MANAGEMENT

SENSORS DRIVE MIDSEASON NITROGEN EFFICIENCY

BY KURT LAWTON

Researcher Laura Thompson works with Nebraska farmers to achieve greater nitrogen efficiencies using drone-based crop sensors like this DJI Inspire 2 drone with a MicaSense RedEdge multispectral sensor.

LAURA THOMPSON

The convergence of quality data by management zone and sensor technology can help farmers achieve greater N efficiency

WHEN IT COMES to nitrogen investment in corn, research shows spending it all preseason guarantees some losses in dollars and nitrates.

That's a bold statement when you consider that a third or more of every corn farmer's crop dollar is spent on fertilizer.

So how many research trials does it take to change this one-shot habit, which not only feeds corn inefficiently, but also can leak nitrates into watersheds?

On-farm research is helping farmers change their ways with confidence, according to University of Nebraska trials using both passive drone-based and active ground-driven crop canopy sensors.

Surveys from field days show that 50% to 80% of farmers want to either start or expand split nitrogen applications and use sensors to more accurately measure how much and when to apply N in season.

"Our two-year drone-based split nitrogen application trials have been really encouraging, achieving nitrogen-use efficiency from 0.62 to 0.84 pound N per bushel — much better than the old corn standard of 1.1 to 1.2 pounds," says Laura Thompson, University of Nebraska Extension educator and On-Farm Research Network coordinator.

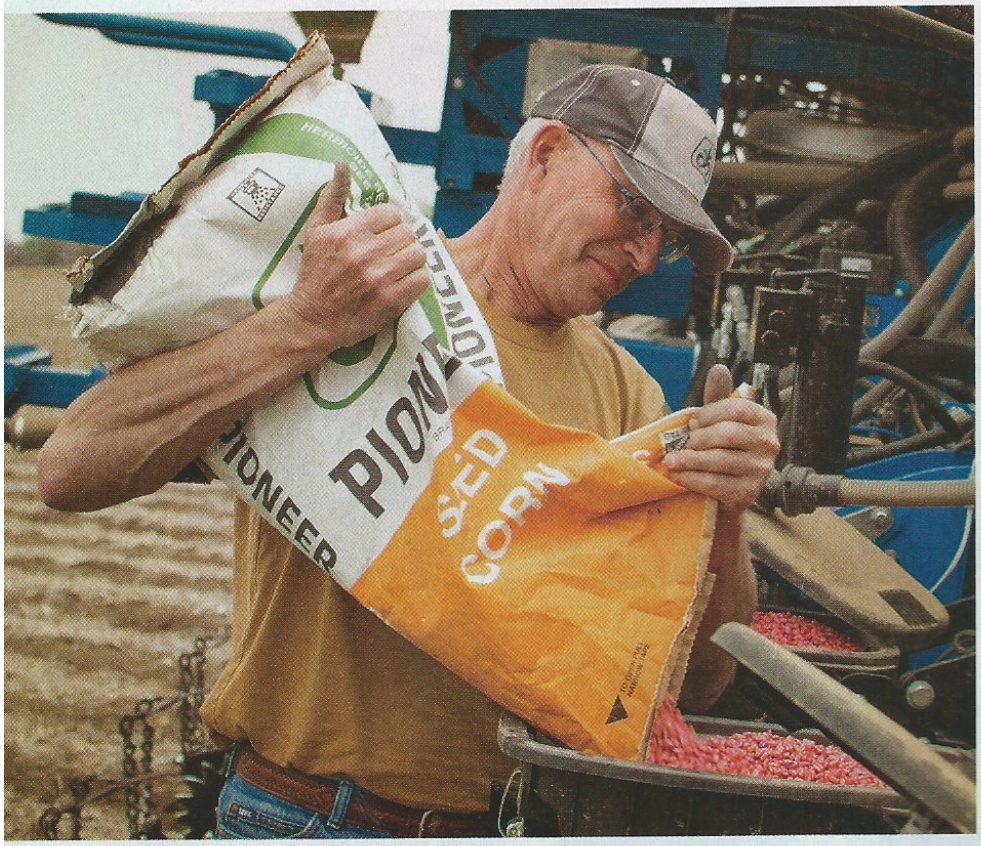
"We not only reduced the environmental footprint by applying less nitrogen, we also increased profits by maintaining equal yields to the standard farmer practice of a single application," Thompson says.

LISTEN TO PLANTS

In southeast Nebraska's rolling, terraced hills, Dean and Deb Stevens have been experimenting with split N applications on corn acres since 2012, using yield and soil data to help drive decisions.

Their goal is to apply less preseason anhydrous and more in-season nitrogen when the crop needs it most, to achieve equal yield, increase profits and improve stewardship.

But rather than use an educated guess for an in-season nitrogen amount — a flat rate of urea flown on by a local pilot — Dean sought better technology that could reveal what the plants needed. This way he could variable-rate feed them at the



LAURA THOMPSON

Southeast Nebraska farmer Dean Stevens fills the planter as he prepares for split-application nitrogen trials in 2018.

right time to drive efficiency.

