incorporated. The researchers collected data from both NTech Industries' GreenSeeker optical sensors and Holland Scientific's Crop Circle Plant Canopy Sensor.

"In a general sense, both sensors performed similarly," Sudduth says. "It appears that they were both varying N appropriately and would call for high N applications in the spots that looked more N stressed and low N applications in spots that looked less N stressed."

Both in-field sensors did well in directing appropriate levels of N to the crop, agrees Peter Scharf, a University of Missouri nutrient management specialist. However, the profit levels achieved from using the equipment were a bit disappointing, he says.

"Overall, we lost 2.6 bu./acre of yield by using the sensors, compared to the producer rate, but we saved an average of 31 lbs. of N/acre," he says. "Using period-average prices for both N and corn, we achieved about a $6.50/acre advantage from using the sensors, not counting application costs and technology costs. However,

*HOLLAND SCIENTIFIC'S Crop Circle Plant Canopy Sensor also correctly applied nitrogen in trials at the University of Missouri.*

Photo: Harlan Palm, University of Missouri

# Precision sensors prove promising for nitrogen management in corn *By John Pocock*

with the new recent increases in corn price and declines in N price, much of that advantage has now evaporated."

Still, future technological advances and refinements could make the equipment work better in Missouri than it has so far, Scharf adds. In addition, state and federal environmental incentives or regulations also could increase the technology's value.

"Right now, the sensor technology isn't a big winner economically, but it's probably a winner on the environmental side," he says. "In Missouri, the Environmental Quality Incentives Program (EQIP) is paying qualifying farmers $20/acre to do this. So if you have the EQIP payments, this gives you a pretty cost-effective way to prevent N from escaping from cornfields."

## Variable results

Corn growers in states with different soils might profit more from the sensor technology than corn growers in Missouri, Scharf says. "As you go farther north in the Corn Belt, there might be better opportunities for N savings than in Missouri, because of the higher organic matter soils that exist there," he says. "There are more possibilities for N savings farther north than we have here."

Yet further west and south, researchers at Oklahoma State University (OSU) have seen better economic results from using optical sensors to improve N management for corn than the Missouri researchers have. "Our on-farm research and demonstrations in wheat and corn have shown that a farmer can save at least $10 to $20/acre by using sensors to manage N applications, and the potential economic benefits would be more in corn than in wheat," says Hailin Zhang, OSU soil scientist. "So the technology could pay for itself in one year's time, especially for a large-acreage farmer."

OSU researchers originally developed their active precision sensing equipment to optimize N applications for wheat and then tried it in other crops, Zhang says. Eventually, NTech Industries Inc. bought the OSU patent and commercialized the GreenSeeker sensor.

"We started our research with winter wheat, but we have expanded it to corn, Bermuda grass and sorghum," Zhang says. "This technique is expanding all over the world with many other crops, including rice."

*OKLAHOMA STATE University researchers developed the Next Generation VRT applicator. It senses plant height and vigor and simultaneously applies nitrogen in liquid streams.*

Photo: Bill Raun, Oklahoma State University

For now, relatively few Oklahoma farmers have bought the optical sensors, says Zhang, who reports that the cost to purchase a handheld sensor would approach $3,500. He adds, however, that crop consultants and county extension agents have been using the sensors for several years as a service to farmers.

"The sensors have also helped to prevent overfertilization," Zhang says. "This year, we had a drought, and the sensor predicted that less N was needed in some fields."

## High-clearance equipment

Ideally, farmers who would like to use in-field sensors to better manage N applications in corn might want to invest in a high-clearance sprayer or find a custom applicator that has one to apply the extra N when it is most needed, points out Jerry Mulliken, owner of JM Crop Consulting, Nickerson, NE. "We don't have a good way to handle N applications above waist high except with a high-clearance sprayer," Mulliken explains. "If the crop is irrigated, we can apply additional N through the pivot, but variable-rate applications won't work that way."

The timing of N applications can be crucial to optimal yields for corn, he says. "The problem with corn is that its main N uptake period comes after you're able to drive through it with an ordinary sprayer," he says. "Also, when corn is short, it's difficult for GreenSeeker to pick out the plant from crop residue in the background."

In addition to working with in-field sensors, Mulliken also offers an aerial imaging service to his farmer-clients. "We do true-color infrared images and geo-reference them," he says. "I work primarily on irrigated fields, and the big thing that it focuses on is N in corn."

Using remote sensing together with in-field sensors has its advantages, Mulliken says. "We need remote sensing as an early warning system and to possibly refine our yield maps with aerial imaging," he explains. "A high-clearance sprayer will calculate the N rate according to the sensor, but it's got to be able to cover the ground fast enough to make it commercially viable. An aerial imagery base map would help speed things up."

The aerial imagery system establishes in-field reference strips that are applied with high N rates early in the season. "We use variable-rate controllers to apply a strip with 50 lbs. extra N in a band across the rows," Mulliken says. "If the N next to this strip is deficient, you'll see a difference from the air. So it helps to establish an index to calibrate the field."

Not all corn varieties reflect the same amount of light, and varying soil types also will have an effect on the corn plant's N uptake, Mulliken says. "The strip should go across all varieties and soil types," he advises. "We apply 110 lbs. N/acre preplant, except in the bands, where we apply 160 lbs. N/acre."

Additional applications would be fairly small, about 20 to 30 lbs. at a time, he says. "The biggest thing is getting the preplant application so that it is not excessive," he says. "If the whole field shows no N stress, you can pretty much bet that you overapplied. We'd like to have the plant show some stress right around tasseling time and then add a little more N after that. So you apply some N preplant, then you check it around tasseling time, apply N if it's stressed, then check it again and apply more N if it's still stressed."

## Combined data

Combining data from both remote and in-field sensing technology will likely improve the results from variable-rate N applications in corn, agrees Jim Schepers, USDA-ARS soil scientist, Lincoln, NE.

"What will likely happen is that the industry will incorporate aspects of each technology," he says. "We'll use yield history, soil color and in-field sensors to variably apply N."

Soil color provides information about the field's ability to convert organic mater to nitrate, Schepers says. Yield maps provide information about a field's yield potential and the soil's ability to respond to favorable weather conditions to produce crops, and in-field sensors give information about the corn plant's ability to respond to more N.

"If you put all that information together, the result is how much N you need to apply as you drive through the field," Schepers says. He adds that as early as this spring, ARS will come out with a simple geographic information system (GIS) that can merge with sensor data as equipment moves through the field.

For now though, both in-field and remote sensing equipment will likely provide the best payback in areas with previous manure applications or no soil fertility records; in high-value crops such as sugar beets and malting barley, where there is a penalty to be paid for too much nitrogen; or where surface and groundwater concerns are greatest, Schepers says. "We'd like to have technology ready to go if environmental regulations restrict how much N farmers can apply to their fields," he adds.

The cost to a farmer might be $5 to $10/acre for a fertilizer dealer to provide the service and to pay for the gadgetry, Schepers predicts. "However, finding consultants who have enough expertise to do this is another matter," he adds. "It's really hard to find people trained in GIS and remote sensing technology with a farm background to do this successfully." ■