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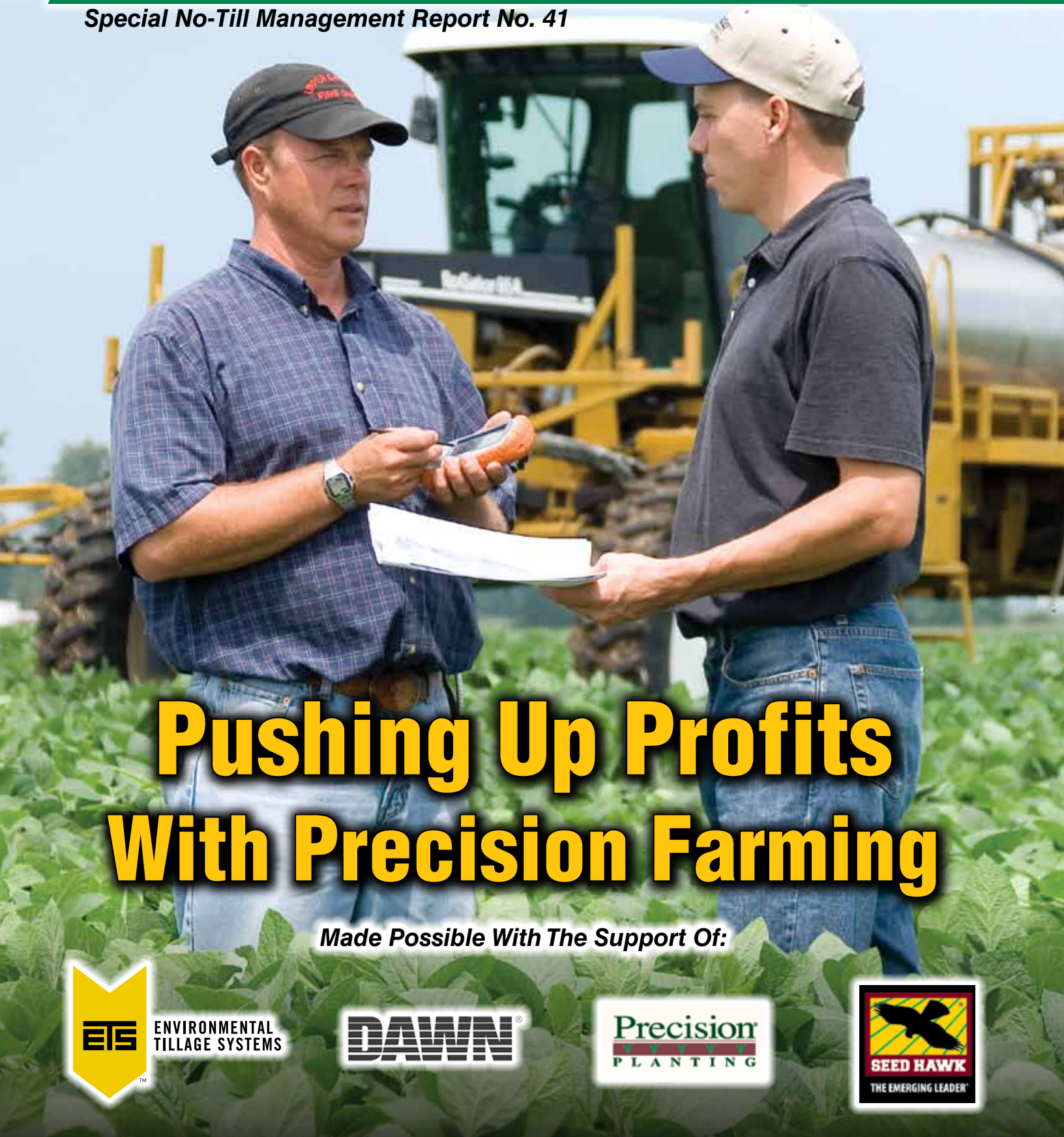

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Precision Technology Proving Its Worth

Nowadays, its rare to talk with a no-tiller or strip-tiller that doesn't utilize some type of precision-farming technology on their farm.

At the very least, many of them have yield monitors in their combines, or GPS guidance on their tractors. But with the rapid evolution of precision technology, industry focus is gradually shifting from hardware and "standard" products, to more abstract offerings like data management and software compatibility.

As one manufacturer of precision farming products notes, "Farmers have been able to steer in a straight line and collect yield data for some time. Now they want to get even more precise with placing seed, applying fertilizer and knowing how to use that data they've collected to make money."

In the pages that follow, *No-Till Farmer* offers an in-depth special report on precision-farming innovations and strategies that no-tillers and strip-tillers are using in their fields today, along with a glimpse into what the future holds.

This report will offer practical tips and first-hand experience on practices, such as using RTK guidance to manage corn residue, or implementing controlled traffic to reduce compaction and crop damage and increase yields.

You'll also learn how cutting-edge technology, like ISOBUS compatibility and unmanned aerial drones, could change what's possible with no-tilling.

It's clear that many farmers are already heading down this path.

According to the 5th Annual *No-Till Farmer* No-Till Practices Survey — featured in the May 2013 issue of *Conservation Tillage Guide* — respondents plan to use more technology in their cropping operations.

Some of the top technologies being utilized according to the survey are:

- Yield Monitor Data Analysis — 46.3%
- GPS Tractor Auto-Steer — 44.1%
- Variable-Rate Ferilizing — 30.2%
- Variable-Rate Seeding — 17.8%
- Satellite Aerial Imagery — 11.3%
- Implement Steering — 6%
- Remote Sensing — 3%

We hope this report provides you with "precision nuggets" of knowledge that you can immediately apply, or gradually adopt, to increase yields, lower input costs and improve efficiency of your no-till or strip-till operation.

Jack Zemlicka, Technology Editor

In This Special Report:

Produced by *No-Till Farmer*… Serving no-tillers since 1972.

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Precision Farming Powers No-Till Yield Quest

A culture of state-of-the-art information technology helps Indiana farmers Curt and Christopher Hudson reap the rewards of continuous no-till.

By Mark Parker, Contributing Editor

Farming by the inch is what propels no-tillers Curt and Christopher Hudson closer to higher yields and increased profitability.

The father-and-son partnership sharpens the cutting edge of precision-agriculture management of their 2,600 acres of corn and soybeans grown near Crawfordsville in west-central Indiana.

"When we see opportunities to push the upper limits of production, we're very interested," says Curt, who began no-tilling their farm ground in 1980. "Our goal is to gather every bit of information we can — soil, hybrids, herbicides and populations.

"We want to know what's going on in the field, and we want our decisions and our choices to be verified with data."

Christopher says his dad has always been an early adopter, but Curt readily admits that his son's technological savvy has been a large help in moving the operation forward.

"We certainly wouldn't be doing a lot of the things we're doing without him taking the lead," Curt says.

PHOTO COURTESY OF THE MOSAIC CO.

TABLET IN THE CAB. Christopher Hudson uses an iPad with FieldView app for row-by-row planter performance data, field scouting, observations and more.

Tablet in the Cab

A recent addition to the Hudsons' precision-farming toolbox is a third-generation Apple iPad tablet that has proven to be a valuable asset.

As an extension of the Hudsons' Precision Planting 20/20 SeedSense monitor, a FieldView app enables the iPad to present a high-resolution Google map image of the field, overlaid with critical data from the planter.

The 20/20 provides plenty of row-by-row information — singulation percentage with skips and doubles, population, row-unit weight, ground contact and more. Precise seed placement in a high-residue environment is a critical component of maximizing yields in their continuous no-till system, Christopher says.

Better Data Access

"When I got it last year, I really just thought it would be a cool toy to have, but it's been a big help when I'm planting, and I think the applications for it on the farm are very extensive," Christopher says. "The iPad gives you a real-time visual representation of what's going on with each row instead of just displaying numbers on a screen.

"The rows appear in a different color, and that enables you to quickly identify and address problems. If there's an issue with singulation or anything else, you can immediately do something about it.

"We haven't fully analyzed the numbers yet, but I think it's pretty clear that enhanced planter performance alone will make this a good investment."

The FieldView app itself is free. A base kit with FieldView module, harness and bracket from Precision Planting connects the iPad to the 20/20 system.

There's a lot going on behind the John Deere 8345 crawler tractor the Hudsons use for planting. It pulls an 80-foot John Deere DB80 48-row planter set for 20-inch rows, replacing the twin-row planter they had been using.

"We really like the planter because it maximizes our planting-time labor efficiency. But that's a lot of rows to monitor," Christopher says. "The iPad and FieldView makes the information more meaningful and accessible."

More iPad Benefits

Enhanced planter performance is just the beginning of the iPad's utility at Hudson Family Farms. All of the planting

data resides on the tablet, so no downloading is required and the information becomes portable.

Christopher and Curt can disconnect the tablet from the 20/20 and take the data to the office or the field.

"You can mark a rock or a tile problem, take the iPad with you to the field later, and go right to the spot," Christopher says.

As a scouting tool, FieldView and the iPad give the Hudsons the ability to incorporate field notes and photos related to the planter-performance information.

Fertilizer, herbicide, insecticide and fungicide data is mapped, using Farm Works computer software, to help assess efficacy.

The Hudsons also use Precision Planting's YieldCheck app for the iPad. The tool takes scouting information, such as ear and kernel counts, and calculates yield predictions.

While YieldCheck doesn't correlate survey locations, Christopher and Curt can use "drop pins" to make note of yield estimations by using the GPS functionality of the iPad.

Anhydrous Application

When the Hudsons switched to 20-inch rows for corn 2 years ago, they didn't want to give up the agronomic or economic advantages of sidedressing with anhydrous ammonia. The problem was that narrower rows left very little room to for placement error.

"To successfully sidedress corn, the planter pass has to be perfect — it's a very precise environment," Christopher says. "The tracks on the 8345 are 16 inches wide — the narrowest we could get. With 20-inch rows, that only gives you 2 inches for error on either side."

Curt and Christopher moved to active guidance with a Trimble FmX RTK system that reduces implement drift significantly compared to a passive system.

They've been using RTK during planting for 5 years because it's the only level of guidance that allows them to successfully sidedress 20-inch rows, in tandem with active implement guidance, for both the planter and sidedress applicator.

RTK corrections are made via radio signal rather than cellular, primarily because the Hudsons have a radio signal contract.

But Christopher says cellular would allow for wider application, to include expanded fleet and information-management systems that allow streamlined data sharing between the field and office.

Hitch Aids Placement

Sidedress accuracy is further facilitated with an MBW ProTrakker hitch that laterally adjusts the path of the planter that is equipped with a 40-foot anhydrous bar.

The ProTrakker fits on top of the factory hitch. Its hydraulic cylinder moves the planter to the right or to the left with input from the guidance system. It can provide up to 13 inches of off-line correction in either direction.

Since the Hudsons go over the planter path twice to cover the planter's 80-foot width, the row units that correspond to where the tractor's tracks will travel during the sidedress operation are moved out 1 inch each way to create two 22-inch rows and provide extra maneuverability.

"That gives us 3 inches, rather than 2 inches, for the track," Christopher says. "It's taken us a couple of years to perfect the system, but it works well."

The system, he says, is a good example of how the yield and economic impact of applying new technologies is difficult to directly quantify, even though a positive impact is clear.

"It's a case of how precision-ag management, in itself, doesn't improve productivity — but it enables you to manage your crop in ways that do," Christopher says. "We wanted to plant at higher populations to get higher yields and felt that 20-inch rows was the best way to accomplish that, because we could have more uniform plant distribution to facilitate nutrient uptake and weed control.

"But we also didn't want to give up sidedressing anhydrous ammonia because that is an economical and effective practice that helps us attain higher yields. Thankfully, we were able to adopt technologies that allow us to do both."

Yield Data Collection

New technology plays a slightly more limited role at harvest. For the 2012 harvest, the Hudsons used a Case IH 8230 combine with a 12-row DragoTec corn head, and a 45-foot MacDon draper head for soybeans.

Guidance isn't utilized for corn harvest, although the Hudsons plan to invest in row guidance for 2013.

WAAS provides combine guidance for soybean harvest. WAAS doesn't deliver RTK-level accuracy, but considering the size of the head and cost of the RTK subscription, they don't feel it's worth the extra investment.

"The margin for error in WAAS means we're probably not fully maximizing the productivity of our MacDon draper, but by no more than a foot at the most," Christopher says.

The Hudsons trade combines frequently, after anywhere from 1 to 5 years of use, to keep them current with higher levels of technology as they become available. The most important factor is that the combine's yield-monitor calibration is continually fine-tuned to guarantee the highest-quality data, Christopher says.

Their Digi-Star grain-cart scale also documents every bushel from every field. The iPad's FieldView app is used in the combine cab at harvest to reference hybrid data, population rates and planting dates, and to make quick observations about areas where problems, such as bad singulation and low population, are apparent.

Curt and Christopher handle all yield-data collection and Farm Works software is used to manage and analyze it. Yield information obtained from the combine, grain-cart weigh scale and elevator-scale tickets is correlated and refined to help the Hudsons assess hybrid and variety performance, population effects, crop protection materials and anything associated with yield.

> "The iPad gives you a real-time visual representation of what's going on with each row instead of just displaying numbers on a screen…"

PHOTO COURTESY OF THE MOSAIC CO.

DATA CRUCIAL. Curt and Christopher Hudson replaced their twin-row planter with an 80-foot-long, 48-row John Deere DB80 that maximizes their planting-time labor efficiency. They use their iPad and FieldView technology to access planter-performance data and reduce the stress of keeping track of all the rows.

The Hudsons fine-tune yield data from multiple sources to gain as accurate production picture as possible. Combine-gathered data, they point out, is representative of yield in the field, but it isn't a perfect measurement of weight and moisture, Curt says.

Comparing and adjusting harvest yield data sources provides them with a very accurate assessment of yield and better decision-making information for management, as well as historical data at a very high accuracy level.

Farm-wide yield data is shared only with respect to the analysis of specific applications. Plot-yield data, for instance, is shared for analysis with their seedsman to aid in future hybrid and variety selections.

Yield data is also shared with the farm's agronomic advisors to help build variable-rate planting prescriptions.

The No-Till Factor

Continuous no-till for the past 30 years has helped the Hudsons operate with great soil structure, and this was still the case last year when drought and extreme heat threatened production.

While farm-wide corn yields are typically in the 220-bushel range, dry weather limited yields by 20% to 60%, which the Hudsons considered pretty good in a very tough corn year. Late moisture benefitted soybean yields. The farm-wide average was among their best ever at nearly 60 bushels per acre.

One of the increasingly important practices for keeping soil in top shape has been cover cropping. Last year after harvest, Curt and Christopher drilled in 1,000 acres of annual ryegrass split evenly between corn and soybean residue.

"No-till plays an invaluable role in our operation and the systematic approach we take toward farming," Christopher says. "My father laid the foundation for a successful and vibrant no-till environment nearly 30 years ago when he made the transition away from conventional tillage — a very bold move at the time.

"His experiences and wealth of knowledge in that regard are still a driving force in the success of our operation. I certainly take the value no-till provides for granted, at times, because it's the only approach I've ever known," Christopher continues.

"But it is easily evidenced by the enhanced soil structure, microbial and earthworm activity, erosion resistance, moisture conservation and economic return."

Future Goals

The Hudsons look back at historical data to identify production challenges, but they look forward to find the solutions. They're continually looking at state-of-the art technologies that may provide some of those answers.

In the short-term, among the precision-agriculture tools they will consider is Precision Planting's DeltaForce automatic downforce-control system for their planter. Weights and sensors on each row allow for independent response to changing soil conditions.

"Advancements in planting systems, from DeltaForce to variable-rate populations and beyond, will increasingly make farmers micromanagers," Christopher says. "In theory, every aspect of our planting is going to be managed to finer details than today by eliminating some, and limiting other, final yield deterrents."

Christopher would also like to test Monsanto's FieldScripts variable-rate seeding prescription. Through FieldView, the product takes farmer inputs for yield-management zones combined with Monsanto seed-by-environment data to come up with a prescription that would be executed by the planter-control system.

The Hudsons are also interested in the possibilities offered by Trimble's Connected Farm program that allows live access to all farm data from any compatible Web browser, along with wireless information transfer vehicle-to-vehicle, or between office and field.

"The continued growth, refinement and implementation of autonomous farming systems have the potential to reduce human capital requirements for crop production," Christopher says. "If we can reduce a full-time laborer during harvest, there's obviously a financial savings to our operation for not only the labor, but the human-error factor — assuming the autonomous systems are error-minimal."

Making A Commitment

For the Hudsons, it all comes down to more information, more accurate information and better access to information.

Three decades of continuous no-till has improved their soil, and precision-agriculture techniques have positioned them to take advantage of that, as well as advanced seed genetics and a growing knowledge base.

It does require a significant commitment, however.

"I'm sure there are instances where precision-farming techniques save us time. But all in all, it requires us to invest more time, too, because we have to do something with all the data we gather," Christopher says.

"There's no point in having it if it isn't going to be used to make better decisions. I can't say that the new technologies make it easier to grow corn, because it definitely adds another layer of management.

"Precision farming makes it easier to do a better job of growing corn and, for me, it makes farming a lot more interesting."