The Stevenses applied for and received a $15,000, two-year Farmer Rancher Grant from the North Central Sustainable Ag Research and Education Program to study how to conserve nitrogen in corn by applying more N in season.

Replicated two-year variable-rate strip trial results (designed by university researchers) in three fields made Dean a believer in the nitrogen-reducing impact achieved with their DJI Inspire 2 drone with MicaSense RedEdge five-band multispectral sensor technology.

KEYS TO SUCCESS

Every farm is different. For the Stevens family, in-season, variable-rate N application by ground rig destroyed too much corn in terraced and rolling topography, where straight rows are seldom found. Dean believes the weekly June drone flights and the sensor-based prescription N map show huge promise.

"We are fortunate to have a local spray plane company that is equipped to apply variable-rate urea that can change rates in 200-foot blocks, so we adjust the prescription map accordingly," he says.

Other requirements include:

- weekly drone flights in June to properly time the application before N deficiency begins to limit yield
- an experienced drone operator who knows hardware and software to achieve sensor calibration and photo stitching accuracy to optimize prescription maps (the Stevenses' daughter Laura Thompson and husband Nathan provided the expertise)
- drone flight conditions that avoid shadows from clouds and too much wind that moves corn leaves around
- aerial applications of stabilized urea before a rain to incorporate the nitrogen

The Stevenses experimented with both a 75- and 100-pound-per-acre preseason anhydrous base rate, opting for the latter in year two of the research. "The 100-pound rate got us further into the growing season so we could collect more drone data, re-evaluate yield potential and reduce guesswork on the sidedress N rates needed," Dean says.

These trials were compared to a traditional 160-pound-per-acre N rate applied in February 2017, followed by a flat rate of 40 pounds of N in season.

In 2017, the sensors called for 75 pounds of N in season on the 100-pound base field, and 102 pounds of N on the 75-pound base rate field. Yield results were identical for all three, but the farmer saved 25 and 23 pounds per acre, respectively, on the sensor-driven strips.

In 2018, a dry year, the sensors recommended a uniform 53 pounds per acre in season (so no variable-rate application) on the 100 pound-per-acre base rate — compared to the one-rate preseason application of 180 pounds per acre. Both trials recorded equal yield, so the drone-managed strips saved 27 pounds of nitrogen per acre.

A second farm was added to the trial in 2018 (thanks to neighbor farmers Dale and Ronda Yoesel), comparing a one-time traditional farmer rate of 160 pounds per acre versus the same drone with a 100-pound-per-acre base rate. The drone sensors recommended an in-season application of 25 pounds per acre. The drone-managed field strips achieved equal yield, and 35 pounds per acre less N was needed.

GROUND APPLICATIONS WORK

For farmers with straighter rows, less field slope and access to high-clearance sprayers, positive results are also being achieved with ground application using active crop

NATHAN THOMPSON

After using drone-based sensors to determine proper N timing and rate, the Stevenses hired a local aerial spray company to variable-rate apply the in-season application.

canopy sensors.

University of Nebraska research, called Project SENSE — Sensors for Efficient Nitrogen use and Stewardship of the Environment — conducted 52 on-farm strip trials from 2015 through 2017.

Over all sites combined, Project SENSE resulted in 45, 33 and 15 pounds less of nitrogen per acre when compared with the growers' usual nitrogen applications. Nitrogen use efficiency was greater for the Project SENSE management in all years, and yields were almost equal (within 2 bushels per acre). On average across all three years, a positive economic benefit was noted between $7 and $13 per acre, depending on corn and N prices.

DROP SINGLE N APPLICATION?

University of Illinois Research ag economist Dale Lattz and his colleagues studied financially resilient farms from 2014 to 2016.

The study covered four N application methods: primarily fall, mostly preplant, mostly sidedress, and 50-50 preplant and sidedress. Lattz found most fall applications apply the most N but produce slightly lower corn yields than the other three methods, thus producing the lowest net profit. The other three methods averaged similar amounts of N applied, with 50-50 preplant yielding the highest yield and returns.

"It is not uncommon that farmers who fall-apply N might apply slightly more due to possible N loss over the winter," he says. "The advantage of fall-applied N is getting this done in a timely way and not competing with the other spring operations that need to be completed.

"We assume that N applied preplant or sidedressed would have less loss and return more. The challenge is having the time and weather conditions to get this done."

Lattz believes a split N application rewards farmers with the same or better yields with less N applied, thus increasing net returns.

"There are risks and some added application costs. That's why we suggest that farmers conduct some trials to see if this works for them and if they have the capacity to get split applications done in a timely manner," Lattz adds.

Thompson hopes to continue to refine their drone-based method to see how it works in other conditions, such as in a wet year.

"We're excited because this split-application method allows for a more responsive N application, at reduced rates, when the corn tells us it needs to be fed," she says. "That is more sustainable and better for the environment." **FF**

Lawton writes from Minneapolis.

FOR MORE INFO

- Visit UNL's On-Farm Research website for Project SENSE data and 2017 drone research (2018 research available soon) at *cropwatch.unl.edu/on-farm-research.*
- See details on the management study at *bit.ly/UNL-drone-sensors.*
- Check out Project SENSE trials at *cropwatch.unl.edu/project-sense-research-results.*