

By Larry Reichenberger

# Just'N time

*Researchers look for ways to help farmers apply nitrogen in-season*

**N**itrogen application is entering a new era. From the old routine of broadcasting a large pre-season dose of nitrogen long before the crop uses it, farmers, researchers, and consultants are now testing systems to apply nitrogen precisely when and where it's needed. Those range from the low-tech approach of eyeballing nitrogen test strips to using hi-tech optical sensors capable of varying the application rate to match the need and yield potential of individual plants.

**Nitrogen use efficiency.** Enhancing the use of in-season nitrogen is the aim of a consortium of researchers from the USDA and 10 universities in the U.S., along with others from Canada, Mexico, and Argentina. Bill Raun, an agronomist at Oklahoma State University, explains that this goal springs from the need to improve nitrogen use efficiency (NUE).

"NUE is the percentage of applied nitrogen removed by the grain. It typically runs 30-40%, but when nitrogen is added in the growing season—such as top-dressing wheat or in-season applications to corn—it can be increased to 50% or more," says Raun.

"We want to improve NUE by helping farmers do a better job of applying nitrogen when and where the plant needs it," says John Shanahan, USDA-ARS agronomist at Lincoln, Neb. "A new way to do that is to let the crop tell us its nitrogen status by assessing

the greenness of the crop canopy."

In recent years, researchers have been developing this ability to "read greenness" using aerial imagery, handheld chlorophyll meters, and two on-the-go crop canopy sensors—the GreenSeeker from N-Tech Industries and the Crop Circle from Holland Scientific. These latter two measure reflected light in specific wave-lengths to sense the chlorophyll content and biomass of plants. The resulting vegetative index readings they gather are

►**Above:** Oklahoma State's Kyle Lawles found nitrogen can be applied in-season to match the wide swings he found in plant-to-plant yields.

compared to those from a well-fertilized area in the field called an N-rich strip to determine the difference and generate a nitrogen recommendation.

Results with on-the-go optical sensing have been encouraging. In 2004, a group of seven Missouri farmers working with University of Missouri agronomist Harlan Palm saved an





can predict the yield potential of corn at the V-8 stage of growth, which allows time to correct any deficiency.”

Applying nitrogen in-season using optical sensors also allows adjustment for variability within the field. Last season, studies at several universities found plant-to-plant corn yields varied wildly, sometimes ranging between 0 and 400 bushels per acre. Nitrogen rates can be varied for individual plants, or row segments of four to five plants, to match that variability.

**Timing.** The best time for in-season nitrogen on corn is debatable. University of Missouri research shows little relative yield loss if nitrogen is withheld until just before the silking stage. “Corn is not as sensitive to late nitrogen application as you might think,” says agronomist Peter Scharf.

However, research last year at Oklahoma State found a 10.6% yield loss if all nitrogen was applied at the VT stage (tasseling) instead of the earlier V-10 stage. “Everything we’ve done says nitrogen has to be on by the V-8 to V-10 stage of growth,” says Raun.

Iowa State University agronomist John Sawyer says the response to late-season nitrogen depends on the degree of nitrogen stress.

“If nitrogen is extremely short you can apply very late and get a yield response, but probably not a full recovery,” he says.

“Farmers get nervous about nitrogen-deficient corn at any stage of growth, so the best advice may be to apply some nitrogen early and monitor the crop for need of an in-season application later,” adds Sawyer.

Raun says that in-season monitoring isn’t necessarily a hi-tech undertaking. “You don’t need a sprayer with the optical sensors. A less costly approach is for a farmer or consultant to install nitrogen-rich test strips in the field to judge the crop’s nitrogen status visually. Or, a single hand-held GreenSeeker sensor can be used to gather a more precise measurement of nitrogen status, then use our online Sensor Based Nitrogen Rate Calculator ([www.nue.okstate.edu](http://www.nue.okstate.edu)) to get a recommended N rate,” he says. ■



►**Above:** Applying nitrogen up to one week after silking can still benefit nitrogen-deficient corn, but yields may not fully recover. ►**Left:** Monsanto agronomist Kyle Freeman uses a hand-held optical sensor to compare the nitrogen status of corn in the field to corn in N-rich strips.

average of 33 pounds of nitrogen—and \$5 per acre—compared to the producers’ conventional rate. In 2005, limited results showed a 98-pound savings and a benefit of \$29.40 per acre.

“Unlike nitrogen recommendations based on yield goals or soil tests that estimate the amount of nitrogen mineralized by the soil, the use of optical sensing analyzes the real nitrogen status of the crop,” says Raun. “We