He also points out that precise farm management demands a time commitment to adapting new technology to the Hudson's crop-production system and fine-tuning to get the results they're after.

"While precision farming advancements will aid our operation in ways unimaginable today," he says, "I expect that advancements will help us grow larger crops from better planted, more advanced hybrids with less labor in the future — if we could only get Mother Nature to cooperate."

Implement Guidance Paves The Way To Profitability

Technology that keeps implements in line gains momentum as no-tillers and strip-tillers see higher yields and lower input costs through improved accuracy.

PHOTO COURTESY OF TRIMBLE NAVIGATION.

BIG PAYOFF. While implement-steering adoption is still in its infancy, some corn farmers using the technology are seeing 5- to 15-bushel-per-acre yield increases and saving 6% to 8% on fertilizer costs.

By Jack Zemlicka, Technology Editor

When Jim Irwin began strip-tilling in 1996, one of his biggest frustrations was being unable to precisely place seed in the strips he formed in the fall.

Irwin was an early adopter of GPS technology on his tractor. But with a fair amount of rolling land, he struggled to keep his planter from drifting, and Irwin was paying the price come harvest.

"When I was able to plant right in the strip, I was in the 250s for bushels per acre in corn," says Irwin, 63, who farms about 1,100 acres of corn and soybeans in Arthur, Iowa. "As soon as I got out of those rows, it would drop down into the 230s and I was losing 15 bushels per acre in some other spots."

Irwin was one of the first farmers in his area to try implement-steering technology for his Dawn Pluribus strip-till unit and Case IH 1200 planter.

Five years ago, he purchased a Trimble TrueTracker active steering system, which uses a guidance receiver on the implement to communicate with a receiver on the tractor. To mechanically connect the tractor with the implements, Irwin added an MBW ProTrakker hydraulic hitch, which automatically adjusts to accurately steer on slopes, contours and variable soils.

Essentially a "guinea pig" for the technology, Irwin says he wasn't sure how comfortable he would be with it. But after

using markers on his planter and planting "free hand," he was frustrated with the inconsistent yields, which were costing him money.

Once he gave implement guidance a fair shake the results have saved him money on inputs, improved yields on uneven acres and reduced fatigue.

"I initially thought I could do a better job of going around those hills and contours myself," he says. "I can't do a better job. I look back and think, 'If I was still planting my corn today, like I was then, I'd fire myself.'"

In The Zone

One of the biggest benefits implement guidance offers to Irwin is stability with yields on uneven ground. Though he hasn't tracked specific numbers, Irwin says his corn yields are far more consistent since he's added implement steering.

"I'm seeing a yield advantage of maybe 4 or 5 bushels per acre. But the big thing for me is that I've lost the variability I used to have on those contours," he says. "I'm either 99.9% or 99.999% on the strips when planting. It's amazing."

For soybeans following corn, which Irwin no-tills in 15-inch rows, he's able to set up 7.5-inch spacing on each side to avoid running over corn stalks and damaging roots.

"Before, we were planting too close on one pass and too wide on the next," he says. "All we had to do was adjust the GPS and we were able to get the spacing we wanted, and potentially better yields because of that adjustment."

> "We're trying to be accurate within 1 to 2 inches, so we need a high-tech system to make that happen…"

Being able to build a seedbed in the fall and precisely place seed in the fertility zone is crucial to the success of a plant. When farmers are setting up their guess rows — the area where two adjoining implement swaths meet — being too narrow or wide with spacing can lead to crop damage, says Cory Miller, president of MBW Products, based in Odebolt, Iowa.

"The big payback with implement guidance is having those guess rows perfect so farmers aren't damaging crops when they come back in the field to spray, sidedress or harvest with a different corn head that doesn't match the planter," he says. "Hitting that nutrient zone is key. If farmers miss it, they're going to suffer."

Nebraska strip-tiller Gordon Shrader started using Trimble's TrueTracker system 8 years ago and eventually paired it with MBW's ProTrakker hitch to improve seed placement in his sandy soils.

"We've got to keep at least 50% trash on top of the ground to keep our soils from eroding," he says. "So it was a challenge when I went to strip-till to put that fertility in the strip and be within 1 or 2 inches when planting to get the full benefit."

Shrader farms about 5,000 acres of corn and soybeans outside of Ewing, Neb. Prior to implement guidance, he struggled with setting up his guess rows because he would get 10 to 20 inches of variability going over a hill. This led to rows running together or being too far apart, allowing invasive weeds to spread.

It was an uphill battle — literally — for Shrader to get the right amount of nutrients to his plants. The combination of sandy soil and uneven rows meant he was wasting fertilizer.

"We apply a lot of potash and sulfur, and in our sandy soils we're not able to put that much nitrogen on at one time because it gets away from us," Shrader says. "We spoon-feed it through our center pivots. With implement guidance, we've saved between 6% and 8% in fertilizer costs because we're putting it right where it needs to be, rather than broadcasting it."

While he still tinkers with application amounts each year, Shrader says he's able to focus on specific zones, saving him time in the field. Better accuracy with seed and fertilizer placement has also led to increased yields.

Shrader estimates a 5- to 15-bushel-per-acre boost through a combination of strip-till and implement steering.

"The payback is increased corn yields because I'm planting right in that fertility zone," he says. "That's an important part for getting early emergence and growth."

PHOTO COURTESY OF ORTHMAN MFG.

THE RIGHT PATH. Steerable attachments, combined with GPS navigation, comprise active implement-guidance systems that provide greater accuracy than passive systems — although at a higher cost.

A Sizeable Challenge

The success of implement guidance can be determined not only by field conditions, but the size of farm implements.

Even in flat fields, large planters are likely to drift, says Gary Mohr, global product marketing manager for Lexington, Neb.-based Orthman Mfg. With a high-horsepower tractor in front of a 48-row planter, that's a lot of mass moving through the field at 5 to 6 mph, he says.

"Some of these planters are huge today, so everyone is stepping back to look at the size of this equipment and figure out the most effective way to steer it," Mohr says.

Orthman makes two styles of implement-guidance attachments controlled by GPS controllers. The Tracker IV system uses steering blades connected by tie rods and a hydraulic cylinder to provide implement-tracking correction. The company's Shadow Tracker system is similar, but the modules don't require a mechanical attachment.

When Shrader first set up his implement-guidance system, he owned a 60-foot-wide planter and used the Orthman Tracker IV with the Trimble TrueTracker, but he has since switched to a John Deere 90-foot, 54-row planter with an MBW hitch.

Despite the size of the planter, the hitch allows for 26-inch lateral movement and precisely adjusts to stay in line with the tractor's movement.

"It doesn't make any difference what equipment you have, if you're not always following directly behind the tractor," Shrader says. "It all depends on how hard the soil pulls that implement to one side or the other.

"We're trying to be accurate within 1 to 2 inches, so we need a high-tech system to make that happen."

For his Environmental Tillage System (ETS) strip-till unit, Shrader attaches the hitch to the tongue of the implement and applies fertilizer behind a coulter in the fall and spring, prior to planting.

"I cut a 40-foot swath, or 24 20-inch rows, for corn. Then we follow with our planter — which doesn't match up — so we have guess rows all the time," he says. "But it works well because with the hitch and RTK, we're right on those rows and don't have any overlap."

Implement steering on a corn planter can require the addition of some heavy machinery to the implement that incorporates the use of coulter wheels, says Mike Martinez, market manager for Trimble.

"So you have these big metal discs that dig in the ground and steer, and depending on the size of the planter you can use either a two-disc or four-disc system that gives you more leverage for bigger planters," he says. "This is an additional piece that the farmer has to invest in and install and modify their planters in order to have something to steer."

> "I've lost the variability I used to have on contours. I'm either 99.9% or 99.999% on the strips when planting…." — Jim Irwin

Path to Adoption

While progressive farmers are embracing implement guidance, the technology isn't nearly as popular as auto-steer on tractors, a technology that has been around for more than a decade.

Although implement steering is basically the same concept as auto-steer, Martinez says the technology is a little more complicated to add to a farm operation than auto-steer if farmers want to realize the full benefits.

"The biggest challenge is modifying the machine. Having to order machinery from third parties and do fabrication to existing planters and implements to install the steerable equipment is just another piece," Martinez says. "When you have too many pieces, farmers can lose interest."

Implement guidance first gained popularity with specialty-crop farmers. Sugarbeet defoliators and potato planters were easily paired with the technology because they were steerable implements.

To reach the same level of adoption in other areas of farming, it's simply a matter of showcasing the benefits, Martinez says.

Two years ago, Trimble set up a test market and worked with several corn and hay farmers in Colorado, where exposure to implement guidance had been minimal. Because of the hilly land, farmers there historically only planted on the flatter acres because bigger planters tended to drift down the slopes.

"I think we opened some eyes because these farmers were able to control their implements on hillsides and plant and harvest on land they never had been able to before," Martinez says. "One farmer we worked with was able to increase his farmable land by 15%."

While examples of payback are emerging, cost is another consideration.

PHOTO COURTESY OF MBW PRODUCTS

HITCHIN' A RIDE. A hydraulic hitch attaches the tractor to the implement and steers in the same path as the tractor. This allows farmers to precisely plant on terraces and contours and increase their farmable land.

Active systems guide the implement independent of the tractor and require GPS receivers and an attachment to the implement. These systems can cost upwards of $25,000.

Passive systems, which require two receivers — one mounted on the implement and the other on the tractor — can be less precise because the tractor steers the implement. But they're cheaper and start at about $3,500.

"It's like trading tractors. It's not cheap, but I felt I could get a return on it," says Irwin, who spent $55,000 on precision technology in a single year to include RTK, receivers for his tractor and implement and the MBW hitch.

One way Irwin helped offset his initial investment in implement steering was by enrolling in the USDA's Conservation Stewardship Program.

"I've gotten so many dollars per acre for using GPS and I've been able to reinvest that money in precision technology," he says. "The reality is I didn't have to get a yield increase because the program is paying for my GPS."

Work In Progress

No-tiller Steve Pontious purchased Trimble's TrueGuide passive implement-guidance system 2 years ago, but says he hasn't seen enough payback to justify upgrading to an active system.

Pontious farms about 1,300 acres of corn, soybeans and wheat in Lancaster, Ohio. His goal with implement steering was to be more accurate while sidedressing nitrogen after planting.

Pontious sets his Great Plains planter for 12-row corn and 23-row soybeans, pulled by his John Deere 8110 tractor.

PHOTO COURTESY OF TRIMBLE NAVIGATION

A PASSIVE APPROACH. Passive implement guidance systems require two GPS receivers — one mounted on the implement and the other on the tractor. These can be less precise, because the tractor steers the implement, but they are more affordable than active systems.

"When I first bought the system, I was dribbling nitrogen with the sprayer and my rows were pretty far off," he says. "My objective, now, is to make it easier to plant off of the corn rows when I plant soybeans. But I'm not there yet.

"My hope, at some point, is to be accurate enough to not have matched header equipment with my planter equipment," he says. "I think it's possible, but right now, my planter still behaves differently on some of the slopes in my fields than I thought it would."

Despite some of the early struggles Pontious plans to stick with implement guidance, because he sees the potential.

"Each year there is improvement and with a little tweaking, it's getting easier to make those additional passes more precisely," he says. "Accuracy gets addictive."

Trending Upward

While manufacturers suggest the technology behind implement guidance is where it needs to be to get results, further equipment enhancements are still likely on the horizon.

Steerable axles on corn planters and other pull-type implements could promote adoption of implement guidance and make the technology more user-friendly for farmers, says Martinez.

"It's kind of an evolutionary step that equipment manufacturers will have steerable devices in the future," he says. "They will need to do this anyway, because implements are getting so big and heavy.

"We already have that mechanical-steering ability and, after that, some type of ISOBUS or plug-and-play capability will-likely follow."

Miller likens the landscape for adoption of implement guidance to the early days of auto-steer for tractors, which started slow but eventually exploded.

"I think in 3 to 5 years it's going to become part of the implement, or part of the tractor," he says. "Right now, farmers are using attachments. But I can see it advancing to where a farmer can back up the implement, drop the hitch pin in and-just go."

Planters and strip-till units are where farmers are getting the most value with implement steering systems today, Mohr says — but it's not a limited market for the technology.

"If you're putting liquid fertilizer and planting in one pass, implement steering probably isn't that critical. But if you're putting on fertilizer in the fall and coming back in the spring to plant, that accuracy is important," he says. "It always goes back to being consistent with fertilizer placement and seed spacing in the two-pass operation."

After some early reservations, Irwin is on-board with the benefits of implement guidance. In fact, he's expanding on his use of the technology this year.

Irwin plans to variable-rate fertilizer in his strips in the fall with two compartments attached to his rig to apply phosphorus and potassium as needed.

Irwin is still one of the only farmers in his area to embrace implement guidance, but he believes that will change, at some point, because of the benefits.

"My soil-sampling advisor told me that I could save $10,000 by applying what I need on just one farm this year, aided by implement guidance," he says. "It made me think that on my five farms, eventually, I can start to see a profit from this change.

"It saves fertilizer and seed overlap and can stabilize or improve yields. I want to be farming at least 5 more years and this will help me do that. I

"In that time, I think there will be very few people who won't be using some sort of implement guidance technology on their farm."

> "With implement guidance, we've saved between 6% and 8% in fertilizer costs because we're putting it right where it needs to be, rather than broadcasting it …"

RTK Helps No-Tiller Tame Tough Corn Residue Challenges

Ohio no-tiller Don Denton finds precise guidance helps his soybean planter steer clear of corn stubble, save seed and improve soybean stands on his farm.

By Jack Zemlicka, Technology Editor

When it comes to residue management in no-till, real-time kinematic (RTK) guidance probably isn't the first tool farmers would consider using in their operation.

But RTK provides Ohio no-tiller Don Denton a precise residue-management solution that also reduces seed costs and improves seed-to-soil contact.

"I don't think I can put a dollar amount on what it's done for me, but it's certainly paid for itself," Denton says. "I don't touch my stalks after harvest, and bought RTK with the goal of being able to manage residue."

CLEARING A PATH. Ohio no-tiller Don Denton checks seed depth behind his Kinze soybean planter set to 15-inch spacings. He's been successfully using RTK to manage corn residue by moving his soybean rows 7½ inches off the old cornrows.

Precise Planting

Denton no-tills soybeans after corn on about 3,300 acres in Cardington, Ohio, and has struggled with planting soybeans into corn residue. He plants most of his soybeans in 15-inch rows with a Kinze planter and also does some seeding with a 30-foot John Deere drill on 7½-inch spacing.

For years, he planted corn with a 16-row planter, but moved last spring to a 24-row Kinze planter. But whenever Denton would plant into the old stalks with his 15-inch soybean planter, he would lose seed-to-soil contact and not get as good of a stand.

"We tried planting at an angle so we weren't running down a row, but it still happened every time we crossed the row, which made it a pain to harvest," Denton says. "I like to see nice, straight rows for harvesting and planting. I tried to drive so I wasn't on a row, but doing that all day long is really stressful."

After having little success applying nitrogen and other products to break down corn residue, Denton turned to RTK as a possible solution. He wanted to move his soybean rows 7½ inches off the corn row and plant right beside the old corn stalks.

"With RTK, I could set up my 15-inch soybean planter by taking the A-B line information out of the corn-planting tractor, from the year before, and inputting it in the soybean planter," Denton says.

He worked with Tim Norris, a precision farming consultant and owner of Ag Info Tech in Mt. Vernon, Ohio, to help set up the system.

Norris, who also no-tills crops on his own farm, says he was initially surprised by Denton's interest in RTK as a residue-management tool and wasn't sure how well it would work because of planter drift.

"We put our heads together and decided as long as he plants the field the same way every year and he goes the same distance and direction, the planter should drift the same amount. That held true," Norris says.

Instant Payback

Planting off of the old corn row with RTK is leading to better seed-to-soil contact and improved stands, Denton says, because he's avoiding residue in the field and allowing nutrients to reach the seed for better germination.

"I'm seeing a big benefit in my stands. In the past, if I just drove randomly, certain varieties of seed were performing worse than others," he says. "With my 15-inch soybean planter, I could physically see 30-inch rows where I wasn't getting much stand when I planted right down the row.

"By straddling the row with RTK, I don't have that issue."

Denton is also seeing more consistency with seed placement, which has allowed him to reduce his populations and save seed. In some areas, he's lowered populations from 180,000 to 150,000 without sacrificing yield.

"I feel a lot more comfortable cutting seed populations on the planter, and there's obvious savings there because I'm not wasting seed planting on that cornrow," he says. "I don't have any data, but it's saving me money."

Another observation made by Norris during harvest is that Denton avoids mashing down a row of soybeans with the combine because he's able to follow the same path through the field.

Long-Term Precision Investment Pays Off

Auto-steer, swath control, implement guidance and numerous other technological tools are saving Martin Farms plenty of time and money.

By Jack Zemlicka, Technology Editor

No-tiller and strip-tiller Doug Martin is a big believer in the concept of spending money to make money.

So when it came down to investing in precision-farming technology, the Mount Pulaski, Ill., corn and soybean grower says it didn't take long to realize the benefits across 5,600 acres he and his father farm.

"It was about 6 years ago and there were not a whole lot of farmers my age around doing this stuff," Martin, 35, says. "I saw it as a way to make the farm more efficient. We do a lot of strip-till, so I thought incorporating some precision would help gain some value in keeping plants on the strip."

In The Bank

Martin's instincts were correct, because the merging of precision technology with no-till and strip-till practices saved time and money.

One of the most beneficial purchases Martin made about 3 years ago was swath control — or auto-row shutoff — for his 24-row planter as a way to reduce overlap, trim seed costs and improve yields.

The price tag to purchase John Deere's Swath Control Pro was about $500 per row, but he says the $14,400 system has already nearly paid for itself.

"Last year on our farm, planting with swath control saved us 16 bags of corn," Martin says. "At $300 a bag, I'd figure that's a $4,800 savings. When I was figuring this up, I assumed overlapping four rows into the end, so it might be more or less than that.

"But you figure those same rows yield 20% better than if they were overlapped." Add another 1,200 bushels at $5 each and that's another $6,000, Martin says. Another benefit is a much easier harvest.

"Those end rows aren't all mangled up together and laying down flat," he says.

Begin With Basics

Martin says his success with precision technology didn't happen overnight, and he knew little about where to begin.

He started with a simple step, installing John Deere auto-steer and John Deere GreenStar 2 2600 touch-screen displays on all his tractors, along with John Deere Apex farm-management software.

"If I want to farm for 30 more years, I need to embrace the technology and not run from it..." — Doug Martin

One of the benefits of the Apex system, Martin says, is that operators don't have to be experts to successfully run the equipment. The system serves as a type of "note taker" that allows him to remotely monitor the operator's movement and productivity.

The cost of the auto-steer, displays and Apex software totaled out at about $20,000 per tractor.

Martin says one of his primary goals with the investment was to simplify and streamline the planting process for all operators, including his father, Jeff.

"Whether it's my dad or a couple guys that help us, what I've seen is that when they have issues or problems, they can call me," Martin says. "I can say, 'What's the screen say?' or 'What's going on?' and I can sit there and walk through it with them and punch the same buttons that they have and see if we can find a solution.

That has been a tremendous time-saver, Martin says, especially when planting. The Apex system allows Martin to map coverage areas and determine if there is a missed pass in one of the farm fields, without having to physically check.

"Each landlord's list is separate," Martin says. "You go in there and it says, 'Doug Martin operator.' Then it will have the farm name and the landlord and then we'll have the field. Whether it's 'Jeff's 40' or someone else's, they're each listed separately so each field we go into, we know what landlord and what field to hit so all the records can be accurate. "

Stay In Line

Martin says the auto-steer technology allows operators to remain in the field longer, without enduring the physical strain of manually keeping the tractor in a straight line, Martin says.

"It's the ease of being able to put anybody in it," he says. "With auto-steer, our people really enjoy running a tractor a lot more and can put in a longer day."

For planting and anhydrous application with corn-on-corn, Martin runs three John Deere RTK satellite-navigation receivers on each John Deere 9350 tractor to track seed placement.

When he started using RTK 3 years ago for planting, he was searching for a more efficient way to strip-till and establish a rotation for rows.

Martin says he used RTK to alternate rows and eliminate confusion between farms because he doesn't have to remember patterns for each one.

With the touch of a button, he can determine if it's an odd or even year and rely on technology to do the rest.

"I thought it would be nice to just flip-flop back and forth 15 inches every year, so we started doing the even and odd," he says. "It took us 2 years to get that set up, but this is the third year we've done it and it worked really well this fall.

"I think it allows for a lot better emergence by staying on the strips more consistently and not driving the strips like we used to do," Martin says. "Most of the time you're right there, right on the strip, and that allows for more uniform emergence."

The consequence of inconsistent strips is late emergence, which can cost yield. If one plant in every 17½ feet of row emerges 2 or 3 days later, it can reduce yield potential by 7 bushels an acre, he says.

"Anything that emerges 2 to 3 days late, a lot of times experts say it's a weed," Martin says. "If we can stay on our strip and have better emergence, it adds $25 to $30 an acre versus driving the strips."

Room To Improve

While the transition to precision technology has improved efficiency and increased yields at Martin Farms, it isn't flawless.

Two years ago, Martin purchased a John Deere iGuide system designed to make quicker corrections in the field and compensate for implement drift. But the $10,000 investment hasn't been as precise as Martin would like.

When plotting his 'guess row' with his 24-row corn planter, he said sometimes the machine has been out of alignment on subsequent passes. Sixteen of the rows might be on, but eight may be off while following the 16-row toolbar.

"There's got to be 30 inches between each pass, and it's not consistent sometimes, which is frustrating," Martin says. "The strip is only about 5 or 7 inches wide, so if you aren't on your strip, it's a different seedbed and that effects emergence."

Searching For Answers

Diagnosing the cause of the inconsistency has been a challenge. Ground conditions that cause the implements to pull one way or another has been one culprit, Martin says, so he makes the necessary adjustments to stay on track.

SAVING MONEY. Planting with swath control last year saved Martin Farms about 16 bags of corn, which equated to $4,800 in savings, says Mount Pulaski, Ill., no-tiller and strip-tiller Doug Martin.

"It's just messing around with this stuff and re-setting the computer or trying something else which can take 30 seconds or 3 hours," he says. "The technology works just about all the time, but for the amount of capital we've invested, when it doesn't work, it's frustrating."

Martin says patience, common sense and expecting the unexpected are often successful approaches for him when dealing with precision technology.

Last fall, for example, he was putting his ammonia strips on when the tractor started going haywire.

"We were about a mile from the RTK tower and all of a sudden I'm driving to the field and the tractor starts spinning in circles and I couldn't figure it out," Martin says. "We did a couple things and it just started working again."

Trial And Error

Although Martin says he isn't afraid to learn how his technology works through trial and error, he says no-tillers should know their limitations and call in an expert when necessary.

A loyal John Deere customer, Martin says he has benefitted from the availability of local technical support from Cross Brothers Implement in Mt. Pulaski.

"If I don't know how to fix a problem, I usually call my dealer and if they don't know, they call tech support at John Deere," Martin says. "Chances are somebody has been exposed to it and there doesn't seem to be as many new problems as there used to be."

Despite a few minor setbacks with precision technology, Martin says he has every intention of expanding its use on the farm in the future. After crunching the numbers, he's looking into swath control for sprayers in the next year. He expects benefits would be similar to those of the auto-shutoff system used on his planters.

"We've got an older sprayer, so we'd trade up to get to this technology," he says. "We'd be able to apply less product and reduce both potential crop damage from overlap and environmental damage.

"I think that's just as important on the sprayer as it is on a planter, if not more. On a sprayer, it adds a lot of economic and environmental benefits. I figured a half a row overlap on our farm would equal about 120 acres of extra work and add probably $4,000 total savings per pass."

For Martin Farms, the bottom line on investing in precision technology is improving the farm's financial future, he adds, because the price of avoiding it would be too steep.

"If I want to farm for 30 more years, I need to embrace the technology and not run from it," he says. "It's not like I've only got 3 more years left, so I need to use this technology to my advantage."

> "Last year on our farm, planting with the swath control saved us about 16 bags of corn…"

9 Tools, Trends That Will Improve Spraying Results

Greater precision, improved compatibility, sophisticated controls and cloud-based information systems can help no-tillers get more out of their applications.

By Clair Urbain, Contributing Writer

Precision farming technology can pinpoint rates and treatments for greater economic payback and more attention to stewardship. When it's done correctly, everyone wins with lower input costs, greater crop tolerance and less over application that can lead to weed resistance and carryover concerns.

Equipment manufacturers often prioritize implementing improvements in spraying technology over other equipment because the payback for the grower can be greater.

"Sprayers are the first pieces of equipment to get advanced precision technology. They cover more acres and go over the field several times a year, so it's easier to cost-justify the investment," says Micah Eidem, market manager for planting, nutrient & pest management at Trimble Navigation Ltd. "In no-till, effective weed and pest control takes on even more importance, so adopting this technology makes even more economic sense."

No-Till Farmer asked industry experts and farmers to share what they see as the top trends in sprayer technology that will change crop chemical application.

THE BIG BOOM. With sprayer size increasing, manufacturers are offering GPS-driven section controls that shutoff the boom over already-applied ground, and they are increasing the number of segments that can be used on a boom to prevent skips and overlaps

1 Nozzle Monitoring. The experts report the trend to wider booms will top out at 120 feet to 136 feet because many farm fields aren't large enough to accommodate anything wider.

"Everyone wants bigger booms, but many fields are not big or square. Instead, we are seeing much more interest in spray control right down to the nozzle," says John Harrison, technical vice president of Harrison Ag Technologies in Mobridge, S.D. "With swath control at the nozzle level, we can easily document 15% to 25% savings in chemical costs by eliminating overlap and not treating grass waterways or other non-productive land.

"At-the-nozzle control eliminates overlaps that can injure crops and create carryover concerns."

Several manufacturers offer GPS-driven section controls that shut-off the boom over already-applied ground, and they are increasing the number of segments that can be used on a boom.

"More segments and mapping on true form factor lines instead of square grids improve sprayer control to prevent skips and overlaps," says Eidem.

Wider booms make monitoring nozzles difficult and manufacturers such as TeeJet Technologies, based in Wheaton, Ill., are developing tip flow-monitoring systems.

"It alerts the operator of reduced flow or a broken or plugged tip," says Tim Stuenkel, TeeJet global marketing communications manager. "A turbine-style in-line flow meter at every nozzle has a CAN Bus connection back to the in-cab console, which emits an audio or visual alert if any nozzle flow is out of spec.

"The system can also be used to monitor liquid fertilizer application at planting or sidedressing."

2 Simplified Installation. The Agricultural Electronics Foundation (AEF), a group of equipment manufacturers and technology providers, are in the final phases of developing a compatibility guide for different models of precision equipment, says David Webster, AGCO director of high-horsepower tractors and advanced technology solutions.

"This guide will identify a component's ISOBUS-level rating and whether certain components are compatible," he says. "This will be extremely helpful to farmers and dealers so they can identify what will and won't work together."

As manufacturers adopt ISO standards, the equipment and monitoring technology will become more plug-and-play, with the trend to fewer in-cab monitors.

Components that wirelessly communicate information from the spray boom to the cab are under development, with some just coming on the market. Harrison says Ag Technologies' Smart Nozzle System uses an Android tablet with high-quality

graphics to wirelessly capture application information. This software is also being ported for use with electric-drive planters.

"We think this is the wave of the future. The cost of the monitor will drop from thousands of dollars to hundreds. It's all in the software, and this code is open source, so it will dramatically improve functionality and cut costs," Harrison says.

That would be none too soon for Adam Kleiss, who farms with his family near Fredericksburg, Iowa. They've used precision farming equipment on their 1,900-acre, 600-cow dairy farm where they grow corn, soybeans and alfalfa since 2007.

"I'd like to see increased interchangeability between monitors. One monitor should run more systems. How can a $3,000 Dell computer do so many things, but a precision farming monitor costs $10,000? It's just code. We need better ways to do this," he says.

3 Better Tools For Boom Control. As booms extend their reach, so does the need to control height to maintain a consistent spray pattern on rolling terrain.

Gary Esselink, application controls product manager at Raven Industries, in Sioux Falls, S.D. says active boom leveling systems use ultrasonic sensors and a floating hydraulic cylinder to adjust boom distance to the ground on the fly.

"Even at high speeds, they maintain an acceptable spray pattern," he says. "Boom height control is very important, and more difficult to do as booms get wider — especially at the speeds these sprayers run.

"Auto height control can be set for preplant or post applications and Raven's system, for example, is ISO-compatible so it can tie in with most monitors," Esselink says. Raven's AutoBoom height control uses an ultrasonic sensor that sends signals to the controlled-float hydraulic system to quickly respond to height changes in the field to assure proper spray pattern.

Jason Starnes of Four S Farms near Salisbury, N.C., says using GPS-guided steering helps cut chemical costs. Their John Deere 6700 sprayer is equipped with a Trimble EZ-Guide 500 light bar, EZ-Steer 500 and EZ-Boom 3-section swath control.

"When we went from using a foam marker to the light bar, we immediately saw a 3% to 5% savings on chemical use," he says. "With EZ-Steer, we saved an additional 5% and the swath control has helped cut our chemical and fuel use probably another 5% to 7% each trip across the field. That adds up."

4 Improved Variable-Rate. Variable-rate herbicide application has come a long way, observers say.

Variable-rate systems can match preemergence herbicide rates to soil type as the sprayer crosses the field, based on field soil maps. Optical sensors, like Trimble's WeedSeeker sensor, can detect weeds in-between rows and activates the nozzle or spray section to treat them.

The system uses optical sensors that recognize contrasts between weeds and bare ground, triggering chemical application only when the sprayer passes over weed patches.

"These are good systems in fields with lower weed pressures, especially in drier climates," says Eidem. "The sensor technology is coming along, and will be able to help farmers better match treatments and rates to the crop's needs."

5 Better Speed, Rate Matching. As sprayers are built to cover more acres at higher speeds, the pumps and nozzles must be able to vary flow to accommodate slower turns vs. faster straightaways.

Stuenkel says pulse-modulated spraying systems are the best choice to adjust flow control and manage droplet size to achieve proper rates and manage drift. "It's been around, but it is going through a renaissance," he says.

Ryan Speer, who farms with partner Steve Jacob at Jacob Farms, a 4,000-acre irrigated and dryland operation near Halstead, Kan., is well-aware of the importance of maintaining spray droplet size and rate independent of speed.

Their 90-foot Case IH 3320 sprayer has Aim Command and pulse width-modulated nozzles. "The sprayer's system is very good because it maintains the appropriate pressure, independent of speed," Speer says. "We're seeing reduced chemical use and improved weed control.

"It adjusts the rate if we go slower on turnarounds so there is less applied, which results in less crop damage," he continues. "It's also helping us reduce our per-acre chemical cost by as much as $10 per acre."

6 Direct Injection. Direct-injection technology is gaining interest again as farmers face herbicide-resistant weeds. Stuenkel says TeeJet is looking at multi-product injection systems.

"While this technology has been around a long time, higher-end farmers and commercial applicators are looking for systems to apply more than one chemical, on the fly, without tankmixing," he says. "That allows the use of older chemicals, such as 2,4-D and dicamba, to control weeds that have developed glyphosate resistance."

Direct injection also allows fast change-over from one crop to another.

"That's very important during the time pressures of spraying season, and it reduces issues with disposing tank wastewater," Webster says. He notes that with the RoGator sprayer direct injection system, operators can designate a specific tank for each chemical, eliminating mixing and cleaning when switching products, which saves time and money.

Raven uses a positive displacement pump for applied chemical accuracy within a tenth of an ounce on a per acre basis.

"When using a tank mix, the applicator can say that this much chemical was applied on a per acre basis, but there is no real actual record of the chemical itself," Esselink says. "When applying a chemical through direct injection, a separate record of that chemical is created for field mapping and records on an as applied basis. This ensures the applicator has records of exactly what was applied."

Skip Klinefelter, who farms 3,100 acres of corn, soybeans and wheat near

> "How can a $3,000 Dell computer do so many things, but a precision farming monitor costs $10,000? It's just code. We need better ways to do this…"

PHOTO COURTESY OF AGCO

QUICK CHANGE: Direct injection, like Agco's RoGator system, allows farmers to changeover from one crop to another, which is extremely critical during peak spray seasons to help reduce problems with tank wastewater disposal, says David Webster of Agco.

Nokomis, Ill., and operates Progressive Seeding Technologies, a precision farming equipment dealership, says injection systems greatly reduce liability risks.

"Being able to haul just water, not premixed tankmixes, reduces our liability. There is the less environmental risk and liability of a spill from an accident," he says.

7 Wireless Communication. Dynamically storing data produced by in-cab systems can be challenging, but so-called "cloud computing" will make the latest data virtually available.

For example, Trimble's Connected Farm solution uses wireless technology to upload or download field data.

"The wireless network can communicate with other equipment within a half-mile of the unit," he says. "That means two sprayers can work in the same field, share A-B lines and eliminate overlap between the two units."

Harrison sees even greater potential with Android tablet-based systems.

"Precision systems generate lots of data and working on an Android tablet allows us to store it on the cloud. An agronomist can match this data up with satellite maps and soil samples and write prescriptive rates for different areas of the field," he says. "That can be downloaded right to the tablet, which will be able to control the sprayer's variable-rate system."

The Raven Slingshot application programming interface (API) allows data transfer and sets up protocols so two or more farm management systems can share data.

"You don't have to be a programmer to appreciate the nearly endless ways this can help in any farming operation," says Esselink. "It can share data real time and there is no need to put it on a thumb drive."

8 RTK For Geo-Positioning. Industry experts predict that real-time kinematic satellite navigation (RTK) use will grow as more farmers adopt strip-tillage practices or precise fertilizer and seed placement technologies. With sub-inch accuracy, it can further reduce pesticide costs and fine-tune application rates.

"We estimate that using RTK over D-GPS positioning will result in a greater than eight-fold improvement in accuracy," says Eidem. "With several spray applications in a season, that performance improvement can quickly add up to pay for the added cost of RTK guidance."

For Speer, the RTK positioning and auto-steer system mean they can work longer at night and reduce operator fatigue. "The operator can pay more attention to the sprayer, and we find it saves as much as $10 per acre in herbicide cost," Speer says.

"RTK costs more than relying on Wide Area Augmentation Systems (WAAS) for navigation, but it's worth it. We follow the same line every time," he says. "Everything but the sprayer is set up to run on 40-foot swaths, and if we go to a 120-foot boom on the sprayer, we can run the sprayer on the same rows as the planter and combine."

9 Prepaid Support, Self-Help. As more farmers adopt precision technology, technical support will be in even greater demand, especially during planting and spraying season, says Klinefelter. Self-help and service contracts are the best way to assure uptime.

Klinefelter says farmers can best prepare for system glitches by taking advantage of training sessions that help you understand how the system works and ways to diagnose it.

"It's surprising how much users forget from season to season," he says.

Klinefelter predicts growing reliance on online resources, such as chat rooms and question and answer sites for assistance.

"When a farmer needs help, he needs it now, and dealer assistance isn't always available at that minute," he says.

Pencil In Profits From Precision Spraying Equipment

Interested in precision spraying equipment, but not sure how you can make it pencil out in your operation?

PrecisionAg Institute's Guidance and Section Control Profit Calculator might be just the tool to help you.

The calculator was developed by Kansas State University Ag Extension with support from the PrecisionAg Institute. It can be used online or downloaded. It focuses on guidance systems and section controllers, helping growers figure the technology's ROI.

The calculator prompts growers to enter acreage, width of field, area of land to cover, equipment information and other factors that affect ROI.

Based on the information entered, it reports a dollars per acre payback and approximately how many years it will take to achieve system payback.

To access the calculator, visit: www.no-tillfarmer.com/calculator

Emerging Use Of Drones May Change Face Of No-Tilling

Crop scouting, 3-D mapping and spot spraying all could be performed by unmanned aerial vehicles to cut labor and input costs and improve efficiency.

By John Dobberstein, Managing Editor

In the not-so-distant future, farmers wanting to scout fields for diseases and pests, spot spray for weeds or obtain 3-D maps of their farm ground will be turning to tiny autonomous helicopters or planes to do the job.

Armed with powerful cameras, these unmanned aerial vehicles (UAVs) — known in popular culture as "drones" — can cover hundreds of acres in an hour and provide a birds-eye view of fields down to canopy level.

After establishing a foothold in the military, agriculture is seen as one of the last frontiers for UAV use because of the increased use of precision technology in farm operations. The units are already being used in Canada, Europe, Asia and South America for various tasks.

The UAV market is mostly undeveloped in the U.S. due to strict FAA regulations, but some farmers are buying the units anyway or requesting demonstrations. The FAA in 2015 is expected to reveal a plan for integrating UAVs into airspace rules, but it's unclear how long it would take to implement the guidelines.

Rory Paul — whose Chesterfield, Mo., company, Volt Aerial Robotics, makes and sells rotary-copter and small fixed-wing UAVs — believes the units are "personal farming implements" that can help farmers get more timely, accurate information about their crops and fields.

"We should have the right to operate these technologies over our properties, to the benefit of the ground below," he says

EYE IN THE SKY. After gaining a foothold in the military, unmanned aerial vehicles (UAVs), or "drones," could find a home base in precision-farming applications, crop scouting, weed control or even detecting harmful pathogens traveling hundreds of feet above farms.

UAV Basics

Typically, UAVs are small enough to fit into a small suitcase and are launched from the side of a field or area of interest. Guided by a radio controller, laptop computer or tablet, the device flies between pre-determined waypoints to film or photograph the desired field areas.

Cameras on the UAVs may take two-dimensional, high-definition photos where every pixel is linked to a GPS location on the ground. UAVs also have the ability to transmit live video images from the flight to ground control.

Depending on the model, some cameras can take thermal images of plants in fields or 3-D models that depict subtle changes in elevation can be built from these images using software.

The accuracy of UAV maps may range from 12 inches to only a quarter inch, depending on how many ground-control points there are. Going for sub-inch accuracy takes time and money, but it's achievable, Paul says.

"As long as you have one ground-control point every quarter of a mile, you can get sub-meter accuracy," Paul says. "Corrections are done post process."

Rotary-wing UAVs can fly up to 20 minutes, depending on the payload, and fixed-wing units can fly about an hour. Ranges can differ depending on the controller, but most UAVs have a range of 2 to 4 miles.

The rule of thumb with operating UAVs in wind conditions is that bigger UAVs can withstand greater forces. The rule of thumb with operating UAVs in wind conditions is that bigger UAVs can withstand greater forces. Smaller rotary helicopters can be flown in winds gusting anywhere from 20 to 52 mph, while fixed-wing systems must fly into and out of the wind rather than across it to generate satisfactory images.

Some UAVs allow operators to upload new directions in flight so the unit can change missions or direction. And if the radio link is lost and not re-established — or the battery begins to go out — the device will fly back to the launch point.

Prices range from $500 for basic units found on the Internet to near $100,000, although Paul believes U.S. pricing will fall significantly in the coming years.

A major advantage of UAVs is they're highly deployable.

"If you need me tomorrow in Nebraska, I can pack the UAV into a suitcase and I'm heading out there to go on a flight," he says.

Changing Agriculture

UAVs may indeed change the way farm decisions are made, especially when the technology and point of view provided by the units can be combined with ground truthing to document conditions in fields.

Drew Janes, who founded Jackson, Mo.-based Aerial Precision Ag just a few months ago, set up a booth at the 2013 Ag Connect Expo in Kansas City and sold out of his inventory.

About a year ago, he built some of the drones for his company, Relentless Inc., to film farm operations for Case IH. Then he brought a UAV to last year's Farm Progress Show and had dozens of farmers ask where they could get one.

Janes says APA has worked to create an easy-to-use UAV kit that can be deployed in less than 2 minutes from opening the machine's carrying case.

"Farmers are searching for ways to make operations more efficient and practical because scouting crops and managing fertilizer, or water use, is a huge time-intensive task," says Janes, who grew up working for his parents' fertilizer chemical dealership in the Midwest. "Most of our interested customers are row-crop farmers, but at some shows you see livestock farmers who want them to check on cows or what's happening in pastures, as well as feed and water needs."

> "With UAVs, we have a way to track plant growth with a high degree of accuracy and optimize harvest time…"

In Canada, where a regulatory framework is already in place for UAV use, these units are already helping farmers gather valuable data, assess environmental conditions and maximize yields.

Aeryon Labs Inc, based in Waterloo, Ontario, sells the Scout, a quadcopter that is capable of taking daytime and near-infrared images and merging them into Normalized Difference Vegetation Index (NDVI) images that can ascertain plant health, soil and water conditions and biomass production.

Imagery taken during flights can also be imported into GIS databases, stitched together with special software and used to generate 3-D reconstructions of fields.

In theory, farmers using a UAV such could monitor farm operations at the same time every day or week and make proactive decisions, says Cameron Waite, Global Sales Manager for Aeryon Labs.

"From a crop perspective, farmers can monitor and make decision on the application of water, fertilizer and pesticides," Waite told attendees at the 20th annual Southwest Agricultural Conference in Ontario. "If you've got a hailstorm coming, or one just came through, you could see how your land was affected."

NDVI images could be especially useful to help farmers see how healthy their crop is or catch issues with crop stress, water, nutrients or weeds that they might have missed with the naked eye and avoid having to make decisions about inputs that aren't necessary.

"You can do precise, targeted applications of pesticides, nutrients and fertilizer and keep your costs down," Waite says.

Multispectral cameras let farmers identify crop health, perform risk mitigation and even identify soil health.

In the future, hyperspectral cameras will let farmers identify specific vegetation types.

If ragweed affecting corn has six spectrums of light, the light bounces back in the sky and is picked up by the camera.

At a vineyard in British Columbia, a grape farmer trying to get a better understanding of his conditions was having geographical challenges. He used the Scout to take 90 images in 8 minutes over 7.5 acres, and generated image resolutions of 1.6 centimeters per pixel.

"Satellites may give you 1 meter per pixel and airplanes may give you 30 to 50 centimeters per pixel," Waite says. "A fixed-wing UAV gets you about 5 centimeters per pixel. But we are able to get around 1 centimeter to as low as 3 millimeters per pixel."

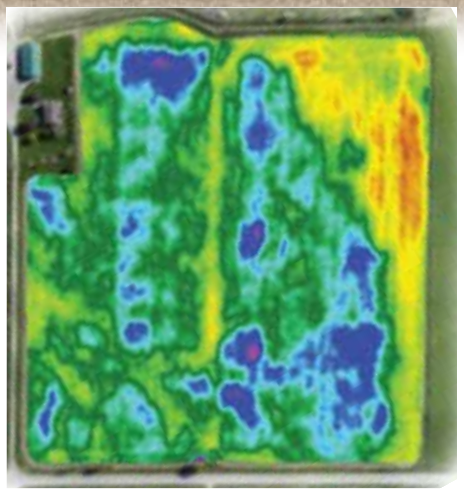
STUDY AID. Fixed-wing and rotary-copter UAVs were demonstrated last summer for the Iowa OnFarm Network, where a corn-rootworm management trial was under way. Rory Paul of Volt Aerial Robotics used a fixed-wing CropCam UAV to map the 200-acre field in 30 minutes (left), then showed researchers how to use real-time imagery from Volt's rotary craft — sent back to a computer on the tailgate of a pickup truck (right) — to find spots in the field marked with GPS from imagery.

Follow The Map

Already, small fixed-wing UAVs launched to fly over fields are helping farmers and ag crop consultants in Ontario.

Felix Weber, who founded Ag Business & Crop in Palmerston, Ontario, after more than 20 years of farming, is also a distributor for senseFly's Swinglet CAM and eBee fixed-wing UAVs. Weber has a pilot's license and has always been keen to what can be seen in a farmer's field from above.

He tried working with satellite imagery, but said he was frustrated with the 1- to 2-week turnaround he was getting — and if the weather changed while he was waiting for images to be sent, it was too late.



PHOTOS COURTESY OF FELIX WEBER

BIRD'S-EYE VIEW. Images taken from a Swinglet CAM drone over a field in Ontario last year show areas with higher or lower organic matter. At right, the yellow-green line in the photo's center is an old fence row and yellow-red areas indicate silty soils with higher organic matter.

Weber feels fixed-wing UAVs work better for scouting and mapping larger farm areas.

"The CAM shows me patterns, things that I don't see from the ground, and gives it to me in a format where I can make maps and extract GPS coordinates to go to a specific point in field," Weber says.

In one project in Ontario involving a test plot for local companies supporting strip-till, Weber used a UAV to fly over a field every 3 weeks for an entire growing season to document emergence, growth and harvest of corn.

One type of map showed him the different soil types and organic matter — including an area where an old fencerow was located that, several years later, still showed higher levels of organic matter than surrounding farm ground.

After corn was planted at a population of 40,000 seeds an acre, he flew his UAV over the crop and got NDVI images that showed emergence wasn't optimal in some areas. Using the GPS tags from the images, he found that field area and determined it had heavier clay content.

"The equipment didn't go quite as deep there, so the planting depth was less than other areas," Weber says.

At the end of the season, he compared the last few NDVI images he took to maps generated from his yield-monitor data and the images were very similar.

"It accurately showed me healthy areas of the field compared to stressed areas, so I was able to compare them and calibrate the data afterwards," he says. "When we looked at images from the beginning to the end of the season, the stressed area was a lot bigger than it was at beginning of the season because we had such a dry season."

A few years ago, Weber did drainage maps for a farmer who didn't know where his tile lines were located. After a rainy period where there some good drainage activity was taking place, images taken by the CAM showed where the tiles were located because the crops around them were in better health.

"You could see exactly where the lines were," he says.

Farms In 3-D

Another way UAVs could improve farmer decision-making is through mapping fields with 3-D technology to provide detailed topographical images where soil changes might be present.

"If you have perfectly flat fields, there may be no interest. But what if you have a 50-foot difference in elevation from one side of the field to the other?" suggests Paul of VAR.

While the technology may not be there yet, UAV-produced 3-D maps could even help farmers fine-tune hybrid selection for higher elevations with less water or lower elevations with more water and higher organic matter.

"In hilly areas, you may use a different variety that isn't a racehorse hybrid but still works well, while in lower areas you may decide to use the racehorse variety," Weber says.

"And with water management," Paul adds, "where am I going to put drainage tile in a field? A farmer may know some of these things intuitively, but if you have a couple thousand acres, this information might be insightful."

Weber believes 3-D maps could be an additional tool to help farmers decide where to apply lime or other nutrients.

"When you only look at yield data, you're seeing the removal rate," Weber says. "That doesn't mean there is no potential in the lower-yielding areas, it's just that something is going on that is hurting yields. Could it be fixed?"

Scouting Crops

Crop scouting could be the best and highest use for UAVs.

Last summer, Paul demonstrated both four-rotor and fixed wing UAVs in Hardin County, Iowa, where the Iowa Soybean Association On-Farm Network had a corn-rootworm management trial under way. The trial contained replicated strips of half-rate and full-rate insecticide with a Bt-rootworm hybrid.

"We'd already done quite a bit of work in the field using our own aerial imagery to locate problem areas," says On-Farm Network spokesman Mick Lane. "Rory mapped the entire 200-acre field with the fixed-wing plane in about 30 minutes.

"Then he showed us how to use the real-time imagery, sent back to a computer on the tailgate of a pickup, from the camera on the rotary-wing craft to find spots in the field we'd marked with GPS from our imagery.

"We got excellent, deadly accurate images from that, which would have helped us immensely in walking into those areas after the GPS data was transferred into our handheld GPS devices."

UAVS could be valuable in assessing crop populations early in the season before the growing foliage makes individual plants indistinguishable.

"You could choose a spot in the field and count how many plants are in a row. The multi-copter will go back to that same exact spot and take another count," Paul says. "You can get population counts more quickly and you can do a lot more of them.

"Later in the season, when plants are too tall to see the field, you can still get a general overview of the field. If you spot a problem, you can drop it down and determine what's going on, or take a still image and walk out and do ground truthing because you have the GPS location."

"Another benefit is on farms with pivot irrigation," says Janes of APA. "You may have a problem with stand 3 or a nozzle at stand 4 is blocked. You can go scope the problem without walking through a muddy field — and you can have the info in minutes."

UAVs could be useful as well for farmers, consultants or crop-insurance agents for scouting damage from weather events, harmful insects, diseases or chemical drift.

"That can be very hard to judge from the ground," Weber says. "When you walk into a field, how do you really make a decision if it's 70% still good or 90%?

"With an aerial image, you can see how large the percentage is and go to that field area and decide if it's an acceptable loss or unacceptable. It's easier to make an informed choice.

"Or when plants are stressed, I can see if I can apply nutrients to help them recover. You can make a change at the beginning of the season, when it's still possible."

Reducing Input Costs

There's plenty of potential for UAVs to help West Coast farmers growing high-value crops gather quality data and reduce input costs through the use of aerial imaging, says Bret Kugelmass, founder and CEO of Airphrame, a precision farming consulting group in Davis, Calif., that uses fixed-wing UAVs made in-house.

Started by former Stanford University roommates Kugelmass, Peter Strohm and William Grossman, Airphrame does the aerial imaging and collects and helps farmers analyze the data so customers don't have to purchase or handle UAVs or learn how to fly them.

The company has worked with farmers who have done trials with variable-rate seeding for vegetables, helping them plant lower-cost seed on poorer soils and better hybrids on higher-performing soils.

"Understanding what seeds go where requires some input from the farmer," Kugelmass says. "But we get high-resolution data points throughout the field that are far better resolution than with a soil-based measuring unit. We can get sub-meter resolution to see gradients of soils."

Doing this work with corn hybrids would take even more input from a farmer, "but we can help them capture where everything is happening on the farm by GPS tagging everything," Kugelmass says. "If you want someone to develop a gradient of soil quality or conditions, then experiment with different hybrids to see how they perform throughout season, there was no way to cost effectively do that before."

Another use for UAVs would be monitoring crop progress before harvest. Kugelmass says a lot of tomato farmers set up contracts with canneries and must meet production goals based on a schedule that isn't based on the optimal use of land itself.

"There's no great way to predict the growth of those plants because weather patterns change so quickly," Kugelmass says. "Now with UAVs, we have a way to track plant growth with a high degree of accuracy and optimize harvest time. What if you could see fields on a map ahead of time before bringing the tractor into the field?"

Finding Pathogens

In the future, UAVs could detect, monitor and forecast the spread of fungus-like organisms like Phytophthora or Fusarium that put crops at risk.

Since 2008, several researchers and students at Virginia Tech University have been deploying UAVs for "aerobiological sampling" at the university's 3,200-acre Kentland Farm near Blacksburg, Va.

Grants from the USDA and National Science Foundation have paid for the work conducted by plant pathology professor David Schmale, researcher Shane Ross, aerospace engineering professor Craig Woolsey and several others at the university.

The fixed-wing UAVs are fitted with spore-sampling devices on their wings that open and close like a clamshell as they trap airborne particles traveling hundreds of feet above the farm.

Using UAVs allows for high-volume sampling, which is important for collecting statistically significant samples of sparsely distributed airborne particles.

Types of sampling surfaces in the plates include grease, sticky tape and filter papers coated with glycerin to collect a varied sample of microbes. Those samples are then inspected in a lab using DNA-based analyses.

Other sensors on the aircraft include an ionic spore sensor and a device with a technology called surface plasmon resonance (SPR) that allows users to detect an agent in real time and identify biological agents while the UAV is flying.

Once identified, the researchers can hypothesize where a sample was flowing from based on the time of year. The university also does back-trajectory analysis to test that hypothesis and looks for seasonal trends in what they're collecting.

"Some of the species are exclusively localized to a certain region or certain crop type, so if you're collecting a tropical species during the winter time in Blacksburg, Va., then you might question, 'Well, it's likely coming from some warmer, tropical region,'" Schmale recently told the Association For Unmanned Vehicles Systems International (AUVSI).

Schmale, Woolsey, and colleagues were initially interested in understanding how Phytophthora infestans, a high-risk plant pathogen that causes late blight of potatoes and tomatoes, is transported through the atmosphere.

Currently, with the NSF funds, Schmale and Ross are tracking Fusarium, which is responsible for some of the world's most devastating plant and animal diseases. Before the UAV research began, there was limited knowledge on the long-distance transport of Fusarium in the lower atmosphere.

"We know that microbes mediate important biochemical processes in the soil, the ocean and a variety of extreme environments," Schmale says. "It isn't so far-fetched that a similar drama unfolds in the atmosphere, which is teeming with microbial life.

"In many of our samples, we've found organisms that have never been cultured before. Some of these microbes may thrive only in the atmosphere, and many of them may be new to science."

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Top Mistakes, And Solutions, When Managing Precision Data

No-tillers can get more out of precision farming if they're savvier about storing and protecting their data and interpreting it, says consultant Tim Norris.

By Jack Zemlicka, Technology Editor

As more farmers gravitate toward collecting and analyzing precision data to make better management decisions, there are numerous pitfalls to watch out for.

Some are more common and correctable than others, says Tim Norris, CEO of Ag Info Tech in Mount Vernon, Ohio.

"Some of these mistakes have been made by me, or even repeated by me," Norris told attendees at the National No-Tillage Conference. "Sometimes it takes making the same mistake more than once before you really learn from it."

Data Overload

When farmers collect grid-sampling information, soil maps, and as-planted, as-applied and yield data, there's a tendency for farmers to get buried by the information, Norris says. No-tillers must know what they want from the information and how to collect it.

"I'll ask customers for their yield information and they'll give me a book," Norris says. "I'll say, 'What about your maps for your fertility and soil testing?' They go and get me another book. Those maps are fine and that information is fine, but it's not in a GIS system where we can really look at the information and analyze it."

Sometimes farmers work with their fertilizer or seed dealer to gather soil-test data and yield maps but don't know what do with it — or worse yet, only get paper copies of the information.

"The farmer doesn't always have the raw data that the maps were made from," Norris says. "They'll take your card, they'll read it for you, they'll clear the card off, and no one knows where the real data or original data went to. So be careful with that."

Farmers should start small with data management and set incremental goals with what they want to accomplish, Norris says. This will allow farmers to pinpoint the easiest solutions first and tackle tougher problems in the future.

Having an independent third party manage the collected data is an easy way to keep track of information, he adds.

"If you don't want to buy a GIS system, hire someone to come in and manage that data for you," he says. "You won't be limited to what you can just see on a map. A lot of times there's meaningful information there, but if you can't drill down and pull that information out, what good is it to you?"

> "That data is your responsibility, so make sure you keep it…"

Stay Involved

If a farmer prefers to work with his or her input dealer to manage data, make sure to keep the raw data and back up the files on a computer drive for later use, Norris says.

Even when working with that "trusted advisor" on data management, farmers need to stay in the loop with the whole process and provide feedback.

Norris took an aerial infrared picture of his farm last June and found two corn rows that didn't have good root growth.

"We couldn't visibly see it, but when you went out and dug the plant up you could see the roots weren't as healthy. The plant just wasn't taking in as much sunlight," he says. "We couldn't really figure it out."

But a closer look at the image, down to the row level, revealed the problem. Norris had just purchased a brand new Case IH Magnum tractor, and he spread fertilizer when it was too wet. This led to increased compaction on the affected rows.

"I wasn't leaving anything more than maybe a cleat mark, but it was showing up everywhere when I pulled up the fertility map for where I spread," he says. "That's where those compaction areas were, where we had problems. It was nice to have the data maps of those lines to identify where we actually drove the fertilizer spreader."

Collect, Protect

While having detailed data to reference is nice, Norris says it's still a challenge to get farmers to collect data at the right time.

"If you harvest a crop and didn't collect that data, you can never go back and collect it again," he says.

Some farmers will delay installing a yield monitor — or worse yet, decide not to spend the money to accurately collect the data, Norris says.

"They don't want to put $1,000 into a GPS unit just to record the data. The yield monitor doesn't do them any good, other than giving them summary information, or on-the-go yield," he says. "If they can't remember anything about certain spots of the field, that data is gone forever."

Once farmers start regularly collecting data, the next step is to protect it. Farmers often simply give their information away and don't preserve the raw data.

"I'll ask a farmer, 'Where's the raw data?' and their answer is, 'I don't know,'" Norris says. "Copy those raw files to a folder on your hard drive. That data is your responsibility, so make sure you keep it and have it for yourself."

Switching Hybrids On The Fly Could Boost Corn Yields

Using available equipment, Beck's researchers are matching corn hybrids and populations to management zones to net higher yields.

By Clair Urbain, Contributing Writer

Researchers at Beck's Hybrids are turning precision farming methods up a notch.

Instead of only adjusting fertility and population on the go using precision-farming methods, researchers at Beck's Practical Farming Research (PFR) farm in central Illinois are switching hybrids on the fly to match changing soil conditions.

First-year research indicates potential for a 20-bushel increase in corn yields and $100 boost in net return per acre with the practice, says Jason Webster, director of the PFR farm.

"Hybrid placement is very important and we've always worked with farmers to pick the right hybrids overall for their farms," Webster says. "We've found a way to more closely match the hybrid being planted to the soil properties. We can show them how to do it."

Offense Vs. Defense

Like a football coach strategizing for a game, Beck researchers are looking at "players" (hybrids) that are best matched to the specific soil characteristics in the field.

They're selecting an offensive hybrid that aims for top yields in field areas with high yield potential, and a defensive hybrid with good emergence characteristics for lighter soils with less water-holding capacity and lower fertility.

"It's really a racehorse vs. a workhorse strategy," Webster says. "Our research this year shows that if you combine variable hybrid selection with a variable seeding rate, you could achieve as much as $100 greater net income per acre."

The researchers obtained their results from two Ford County fields in central Illinois in 2012. Both fields had highly productive Ashkum silty clay loam soil, and other areas with Elliot silt loam with up to 4% slopes and Varna silt loam with up to 6% slopes.

These Elliot and Varna soils have lower fertility and water-holding capacities and lower yield potential, Webster says.

Researchers plotted the field into management zones, based on soil maps and past yield data, and developed a variable-rate prescription that tested the effects of corn hybrid and planting population for each hybrid in different areas of the field.

Generally, high plant populations suffered significant yield losses due to the severe drought conditions, Webster says. In both field studies, the low-productivity zones achieved the highest yields at populations of 28,000 to 30,000 seeds an acre.

As populations increased, yields decreased about 11.23 bushels an acre.

In high-productivity yield zones, the hybrids tested reached economically optimum planting populations at 34,000 seeds an acre, Webster says.

At 36,000 seeds, there was minimal yield loss, but the higher cost of seed resulted in negative net gains.

"In the highly productive soils, the hybrids we tested offered highest yields and returns at the lowest populations," Webster says. "This indicates that planting populations can be easily manipulated by knowing the soils' yield capabilities.

"If a farmer understands management zones within a field, variable-rate seeding is an effective way to increase yield potential, net return and, at the same time, efficiently place the correct amount of seed where it's needed," Webster says.

How To Do It

When Beck's started out on this project, they wanted to use readily available components so it could be adapted easily by farmers.

PHOTOS COURTESY OF BECKS

TWEAKED MACHINE. To get this Kinze 8/16 split-row planter to plant in more of a twin-row fashion, the front and rear row units were offset. Separate hydraulic pumps, controlled by a Precision Planting 20/20 monitor with a RowFlow module, control the seeding and population rate.

> "This isn't just looking at variable planting populations — it's prescribing the right hybrid and population for a specific area in the field..." — Jason Webster

If Beck's couldn't use standard equipment to do it, they didn't feel the research would be very helpful to farmers because they couldn't adopt the system.

"Approximately 20% to 25% of our farmers already have planters that can variable-rate seed, so they can do this," Webster says. "And we'll be further exploring the cost and benefit of increasing and decreasing seed populations in various farm management zones.

The company built its variable-hybrid research planter with a modified a Kinze 8/16 split-row planter. It has eight planter units positioned on the each of the front and back toolbars. Beck's converted the machine to a twin-row configuration so it actually serves as two 30-inch-row planters on the same toolbar.

"We had to have the front toolbar extensively modified so it would carry the front eight units within 8 inches of the row spacing on the rear units," Webster says.

Each row of the units are controlled by a separate hydraulic motor, so Beck's set them up as 2 sections in the Precision Planting 20/20 monitor with RowFlow.

Variable hybrid and population-rate prescriptions were developed and sent to the Precision Planting 20/20 monitor with a RowFlow module.

Typically, Webster and his colleagues set the front eight units to plant the defensive hybrid, and the rear units to plant the offensive hybrid.

"Based on the management zones we've set up, the 20/20 RowFlow system engages the front or back row of units and determines the population planted," he says.

Beck's also set up "educational blocks" within their fields that placed variety and population variables to ensure they would be placed on the same soil types. The variable-rate/hybrid planter was able to establish these educational blocks on the go.

"The educational blocks were developed as a control method to help evaluate if the intended hybrid and population were, in fact, the correct placement or population," Webster says. "The educational blocks evaluated both corn hybrids in each management zone and compared various plant populations within those zones."

Planter-unit placement on the toolbar also helped identify the educational plots, as well as the transitions from one hybrid to another in other areas of the test fields.

"The 8-inch offset makes it easy to see the transitions and caused no problems with the combine at harvest," he says.

No-Till Angle

While the 2012 research was conducted on conventionally tilled, first-year corn and corn-on-corn fields, Webster says the principle could be adapted to no-till systems.

"We'll also be looking at no-tilled soybeans, as well as continued corn plots in 2013," Webster says.

With soybeans, Beck's will be evaluating populations and varieties with various maturities and it's likely they will increase populations on poorer ground and cut back populations on better ground — just the opposite of what was previously tested on corn.

"This isn't just looking at variable planting populations — it's prescribing the right hybrid and population for a specific area in the field," Webster says. "We think that a third hybrid, or some transition in seed population between management zones, may be the way to go.

"With planters that can vary population on the go, it may be best to adjust population in transition areas before switching to the other hybrid. We've started doing this in a small geographic area. But we have lots of work ahead of us."

Multi-Hybrid Technology Takes Shape

The industry's first, patent pending, multi-hybrid planter control system was recently unveiled by Raven Industries. This new multi-hybrid system is an enhancement to its OmniRow advanced planter control solution. When combined with variable rate seeding, it is designed to increase yield potential and profitability.

Raven introduced the technology at its 11th annual Innovation Summit, in Sioux Falls, S.D., in June, 2013. The company developed the system in conjunction with South Dakota State Univ. and the technology allows growers to automatically switch between different hybrids on the go, based on a variable-rate prescription planting map.

"Variability across a field can vary greatly, in terms of fertility, in terms of multiple conditions and rarely is a one-hybrid solution the ultimate answer," says Matt Burkhart, vice president of Raven's Applied Technology division. "Now, farmers have a choice to switch on the fly between different hybrids across the field."

Features of the new system include optimization for interplant and twin-row planter configurations, automatic shifting of tractor or implement guidance line to keep rows in line and integrated liquid and granular product control for each hybrid.

"Variable-rate on corn is part way there, and we feel to variable-rate hybrids and population is that next step," says Doug Prairie, product manager for planting and seeding systems with Raven. "Based on what is available for hardware, we feel the twin-row and interplant toolbar configurations that are in customers' hands today is where we'll focus our efforts. Farmers can assign one hybrid to the primary row and a second to the secondary row unit and manually switch on the fly, but it can also be driven off of the prescription planting map."

Prairie says the goal is to make the system commercially available for spring 2014 planting and the company will explore additional planter configurations to partner with the dual-hyrbid technology. Learn more about the set up and capabilities of Raven's new dual hybrid planting system from a video with Greg Witt, precision application specialist, at *No-Till Farmer.com*

More Info Online

To find out more about Beck's multi-hybrid trials, check out a video with Jason Webster at *No-Till Farmer.com*

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SEED HAWK

Variable-Rate Technology Plants Seeds Of Profitability

Once they commit to the investment, no-tillers often find that managing planting populations on the go can cut seeds costs and maximize yield potential.

By Jack Zemlicka, Technology Editor

THE GLOBAL PUSH to increase crop production and keep pace with population projections underlines the importance for no-tillers to make every seed count.

Estimates predict that by 2050, the world's population will increase by nearly one-third to reach 9.1 billion people, and agricultural demand is projected to grow by 70% to 100% by then, according to the USDA Economic Research Service.

Maximizing growing potential with corn and soybeans will be key, and one way no-tillers could do this is adopting variable-rate seeding, which precisely places the right type and amount of seed in the correct fields. This technology has the potential to not only boost yields but also save input costs.

Modern planters with newer technology lets no-tillers control, by the row, when and how much seed they place in the ground, based on prescription maps. And hydraulic, or newer, electric drives provide for faster and more efficient seeding.

"If you look at what's going to propel yields over the next decade and beyond, more and more farmers will need to hone in on every section of land on a much more granular level than before," says Rhett Schildroth, product manager with Kinze Manufacturing. "Optimizing every acre will require rapid changes in seeding and farmers will need the equipment and the data to create prescriptions."

In the past, seeding at a flat rate worked well for farmers and they were able to harvest a good crop, says Sean Arians, product marketing manager for Precision Planting.

But farmers need to challenge themselves to increase productivity and profitability, he says, and precision technology is allowing them to do so.

PHOTOS COURTESY OF SEED HAWK

PLANTING BY THE SEED. Modern planters equipped with precision technology allow no-tillers to control, in some cases by the row, when and how much corn seed they place in the ground, based on prescription maps.

"We always talk about farming by the seed, rather than by the acre. What that means is being able to put the right seeds in the right place and increasing population on good ground, where the biggest return is going to be," Arians says. "As we increase populations and manage varieties, increased yields will drive home paychecks at the end of the year for farmers."

Profitable Populations

Two years ago, South Dakota no-tiller and strip-tiller Todd Boesen got his first taste of variable-rate seeding when he purchased a new16-row John Deere 1720 planter, equipped with Keeton seed firmers, pneumatic down pressure and variable-rate drive motors for seeding.

With soil types ranging from "gravel to good black dirt" across his 2,000 acres of corn, soybeans and sunflowers, Boesen long struggled with planting the proper seed populations to accommodate the variable soils.

"I felt I was losing corn yield in my better soils because there weren't enough plants there, and I was seeing many double ears," he says. "In turn, I was also losing yield on the poor ground because the plants where too thick and I was getting a smaller ear."

He started down the path to implementing variable-rate seeding on his farm by analyzing 2 years of yield maps collected through John Deere's Apex farm-management software, cross-referencing the data with his soil-test maps. The comparison, combined with his own knowledge of his

fields, gave Boesen a reference point on how different soils performed with a consistent rate of corn seed.

He used 22,500 seeds per acre as a baseline for check strips, then split fields into 4 zones and applied 4 different population rates of corn seed — 16,500, 20,500, 24,500 and 28,500.

"After doing some research, I thought it was best to jump populations between 3,000 and 5,000 seeds per acre, so I chose 4,000," Boesen says. "What was surprising was that after the maps were generated, they showed that I was pretty close to 22,500 as an average seeding rate per acre, so my cost per acre wasn't going to change all that much."

While Boesen didn't spend any less on seed, he did see a higher return population. On his poorer ground, where he planted 16,500 seeds per acre, he saw a yield increase of 10 bushels per acre compared to the test strip.

He lost 3 bushels per acre in his 20,500 population field, but gained 15 bushels per acre in the 24,500 field, and 35 bushels per acre in the 28,500 field, compared to the test strips.

"In the end, my variable-rate seeding gained me an average of 14.75 bushels per acre over a solid seeding rate of 22,500, and with no extra seed cost per acre involved," Boesen says. "It was a very worthwhile project."

Filling The Prescription

Last year, Boesen looked to replicate the results, but the drought took its toll on the corn crop and the test sites were harvested and chopped for silage.

But with the abundance of moisture in 2013, Boesen is more optimistic the results will be more on par with 2011. He's also taken the step of hiring an agronomist to build prescription seeding maps.

Painting a thorough picture of a farmer's field is a critical part of developing an accurate and useful variable-rate seeding program, according to Chris Bettschen, market development manager in Canada for Seed Hawk.

"It would be extremely difficult to get the benefit of variable-rate seeding without the mapping," he says. "Most farmers know where the good and poor areas are on their land. But as they put in longer hours and seed more acres, mistakes can be made. To have automatic changes, you need those prescription maps to be made."

One challenge for farmers to develop a reliable map is knowing what information to include or provide to agronomists.

There are no universal standards for creating variable-rate seeding maps because every farm or field is different, Bettschen says.

It's wise for farmers to identify the most important aspects of their field before they invest in mapping, including topography for water flow, soil pH, organic-matter content and yield data. These criteria provide a good framework for building a useful prescription says Tom Evans, vice president of sales for Great Plains Manufacturing.

Saving Seed

Building an accurate map can lead to seed savings because higher populations will be planted in farm ground that can support it, he says. Prescriptions should rely on yield history, soil type and moisture content so proper populations can be recommended.

"Even if farmers are using slightly less seed, at $350 a bag that's a major savings," Evans says. "Variable-rate seeding can save you seed where you don't need as much and cuts population on thinner ground. That also leads to yields as high or higher than you had before."

This is a benefit Wray, Colo., strip-tiller Jerry Graham is seeing since adding variable-rate seeding technology 3 years ago. Graham is also co-founder of Graham Electric Planters, and his 16-row, twin-row Monosem planter is equipped with Precision Planting's 20/20 SeedSense monitor and RowFlow rate/section controller. The planter is also equipped with Graham's electric planter-drive system.

With sandy soils and variable pH levels throughout his 2,000 acres of irrigated corn, Graham says he'd struggled with productivity — especially on hilltops — and it was difficult to know where to cut population because residue tended to blow around during winter.

"We ran tests for a few years, and on every fourth pass with the planter we'd set a base rate of 34,000 seeds per acre," Graham says. "When we harvested those hills, we didn't see any increase in yields for that extra seed.

"We looked at the yield maps and they were about the same where we cut population, compared to where we left it high. That told me I was wasting seed there."

Graham says he's saved about 5% on seed costs, but it's been more pronounced on hilly acres. Based on grid-sampling results, he cut populations on some hills to 22,000 seeds per acre in 2012, and it was a well-timed move given the drought.

PHOTOS COURTESY OF KINZE MANUFACTURING

ELECTRIC CHARGE. An emerging alternative to hydraulic planter drives are electric-drive systems which replace chains, sprockets and clutches, meaning less maintenance and the ability to change rates at higher speeds.

"Even under irrigation, those plants were too stressed and it was a lot easier to keep fewer plants alive with water and residue during a rough summer, than had we planted a higher population," he says. "We all want to go for that bumper crop every year, but in some cases you have to plan for the worst, Variable-rate seeding can help you do that."

"It would be difficult to get the benefit of variable-rate seeding without the right mapping..." — Chris Bettschen

Electric Enhancement

One recent innovation that could help variable-rate seeding systems perform better is electric planter drives, which are gaining popularity in North America as a more efficient alternative to hydraulic motor drives.

Graham Electric Planters is one of several manufacturers that have developed or enhanced electric-drive systems as a simpler and faster way to precisely place seed.

"The electric drive is easier, because it replaces all the chains, sprockets and clutches which can wear out and need replacing, so there's a maintenance savings there," he says.

While hydraulic planter drives allow farmers to adjust seeding rates, electric drives are even more precise, says Arians. Precision Planting recently launched its vDrive electric drive system that works in conjunction with the manufacturer's vSet seed meters and 20/20 SeedSense monitor system on planters.

"When you have a zone 100 feet by 100 feet or smaller, you've got to be able to change and adapt quickly. Hydraulic motors allow for that, but electric drives allow one row overlapping into another zone to plant the correct population," Arians says.

Spacing Is Crucial

Proper seed spacing is also an important factor to achieve optimal corn yields, especially on variable soils and contours, says Schildroth.

On large contours, seed spacing can vary by up to 15%.

In 2013, Kinze launched its new 4900 planter, which is available with electric drive and a seed metering system that offers nearly 99% planting accuracy at speeds of 2 to 8 mph.

"When spacing is off, seeds can get so close to each other that they see each other as weeds," Schildroth says. "With electric drive, farmers can slow down on inside rows and contours and have the same seed spacing as if driving in a straight line."

Emerging Technology

For many growers, variable-rate seeding sounds like a great idea, but it's still just that — an idea — in part, because of the financial and agronomic investment needed to implement the technology.

Schildroth estimates only about 10% of corn and soybean farmers have adopted variable-rate seeding. Farmers need to have a planter equipped with the technology, and also need a prescription map to realize the full potential of variable-rate seeding programs.

"There is still a gap in interest and implementation in the field. But we're seeing companies start to fill the void of creating maps and that's going to help adoption immensely," Schildroth says. "But if you have a ground-drive planter, it's going to be difficult — and probably not feasible — to do variable-rate because you'll have to manually change gearing every time you want to change the application rate."

It's going to take time and education of farmers to embrace variable-rate seeding, but Bettschen sees a bright future for the technology. In 3 to 5 years, he expects that more planters will be manufactured "variable-rate capable."

Whether farmers utilize the system remains to be seen, but the option will likely be more available for those that do.

"Even if guys aren't sure they want to variable-rate themselves, or do it right at the time of purchase, they'll probably make the investment," Bettschen says, "because in 10 years it's going to be extremely common."

Farmers Testing Monsanto's FieldScripts Program

Indiana no-tiller Don Thurston is a relative newcomer to variable-rate seeding, but he has a clear idea of what he'd eventually like to accomplish with the technology.

Thurston and more than 100 other farmers are participating in Monsanto's Integrated Farming Systems (IFS) on-farm research program, known as FieldScripts. Launched this planting season, the program integrates Monsanto's hybrid performance data with participant's yield data to identify the most productive hybrids and a useful variable-rate prescription for each field.

"I'm excited to get an early peak at yield response, because I think having this information will allow us to make decisions on which hybrids to order earlier," Thurston says. "Right now, when a new hybrid is released and farmers have to evaluate how fits into their operation, it might be 3 years before we know if it's a good fit — and that's if the farmer is good at crunching data."

The opportunity to do side-by-side trials and multiple populations to determine optimum rate for each soil type was attractive to Thurston, who set up 400-acre test plots on 6 fields with varying soil types and organic-matter content.

"We go from depressional soil with up to 4% organic matter and run across a clay knob with organic matter of 1.2% within 400 feet of each other," he says. "We've got fields that may have 7 different soil types in them."

Monsanto uploaded the FieldScripts prescription via a cellular data connection to an iPad in Thurston's 16-row Kinze 3600 planter, equipped with Precision Planting's 20/20 SeedSense monitor, FieldView app and RowFlow system.

He used three different hybrids and also did test strips with static rates to compare the yield results in fall with the IFS field. Even though it's only going to be 1 year's worth of data, Thurston is hoping to able to use the information to make more accurate planting decisions going forward.

"Hopefully, in doing this we'll be seeing what factors are affecting yield and not have everything thrown in one bucket," he says.

ISOBUS Could Trim Costs, Boost No-Tilling Efficiency

Manufacturers and early adopters are tweaking technology that lets farmers pair different brands of equipment and reduce the clutter in the tractor cab.

By Jack Zemlicka, Technology Editor

The rising cost of fertilizer, seed and equipment is a reality that many farmers face in today's ag market.

One solution farmers are beginning to examine is ISOBUS technology that lets them pair different brands of tractors and farm equipment together that weren't previously compatible.

Some farmers are already using this technology to offset input costs, as well as increase productivity and improve purchasing flexibility.

"As input costs have exploded, the cost of putting an acre of corn in the ground has also exploded," says Ryan Christopherson, who reduce-tills continuous corn and soybeans in Clarkfield, Minn. "Through precision farming and ISO technology, I've been able to regulate my costs and pick and choose components."

Finding The Benefits

The concept of ISO — which stands for International Standards Organization — is very much a work in progress. BUS is a generic term to describe the connection between electronic components. But in it's simplest form, the concept allows farmers who are using precision technology to connect any brand of tractor with any implement without losing functionality and performance.

Farmers wouldn't have to switch monitors, displays, wiring harnesses or electrical connectors when they move from one implement to another, regardless of brand.

One of the primary benefits for Christopherson — who adopted precision-farming practices in 2004 — is the freedom of running his Challenger 800 series tractors with his John Deere planter using an ISO connection.

He uses his Deere ISOBUS display in his tractor with the Deere planter and also runs an Ultra Guidance PSR auto-guidance system from Reichhardt Electronics to run steering for his Challenger tractor thru the Deere display.

The Reichhardt display allows him to eliminate the cost of an additional monitor to run auto-steer on his tractors.

"I didn't want to have to keep buying expensive displays," Christopherson says. "Instead of spending $5,000 for a new auto-steer display in each of my five tractors, I use one for all of them through the ISO connection. It's a huge cost savings."

The hook-up is essentially a "plug-and-play" connection into the back of the tractor to get the same auto-steer capability as if he were running the same brand of tractor and implement together.

He's also upgrading his AGCO TerraGator spreader control from a DICKEY-john Falcon controller to a Raven Viper II system for shape file variable-rate fertilizer application.

The switch is allowing Christopherson to save money through the increasing standardization of wiring and voltages that ISO components are running on. Farmers are able to update a piece of machinery to newer electronic controls without having to replace hardware like hydraulic valves, hydraulic motors or encoders.

"I only purchased the cables and controller for about $12,000 and all components on the machine are compatible," Christopherson says. "Before ISO standardized all machine-control components, we would have traded in the spreader and spent $80,000 on a new one."

MORE ACCURATE. Canadian no-tiller Dennis Connor began experimenting with ISOBUS technology 6 years ago and now runs his John Deere 9630 tractor with his Bourgault air cart and air seeder. ISOBUS has given Connor flexibility to combine machinery that suits his farm, which has improved planting accuracy and, "put a few more bushels in the bin."

Beyond eliminating the expense of unnecessary equipment, Christopherson is saving money in the field, as well through ISO. On his 48-row planter, he variable-rate applies 10-34-0 liquid fertilizer through a CDS-John Blue pump, coupled with a Precision Planting hydraulic motor and three Raven ISOBUS product-control nodes to regulate application.

The system is run through his John Deere rate controller, which Christopherson connected through the ISO port on his planter.

"The data shows up on my Deere monitor in the tractor cab, and the system basically turns the planter into a variable-rate, swath-control sprayer," he says. "If I had to buy the fertilizer, plus all the wiring harnesses and monitors, it would be $10,000 to $12,000."

Instead, Christopherson says he spends about $3,000 for variable-rate application of 10-34-0 on his farm.

"At $60 an acre to apply, it doesn't make sense to put 10-34-0 where I already have high phosphorus levels," he says. "I'm able to variable-rate apply and save money due to ISO technology."

But Christopherson's success with ISO didn't happen overnight.

He's been tinkering with the technology for 7 years.

Guarding Expectations

Christopherson and many others admit that ISOBUS is far from perfect and hasn't gained the same traction with North American farmers as it has in Europe, where ISO originated.

ISOBUS is still a buzzword here, since the ISO 11783 standard was introduced in tractors and implements in 2001, says Djamel Khali, vice president of operations for Ally Precision Industries (API) in Sioux Falls, S.D.

API is one of several third-party manufacturers that produce ISO components designed to connect different colors of farm equipment. Khali notes that not every North American farm-equipment manufacturer is on the same page when it comes to ISO.

Historically, if farmers had an ISO-certified tractor from the factory and an ISO-certified implement — but they weren't the same color — certain features would be locked out because of compatibility issues.

"If we're going back to the core goal of ISO — to be color agnostic — we need to make sure farmers are getting what they expect," he says. "Farmers might be losing row-shutoff or variable-rate planting capabilities. That's where a lot of the frustration comes from today."

The last thing a farmer wants is a false assurance that ISO is the answer to all their compatibility problems because the term often means something different to each customer, notes Doug Prairie, product manager for planter, seeder and harvest controls for Raven Industries.

The challenge for manufacturers is to provide a level of ISO integration that truly allows customers to be able to get the most out of their technology.

> "Farmers want a one-stop shop. They don't want something to have to be added on…" — Trevor Mecham

Some run proprietary software, which creates confusion about the compatibility ISO offers to farmers. This can muddy confidence in the technology.

"There is some electronic finger pointing that goes on in some cases," Prairie says. "The tractor says the implement is to blame and the implement says the tractor is to blame, and then the customer is caught in between."

The end result for some farmers is utilizing only a portion of their precision functions through their ISO connection or being forced to add an extra monitor.

Fixing The Bugs

Ideally, ISO compatibility is supposed to decrease clutter in a farmer's tractor cab and minimize the need for additional terminals to run a variety of precision-farming functions.

But that isn't necessarily the case. Canadian no-tiller Dennis Connor began experimenting with ISO 6 years ago when he ran GPS on his Versatile tractor with his John Deere 1900 series air cart through a Satlock receiver, which had a light bar in the cab for auto-steer.

Connor grows durum wheat, lentils, chickpeas and canola on 7,500 acres in Beechy, Saskatchewan, Canada. He used an early-model John Deere Brown Box terminal in the tractor with his Deere 1900 air cart to variable-rate plant his durum seed and canola.

Connor later switched to a larger John Deere tractor and invested in a Bourgault air cart and air seeder, but he needed separate displays to monitor planting and track auto-steer.

His John Deere monitor ran auto-steer, but Connor ended up spending $20,000 on a Topcon display to effectively implement his variable-rate program.

"It was a little frustrating, but it's something I just have to accept for now," he says of the expense. "I know there's lesser-involved monitors that cost probably a quarter of the price that will variable rate for you, but you can't see it."

Still, Connor says doubling up on monitors in his tractor isn't a major inconvenience He'd rather spend money on the right technology to maximize ISOBUS capability and avoid limiting his farm equipment selection.

Although he doesn't consider himself an expert on the ISO concept, Connor knows enough to understand the value it provides in terms of purchasing flexibility and efficiency in the field.

"The benefit of owning two different colors is that I have a good tractor and an air seeder that really fits my fields," he says. "Because of that accuracy, it probably puts a few more bushels in the bin."

When maneuvering down a ravine or washout, Connor says, the Bourgault air seeder maintains his desired seed depth, which translates to more consistent emergence based on his planting prescription.

"It builds confidence as to what my agronomist is going to get me," he says. "What they prescribe could make me money or lose money, so it's important that I have equipment that works together."

Khali agrees that the flexibility ISO provides can be a significant money-saver. He recently installed an API ISOLynx system on a customer's Versatile tractor to run his Deere planter.

"We put the whole system on there for

under $15,000," Khali says. "He saved the $30,000 of having to buy a John Deere tractor to run the planter, and he could run it the same way with the tractor he already owned."

Farm-equipment manufacturers also recognize the need to offer broader equipment compatibility for farmers.

While there is an incentive for companies that produce both tractors and implements to have their brand of machinery running together on a farm, in conjunction with their precision-technology platform, they acknowledge the value of ISO.

The Agricultural Industry Electronics Foundation (AEF), an independent international organization, is working with manufacturers to answer some of those questions. John Deere, Case IH and Agco are three of more than 50 companies working with AEF to test and certify ISO components with the goal of creating a standardized platform.

More than ever, there's a push by manufacturers to create a uniform ISO standard that will further simplify compatibility for farmers.

"Farmers want a one-stop shop," says Trevor Mecham, marketing manager for advanced farming systems for Case IH. "They don't want something to have to be added on. The technology needs to be built in and integrated.

"So if the farmer wants to make a change with his or her planter or tractor, they have the capability to run what they want together."

> "Instead of spending $5,000 for a new auto-steer display in each of my five tractors, I use one for all of them…"
> — Ryan Christopherson

Playing Catch-Up

Although the ISO standard was introduced in North America more than decade ago, it's real value is only just starting to be realized by farmers. Part of the problem is a lack of knowledge by farmers about how ISO compatibility can change their farm operations.

"It's not something I knew much about, beyond the idea that one color of tractor could electronically talk with another color of implement," Connor says. After investing in precision technology, with guidance from his equipment dealership, Connor took the initiative to try ISO.

But it took a leap of faith, since he wasn't sure how effective it would be.

"I'm not heavily into technology, but I had to do it because I wanted to variable-rate seed and I needed to see the mounting while I'm seeding," he says. "Basically, I just had to trust the system and have confidence in my dealership to make it work. And it did."

ISO education is still an ongoing process for farmers, but more are starting to realize the practice's capabilities.

Saskatoon, Saskatchewan-based Agtron Enterprises offers ISOBUS upgrades for Bourgault 5000 and 6000 series air carts to simplify the hook-up

International Group Works Toward ISOBUS Adoption

The concept of ISOBUS is still relatively new to the North American farming sector, and its origins are based on farmer preferences to use one brand of tractor with another brand of implement.

The ISO 11783 standard — agreed on by ag-equipment manufacturers throughout the world — is designed to simplify electronic communication between different brands of farm machinery. The ultimate goal is to provide "plug-and-play" compatibility through the use of one ISOBUS terminal.

One challenge in ISOBUS adoption is the lack of a comprehensive certification process for ISO components.

The Agricultural Industry Electronics Association (AEF), an independent group formed in 2008, is working towards a solution by developing a list of ISO-certified products, through extensive testing, says AEF secretary Ken Edwards.

"These conformance tests are going to determine the industry standard globally," he says.

The independent conformance tests are being performed on tractors, implements and other ISO components, like virtual terminals and control units, to determine if they meet the ISO standard.

"If the product passes the conformance tests — which AEF has been working on for the last 4 years — it gets a certificate," Edwards says. "Then it's entered into the database that can be accessed by dealers to determine if a product is ISO-certified."

The database — which is actively being populated by products — provides a reference guide to ISO-compliant components and will help reduce confusion about compatibility, Edwards says.

"If a customer calls their dealer and is having trouble running their Deere tractor with a Case IH planter, the dealer can run the serial numbers in the database to check their ISO compatibility," Edwards says. "You can tell right away from troubleshooting what the problem is."

The goal is less down time for farmers because dealers will be able to identify compatibility problems sooner.

Another benefit of the database is that it will give farmers better information about ISO-capabilities at the point of purchase.

"If the farmer is buying a new planter, they might want to select something that is compatible with his tractor," Edwards says. "Today, it's a bit of a lottery, and they may not get the efficiency out of the implement because it's not completely compatible with the tractor."

Conformance testing is only the first stage of improving compatibility between farm components, Edwards notes. AEF has six other groups working on different elements of ISO.

Those include:

- **Functional Safety of Electronic Controls:** Designing and applying safety-related application guidelines for all manufacturers of ag equipment according to ISO 11783.
- **Engineering and Implementation:** Coordinating the market introduction of new ISO features across the ag industry, along with monitoring of ISO engineering and implementation processes.
- **Service and Diagnostics:** Servicing combined ISOBUS systems from different OEMs with tangible results to include quick and efficient troubleshooting.
- **Sequence Control:** Defining the sequence-control system with items that blends tractor and implement functions into 1 system.
- **Marketing and Communication:** Assuming marketing responsibility for ISOBUS technology both in the ag-equipment industry and the general farming community.
- **High Voltage:** Working out a proposition for the standardization of an interface on the tractor providing external implements or components with electric power.

and compatibility for farmers. Bill Baker, Agtron's president, says the adoption of precision-farming practices is fueling interest in ISO as farmers gain an understanding of technology.

"Farmers tell me all the time that they spend a day each spring putting all the monitors in the cab and mounting and running harnesses in and out," Baker says. "ISO lessens that learning curve because they know that same tractor terminal will be in there 365 days a year."

If a farmer has a new data set, rather than having to rewire a new monitor, he can plug into a baler, seeder or sprayer through the ISO connection and pull up the information. Christopherson recalls his early time-consuming experiences trying to connect monitors to machines.

"To get things to talk, we had to work endless hours down to the point of looking at individual wires on individual wiring harnesses," he says. "All it took was one crossed wire and nothing worked.

"When there is a bundle of 35 wires, there is potential for trouble."

Farmers today don't have time to diagnose faulty connections, which is pushing manufacturers to develop better ISO solutions for the future and compensate for compatibility shortcomings of the past.

"In the past I think ISO has been advertised for more than it was," says Rhett Schildroth, product manager for Kinze Manufacturing. "The North American industry is now catching up with the original intent of ISO."

> "ISO lessens the learning curve for farmers because they know the same tractor terminal will be in there 365 days a year…"
> — Bill Baker

ISO Equipment Emerges

In 2012, Kinze announced production of its ISOBUS line of planters. A component of its ISO system is a single monitor in the tractor cab.

One industry goal, Schildroth says, is to broaden the availability of automatic controls, where a farmer wouldn't have to manually input seed-rate changes or import prescription maps.

Currently, only a handful of tractors and implements support automatic control through ISO.

Kinze's new line of ISOBUS planters will support the automated-control function, which means farmers can automatically view their prescription maps on the go and change their seeds rates without having to touch a button.

"I still think we're 1 to 2 years out from that advanced functionality of working with any brand or make of tractor or implement," Schildroth says. "But manufacturers are working to get it there."

Case IH recently introduced its ISO Task Controller system, that lets farmers plug into the ISO connector, and the task controller logs the work that's been done.

Beyond improving the electronic conversation between different brands of machinery, farmers also envision a day when ISO functions can integrate with mobile devices like iPads or smart phones.

Christopherson acknowledges that getting to the point of only needing one monitor in the tractor cab would be a significant achievement, but he sees more potential for ISO.

"Even on a 6-by-9-inch display, there's no way to see everything you need to see," he says. "I talked to my tractor manufacturers about having my iPad plug into the system and being able to select different displays. That would be useful."

But for now, Christopherson is satisfied with the return he's gotten from ISO on his farm.

The fact that the technology helps manage input costs and allows Christopherson to eliminate paying for unnecessary precision equipment is letting him run a more efficient operation.

"The capability of ISO drives us to collect more information we can turn around and use to refine our farm management," he says. "In the age of increasing crop input costs, we're able to do use variable-rate technology, and ISO is allowing us to do that in a productive way."

PHOTO COURTESY OF KINZE MANUFACTURING

FINDING ANSWERS. Manufacturers like Kinze are working to simplify ISOBUS capabilities for farmers by improving "plug-and-play" capabilities. Ideally, farmers won't have to change monitors, displays, wiring harnesses or electrical connectors to run one brand of tractor with another brand of implement.

Precision Data Sharing 'Crosses The Line'

Consultants are working with no-tillers, strip-tillers to pool and share precision data to improve decision making and boost farm profits.

By Jack Zemlicka, Technology Editor

Farmers have always trusted the advice of their peers when it comes to adapting their planting, fertility and harvesting methods.

But as they use precision technology to review yield-monitor data and make management decisions, the information is rarely shared beyond farm borders.

When it does happen, it's often limited to coffee-shop conversations and only a few farmers may hear an insight that applies to their own fields.

"There's been a lot of success with using precision data to become more efficient on your own farm," says Crop IMS technology specialist Jeremy Wilson, who no-tills corn, wheat and soybeans on 1,200 acres in southern Illinois with his father, Wade. "But getting farmers to share those data sets has been a real struggle because they all want to know, 'What will other people see?'"

But through new farm-management strategies, farmers are slowly opening their eyes to the benefits of pooling precision data to make better decisions.

Small-Scale Results

The concept of "community data sharing" is new and the quantifiable results, on a large scale, are a work in progress. But Wilson is seeing the value as both a farmer and as a data-management consultant.

A few years ago, he coordinated a multi-farm trial to track corn hybrid performance. The results ended up helping him improve yields on his family's farm.

Wilson's first step was taking several years of yield data and identifying a common problem both he and other local farmers with similar soil types were encountering.

"We found, in a couple of instances, that we had some growers who were really struggling with specific hybrids on soil types," Wilson says. "So we took that data, separated it out and looked deeper into it."

After analyzing the data, the only difference Wilson found was a tillage pass.

Based on that finding, he and his father set up test plots on six different types of soil to test a variety of hybrids on four different farms.

Wilson ran a no-till ripper and put strip trials across the fields. And then any time a tractor went through the field, he collected the data through a handheld device and streamed the GPS data to keep a record.

"At the end of the day, I determined that we had three particular soil types on my father's farm that responded very well

to this no-till ripper," Wilson explains. "So we went out the next fall and only ripped that soil type with the no-till ripper."

The result was about a 15-bushel-per-acre increase for the Wilsons the following year, and measurable improvements for most neighbors that took part in the data sharing experiment.

Being able to find a solution through data comparison with other farms, albeit on a limited scale, saved the Wilsons from wasting money planting the same way on areas where they had seen gradually decreasing yields and soil stratification. Data sharing also prevented them from taking drastic measures to fix the problem.

"That's where the value in compiling these huge data sets is," Wilson says. "Then you can go out and do some trials like that and it doesn't require a farmer to completely change his operation. At the end of the day we bring it all back together and say, 'What did we learn?' so that my father doesn't go and throw away 20 years of no-till by disking to mix the soil."

What Really Works?

At this point, widespread community data sharing is still in the experimental phase, but reception to the concept seems to be increasing.

CrescoAg LLC, a precision-farming, data-management company in Memphis, Tenn., recently launched a survey program in conjunction with Mississippi-based Jimmy Sanders Inc., to collect, analyze and aggregate precision data from about 150 farms in Mississippi, Louisiana, Arkansas, Tennessee and Kentucky.

The volunteer program is designed to be a comprehensive database of 2012 yield-monitor data to include planting dates, tillage types, row spacing, plant populations, hybrid variation identification, fertilizer rates, seed treatments and anything else done to crops in the field.

The goal of the pilot project is two-fold, says Chism Craig, vice president of research and development with CrescoAg.

"We want to show farmers the value of community analysis and how to be more profitable by sharing data," he says. "But we also want to show farmers that you can trust a third party with your data, which is why we want their feedback during this process."

Many of the farmers who agreed to participate in the survey have worked with CrescoAg in some capacity, Craig says, and all have experience with precision technology and data collection.

"We wanted innovative, tech-savvy farmers who are thirsty for knowledge," Craig says. "Some of the people we chose were 'bell cows,' or farmers that are looked up to in terms of technology."

> "At some point, you've got to stop throwing everything and the kitchen sink at these fields and go where you can make the most money…"
>
> — Eugene Pugh

Parameters to participate in the survey included a minimum of 1,000 acres and a diverse crop rotation that includes corn, soybeans, cotton, rice or wheat.

About half the farms participating in CrescoAg's program follow no-till practices to some extent, Craig says, and 90% of the growers engage in some sort of conservation-tillage practice.

That includes Eugene Pugh Jr., who farms about 10,000 acres near Hall, Tenn., — half of which he no-tills corn and soybeans. About 4,200 acres are dedicated to cotton, and Pugh uses a stale seedbed where he works up the ground after the fall harvest then leaves it until spring.

For the last decade, Pugh has invested in precision-farming technology. He has yield monitors on all his combines and cotton pickers and also variable-rates fertilizer application — mainly lime — and does frequent soil sampling.

The accumulation and analysis of his own precision data throughout the years, and limited sharing with neighbors, has given Pugh a good read on how his investments are paying off on his farm. But now he's ready to take the next step in data analysis, which is what prompted his participation in CrescoAg's program.

"Most farmers really do want to work with each other, especially with what precision technology can do now," Pugh says. "But so much of it right now comes from word of mouth and you just aren't sure what's true.

"I'm really interested in being able to get good, hard facts on what works for other people and what doesn't."

For several years, Pugh has planted test plots of several varieties of corn, soybean and cotton hybrids and then collected the yield data after harvest.

In some cases, he works with his input supplier, Jimmy Sanders Inc., on testing, but often Pugh will plant his own plots and analyze the data.

Though he casually shares some of his conclusions with friends, he would like to share his knowledge more broadly and, in turn, tap into what other growers are experiencing under similar conditions.

"We just got done harvesting cotton and I know all my neighbors are going to want to know how those test plots did," Pugh says. "I think that's where having my data combined with others is going to really benefit us growers, to be able to make better decisions down the road."

Overcoming Skepticism

While Pugh is eager to expand his network of precision-technology partners, he acknowledges that not all farmers are as willing to share their knowledge, even on a small scale.

"Some farmers don't share information because they don't think it will help them," he says. "They see it as their business and don't want anyone else to know their yield or what they make."

Wilson has run into the same roadblocks. "There's this giant tree that just stands in the way of farmers seeing the forest," he says. "They think, 'You know what, Jane and Joe don't need to see what Tom did.'"

Concerns are often security-based, with farmers questioning who would have access or ownership of their precision data and how it would be used.

Co-ops and fertilizer suppliers would benefit from pooled yield data as a way

“At the end of the day, we bring everything together and say, ‘What did we learn?’ so my father doesn’t throw away 20 years of no-till by discing to mix the soil…” — Jeremy Wilson

to promote products, notes Djamel Khali, vice president of North American operations for Ally Precision Industries, a precision-farming integration company based in Henderson, Nev.

Those partnerships may form in the future, Khali says, but for now, farmers are hesitant to fully share data with distributors until they understand the benefits.

“The goal of data sharing is to empower farmers so they can make the best decisions for their operations,” he says. “They don’t want someone smooth-talking them about the best seed or fertilizer if the data doesn’t back them up.”

In the future, Khali envisions community data being used by farmers to not only improve efficiency on their farms, but also as a competitive shopping tool.

As the volume of shared data increases, farmers may be able to use the results to make more informed purchasing decisions for seed or fertilizer.

“One of the big benefits will be farmers won’t have to guess as much to figure out which is the best product for them,” Khali says. “Once there is some historical data, they will have some proof whether one brand is better than another.”

Pugh shares that vision and says he wants to use pooled precision data as a financial tool to manage input costs.

While he doesn’t shy away from testing new hybrids or fertilizer blends, Pugh says there’s a limit to what he can learn on his own farm.

Being able to tap into data from other growers could refine his practices.

“At some point, you’ve got to stop throwing everything and the kitchen sink at these fields and go where you can make the most money,” he says. “I think this community data can really help regulate input costs.”

But to reach that point, farmers must be convinced that sharing their data is going to be worthwhile and secure.

Owning The Data

In its survey program, CrescoAg is attempting to minimize farmer concerns about the safety of their precision data. Any data aggregated by CrescoAg as a result of the survey is firewall protected online and wouldn’t contain identifying information about individual farmers or their operations.

As part of its agreement with farmers, CrescoAg will only have a license to the data, not complete ownership.

“The farmers will still have control over their data and can request to have their information removed from the system at any time,” Craig says. “We’re contractually bound to do that. When farmers signed the consent form, we wanted them to know we weren’t going to violate their trust.”

Another key component in attracting farmers to the survey is its independence. As Craig says, CrescoAg isn’t selling seed, fertilizer or chemicals, so they have no direct interest in which brands perform best in the pilot.

“It doesn’t matter to us who wins,” Craig says. “That’s not our business.”

Participation in the program is “100% volunteer,” Craig says, and farmers aren’t paying CrescoAg or being paid by the company for their precision data.

That will likely change in the future, depending on the value of the results.

“We didn’t want to come out of the gate with big premium rates for growers because this is a pilot project,” he says. “But I think eventually, there will be a sort of subscription service.”

However, that cost versus the value is still expected to be minimal, Craig explains, to incentivize farmers to take part in the community data program. Ideally, farmers around the world could subscribe to categorized data.

Pugh says he had no reservations about participating in the survey study, and considers himself a “precision guinea pig.” But if he’s someday forced to pay for accessing community precision data, everyone participating needs to have the same objective, he adds.

“It’s got to be a give and take, because I do wonder about the cost,” Pugh says. “You can’t just have someone look at the data and not share what they’re doing.”

Proving Value

Spotty participation is another factor that could hurt the believability of the data and decrease the value for farmers. Without a comprehensive pool to draw from, growers simply won’t see any point to sharing data, Craig says.

The No. 1 question he gets from farmers is what they’ll get in return if they share data. The answer — on a large scale — remains to be seen.

CrescoAg’s project is designed to answer that question, to provide a broader view of problems farmers are facing in the field, and give growers like Pugh better intelligence to solve those problems.

But return on investment will hinge on participants contributing as much information as they receive. The results of CrescoAg’s effort could provide a starting point for an expanded program in the future

“Farmers will need to have skin in the game to make this work,” Craig says. “If they are not inputting any data, it’s not going to be worth it for them or fair to others who are going through the trouble of sharing data.”

Wilson says the next step is expanding the network and showing more farmers how data sharing can work for them. While challenges of trust and reliability still exist, Wilson is working toward proving his only motive is making farmers more successful.

“If we raise the tide just by 2 bushels per acre, at corn prices today, what did we bring?” he says. “Even incremental change can mean a lot.”

A Permanent And Profitable Pathway For No-Till

Reduced compaction and higher yields await no-tillers who overcome equipment and technology challenges to adopt controlled-traffic systems.

By Jack Zemlicka, Technology Editor

Five years ago, Canadian no-tiller Craig Shaw had never heard of controlled-traffic farming. But today, he's making a long-term commitment to the system.

After attending a presentation by a group of visiting farmers from Australia — where controlled traffic thrives in adverse growing conditions — Shaw saw promise in the system to boost yields, minimize soil compaction and improve water infiltration across his 2,500 acres of canola and barley at Durango Farms in Lacombe, Alberta.

"What really got my attention with controlled traffic was how it can help farmers pull a good crop in extreme conditions," he says. "We've got some pretty diverse soil conditions and have had some wet springs. My hope is that controlled traffic can build a better soil environment for plants to grow."

PHOTOS COURTESY OF CTF EUROPE

LINING UP. Reducing compaction and increasing farmable acres are the primary benefits of controlled-traffic farming. Research shows that compaction leads to a 5% to 10% yield loss in most soils. Controlled traffic can reduce yield loss to 2% and gradually boost yields by 10% to 15%.

Tangible Benefits

Controlled-traffic farming is basically a system in which farmers standardize equipment widths and tire spacings to establish permanent driving lanes in the field and increase farmable acres.

Understanding the system and its potential are keys to successfully implementing it, says Phil Needham owner of Needham Ag Technologies in Owensboro, Ky., who has consulted on and written about controlled-traffic farming systems around the world.

"Controlled traffic is driven most by areas really struggling from a profitability standpoint, because margins in agriculture are getting so tight," Needham says. "If you can make another 10 to 20 bushels per acre, that can double or triple your profits."

Australia, parts of Europe and western Canada are areas where controlled traffic has been most popular because excessively wet or dry climates and variable soils tend to limit yields. Increasing the percentage of farmable land and reducing compaction zones are the primary benefits of controlled-traffic systems, Needham says.

Some of the more tangible research results on controlled traffic have shown moderate yield improvements, along with a significant decrease in fuel consumption.

"An incremental increase in the bottom line is driving research suggests a 10% to 15% yield response from random traffic to controlled traffic, because you're managing wheel compaction running up and down the same path rather than random running," Needham says.

Group Approach

In the rolling parkland region area of Alberta, Shaw and neighboring farmers deal with variable precipitation year-to-year, and soil types ranging from "pure sand" to heavy clay.

Moving to no-till 12 years ago helped manage some of the variability, but Shaw was looking for a way to further improve his operation.

He and four other farmers in Alberta are participating in a 3-year, controlled-traffic pilot project, — Controlled Traffic Farming Alberta (CTFA) — to evaluate the short-term impacts of the system, increase awareness and promote adoption.

Shaw started with farming 160 acres in the project, half set up in controlled traffic, and the other 80 acres using conventional farming methods. He expanded the second year and heading into 2013, has 80% of his farm in controlled traffic.

"So far, we've seen some firming of our traffic lanes and better traction capacity because we're running on harder ground vs. what we normally had done running randomly," he says. "Our goal is to put ourselves in a position where we can manage risk better, and we're on the right path."

Proven Payback

Participants in the CTFA initiative are already starting to see similar yield bumps to what Needham reports, according to CTFA Project Manager Peter Gamache. Yield analysis of controlled-traffic fields — broken out into 80-acre or larger plots compared to equally sized "check" plots — are showing 10% yield increases in barley in some areas.

"It's not enormous, but it is a bump," Gamache says. "Another analysis we're doing is with water infiltration, in terms of how long it takes 'X' number inches of water to infiltrate into the soil. What we've seen so far is improvements and more consistency, which is what we hoped for."

Soil permeability is enhanced by the fact that equipment is running on a smaller percentage of acres in a controlled-traffic system. Fewer compacted acres means the soil can absorb water at a faster rate and ultimately lead to a better crop.

Research done by the Ohio State University Extension shows that compaction leads to a 5% to 10% yield loss in most soils. In a controlled-traffic system, farmers are able to turn those previously compacted zones into profitable areas, notes Randall Reeder, retired agricultural engineer with the Ohio State Extension.

"If you have a 7% yield loss from compaction caused by typical machinery used on a particular soil type, switching to controlled traffic should reduce yield loss to 2% to 3%," Reeder says. "There's no reason to claim all compaction losses would be eliminated, but there's going to be substantial improvement."

No-Till Benefits

Controlled traffic can be even more valuable in no-till, Reeder explains.

With the size and weight of equipment today, compaction tends to go deeper than typical tillage depth. No-tillers are able to avoid that challenge when transitioning to a controlled-traffic system.

"One reason farmers give for tillage is they need to eliminate compaction from trafficked areas from the previous year," he says. "For farmers going into no-till, controlled traffic eliminates that concern because all of their tracks will be in the same place. If they have a good system, those tracks will exist year after year."

Ohio no-tiller Bill Richards is considered one of the North American pioneers of controlled traffic, having transitioned into the system more than 30 years ago.

Consistent lanes for their tractor, sprayer, planter and anhydrous-ammonia rig means only about 25% of the family's farm is driven on across 2,700 acres of corn and soybeans, compared to about 75% in more conventional farming operations.

A major benefits for the Richards family is the ability to plant earlier than most farmers because water infiltrates into the ground faster than on compacted ground.

"We had all our corn planted by May 6 and it was knee-high by mid-June," Richards says. "Having those compacted tracks is a real advantage because we can come in here after a big rain and the only water we see in the field ever is in those tracks. That tells us a lot about the water infiltration advantage we're picking up."

Tim Chamen, director of Controlled Traffic Farming Europe, an international organization based in Bedfordshire, England, says no-till can be a natural partner for the system. The international organization focuses on promoting and researching controlled traffic.

Northern European soils are predominantly "clay, cold and plasticky," Chamen says. As little tillage and traffic as possible in Northern Europe can help get crops planted in fields that aren't waterlogged.

"In many ways, it's a logical fit. If you can keep traffic off 80% of your land and only have to manage 20%, why wouldn't you?" he says. "You don't have to compromise overall yield and you can also lower input costs."

Studies by CTF Europe show that avoiding tillage in controlled traffic can lead to a 35% to 50% savings in fuel costs.

In a no-till, controlled-traffic system, there's little variability year-to-year, Chamen says, so it's not demanding that farmers make annual tillage decisions and question if they will work.

"Because you don't do this deep, rigorous tillage, time spent getting crops established is much less and that translates to substantial fuel savings and wear and tear on machinery," Chamen says. "It also becomes simpler once have you the system established, compared to traditional practices, where every season farmers decide to what extent they've damaged the soil and how deep will they till to repair it."

Matching Multiples

While an established no-till operation puts farmers on the right path to more sustainable farming, realizing the benefits of controlled traffic won't happen overnight.

The end goal is fewer tracks in the field and the least total width of those tracks. But it can take several years to fully implement such a system, and knowing where to start is the first step.

For Gamache, and the farmers taking part in the Canadian initiative, building the system began with the combine header.

"Most farmers here are in a 30-foot,

PHOTOS COURTESY OF CTF ALBERTA

PROFITABLE PATHWAY: Farmer groups like Controlled Traffic Farming Alberta have been working to increase awareness and adoption of the system. Some farmers participating in the CTFA's 3-year program report seeing 10% growth in barley yields and improved levels of water infiltration, into no-tilled soils.

straight-cut header on grains, and the seeder can be an increment of that width," he says. "The key is having that 2-to-1 or 3-to-1 system to match up machinery to stay on course."

Basing a controlled-traffic system on the combine header gives farmers the most common multiples to build the rest of their equipment off of — typically 30 or 40 feet.

As Needham explains, for 30-foot headers on 12-row, 30-inch spacing, farmers can match-up with 60-, 90- or 120-foot sprayers to stay in a consistent path. If farmers move up to a 40-foot header, they will need a 16-row planter on 30-inch spacings and a 16-row corn head to sync-up with 80- or 120-foot sprayers.

Whatever size farmers decide to start with, the key when transitioning to a controlled-traffic system is to maintain a consistent equipment and tire distance.

"You can't mix-and-match," Needham says. "I've talked with farmers at conferences who say they've been doing controlled traffic for 3 or 4 years. I'll ask them what multiples they're using. They'll say they've got an 8-row corn head, a 90-foot sprayer and 40-foot wheat drill.

"The numbers don't add up, so what they're doing isn't really controlled traffic."

"If you can make another 10 to 20 bushels per acre with controlled traffic, that can double or triple your profits…" — Phil Needham

Get On Track

Planning ahead is necessary when implementing controlled traffic because farmers typically won't convert all their equipment in one year.

Shaw used his New Holland combine 30-foot header as the basis for controlled traffic He gradually incorporated a 90-foot Agco SpraCoupe sprayer, Fendt FWA tractor and a 30-foot Salford 522 Precision Disc Air Drill, all run on 25-inch tracks.

Establishing the system went beyond simply purchasing the equipment. Shaw initially struggled with getting the tractor on 120-inch, wheel-gauge spacings.

"With most tractors, even with extended axles, it's a stretch to get out to 120-inch wheel gauges to match the combine," he says. "We worked with our dealer to switch out the axles on the back end to get where we needed."

Trading or upgrading to a piece of equipment that doesn't fit what a farmer already has can also require significant changes to an established controlled-traffic system.

This was the case for the Richards family, who abandoned the majority of their "concrete" tracks in 2012 when they upgraded planters.

For years, they'd run a 55-foot pattern with a Kinze no-till planter in 20-inch rows for corn and soybeans. They planted 31 rows with two 40-inch skips for a 33-row pattern. But they upgraded to a new Case IH 60-foot wide, 36-row planter.

The new pattern allowed the Richards to plant two extra rows by avoiding those skips, but it also meant they had to re-establish tramlines to match the 60-foot width. Their tractor, anhydrous-ammonia applicator and sprayer all have 80-inch tire spacings to fit 20-inch rows.

The Richards don't run their combine harvester in controlled traffic because generally dry conditions in the fall haven't led to compaction issues.

"We were odd with the whole world. We used to have 11-row corn heads and three rows underneath the tractor. Now we have four," Richards says. "We had the advantage of tram lines and followed that path for 30 years. But we were worried about wasting those two rows."

At 120 or 150 bushels per acre of corn, Richards says planting those two rows wasn't as significant. But current yields consistently above 200 bushels per acre, and current corn prices, prompted the change. After ripping up the old tracks and planting into them, it was evident what 30 years of compaction did to the soil.

"When the corn was waist high, we could look across and see every one of those old tramlines. It was yellowish and stunted," he says. "At this point, I'd say breaking it up was a fair success. Whether we'll grow enough in those two extra rows to pay for the corn planter, I don't know."

Turning To Technology

When Richards first moved to controlled traffic, the system's success relied exclusively on his ability to manually keep machinery in the tracks.

But during the last 15 years, precision-farming technology has decreased the burden on farmers to establish and maintain a controlled-traffic system purely by sight.

In Australia, farmers tended to circle their fields — creating lots of overlap, says Reeder, who in 1999 spent time in the country researching controlled traffic. When farmers gravitated toward controlled traffic, many also adopted precision technology and changed to parallel tracking, common for American row-crop production, allowing them to navigate fields more accurately and minimize overlap.

With equipment getting larger and heavier, precision guidance is an integral part of maximizing the benefits of controlled traffic, Reeder says.

"Today, I would never even try controlled traffic without auto-steer," he says. "On the flip side, if you're going to have auto-steer on equipment, it's foolish not to consider the system."

Sub-inch accuracy isn't considered a necessity in no-till farming, but it is an essential part of controlled traffic, says Chamen. In Europe, many farmers in controlled-traffic systems rely on Real Time Kinematic (RTK) and some are now trying cellular signals.

"Anything less than RTK and you're going to be fraught with difficulties trying to make it work," he says. "But cellular isn't completely reliable, so farmers need to think about if that's the way they want to go instead of radio. A 10-minute dropped signal is considered a failure and farmers can't afford to lose that time."

Shaw moved away from cell-based RTK to an in-field base station, in part because of reliability — but also because of cost.

"We weren't totally unhappy with the cellular system, but there is a cost to running three modems and we've had some

issues with service," he says. "Plus, we're looking at possibly doing some tile drainage and would like to have our own base station to get accurate elevation readings."

Although controlled traffic requires consistent equipment widths, precision guidance allows farmers to experiment with expanding their system.

The Richardses plant Austrian winter peas as a cover crop and plan to use RTK with their 55-foot planter to accurately place the crop following harvest.

"We'd get the cover crop in the same pattern by planting in the middle of every cornrow," he says. "If we plant mid-row following harvest, we would be missing the residue."

Precision Paradox

Overall, Richards admits GPS and auto-steer have simplified controlled traffic, but he adds the technology produces a fair share of frustration. It's been a constant challenge keeping their 16-inch sprayer tires on the 20-inch rows.

"We're having an awful time, despite the fact that the guidance system advertised it could provide the accuracy we wanted," Richards says. "If a company is going to claim we can have that kind of accuracy, by golly, it had better work."

This year, his son Bruce, who manages the farm's operations, moved the planter units on each side of the tracks to leave a 22-inch lane, giving the sprayer more wiggle room.

"It takes discipline to stick to those tramlines. If you move a little every year, sooner or later you're compacting a whole area," Richards says. "We worry a little about getting the guidance system working, and if it's 2 inches off every year and we keep moving over 2 inches at a time, it only takes 10 years to move a whole row."

Getting one guidance system to function can be frustrating, but trying to blend multiple brands of precision technology can be a major headache in maintaining controlled traffic.

Even if farmers have their machinery matched-up, unless it's all from one manufacturer, they could encounter compatibility problems.

Once farmers get into controlled traffic, consistent A-B lines are necessary so every time new machinery goes into the field, it runs across the same track, Needham says.

But if a farmer has one brand of sprayer, another brand of tractor and another brand of combine all in the system, it's hard to get all three to communicate the same A-B line.

"Most guys almost have to stick with one supplier to stand a chance of being able to get consistent A-B lines," Needham says. "Of course, it's what those manufacturers want, for farmers to integrate within their color."

Shaw ran into trouble in 2011 when he upgraded the auto-steer system on his Fendt tractor. The upgrade required new firmware to get the third-party system compatible with the tractor.

But after the update, Shaw couldn't run his planting system off the same display he'd used in the past, without changing the system in the planter to be compatible with the auto-steer upgrade on the tractor.

"Lots of additional headaches, time and money were spent to rectify the issue," he says. "It was a challenge."

Manufacturers are working to improve compatibility across multiple brands and it will take time to get to the point of plug-and-play simplicity.

But there are compatibility solutions already on the market that can help keep controlled-traffic operations on track, says Matt Pifkin, steering product specialist with Ag Leader Technology.

Aftermarket products, like Ag Leader's SMS Software, allows farmers to transport guidance lines across a variety of technology platforms.

"Those A-B lines can be transferred if they were logged and exported out of the base monitor through the software," Pifkin says. "The difficulty comes in when operators don't have that software, or don't have ability to operate software in that way. So there are ways to get around some of that perceived incompatibility."

Adoption Obstacles

Getting manufacturers to simplify compatibility solutions is one of the challenges to getting more farmers to embrace controlled traffic, especially in the U.S., but it's certainly not the only one.

Pifkin says controlled traffic is often a tough sell because of the financial and management commitment needed to implement the system.

"I've talked with people about updating the way they farm and I'll hear, 'What we've been doing the last 50 years works just fine. Why change?'" he says. "There's a lot of resistance to change throughout the ag community."

A major deterrent from a financial standpoint is the fact that farmers have to invest in trading out equipment to fit a controlled-traffic system.

The transition doesn't need to happen in one year, but Pifkin says there is that misconception.

"Replacing the planter, sprayer and combine are all major pieces and farmers should know they don't have to spend a million dollars in a year to get to controlled traffic," he says.

With as often as farmers trade equipment nowadays, Reeder says it's reasonable that a controlled-traffic system could be set up in about 5 years, without much economic impact.

Needham agrees, but also notes that farmers, particularly in the U.S., have never had much motivation to match up their equipment to run on a consistent path through the field.

"Some farmers are selling corn at $6 to $8 a bushel and harvesting 200-bushel-per-acre corn, so the incentive may not be there to seek a few extra bushels," he says. "If commodity prices drop down, then we could have the farmer looking for every dollar, which is what's been going on in parts of Australia and western Canada.

"Had some of these growers not adopted controlled traffic 10 to 15 years ago, some of them would have been out of business by now."

Long-term sustainability is Shaw's goal with controlled-traffic, even though his system is still in its infancy. Despite some early challenges, Shaw says he's seen enough promise to commit to controlled traffic as a permanent system.

"My expectation is to see incremental gains with yield, fuel savings and less compaction during the next 7 or 8 years," he says. "It's going to take us some time to get there, but we think we're on the right track and we'll keep moving forward."

ON THE WEB

Go to *www.No-TillFarmer.com* and see how flotation tires and the proper equipment can help no-tillers solve controlled-traffic pitfalls.

Avoid Garbage-In, Garbage-Out When Gathering Soil Samples

The advice may vary each year, but a good overall plan for soil data collection, analysis and use is a perennial must for no-tillers and strip-tillers.

By Martha Mintz, Contributing Editor

Now more than ever before, no-tillers have the ability to compile mounds and mounds of data. But you may need to be careful about gathering too much rope.

The wrong data — or data not carefully collected — can hurt more than it helps. This is especially true with the progression of precision variable-rate technology.

"We now have the ability to accurately apply the wrong nutrient at the wrong rate in the wrong place and create more variability than there was to begin with," says Joe Nester, a consultant from Bryan, Ohio.

Precision management can pay, but it must be based on accurate, reliable and representative data. A key source for this information comes from soil sampling. It is a process where there are multiple opportunities to gather misleading or completely wrong data.

PHOTO COURTESY OF UNIVERSITY OF ARKANSAS

SAMPLING TIP. No-tillers must strive to get accurate representations during soil sampling, understanding that even a small field can have many different soil types. If sampling by field, all the samples might get tossed in one bag and the results won't be accurate.

To get it right, no-tillers must correctly navigate these four challenges:

1. Choose the most representative soil sampling strategy.
2. Collect the samples correctly.
3. Order the right tests for conditions.
4. Integrate with other data to create sound management strategies.

There are many different strategies for soil sampling. Samples can be taken by field, topography, grid, soil type or other established management zones. Some no-tillers opt to test every field every year, while others coast on data that's several years old.

Coasting may not always be an option, though. Nester sees change on the horizon for soil testing, including heightened accountability. Stepping up field assessment may be necessary for those that are doing the bare minimum. But that may be a good thing for a no-tiller's bottom line.

"There will come a time when the rate and timing of nutrients will be regulated. Farmers will have to prove what they've done with their nutrients," he says. "That's OK because better information and a higher degree of management will make farmers more profitable."

Proper Representation

Determining where to collect samples can significantly change field recommendations. For example, even a small field can contain three different soil types. If sampling by field, all of those samples would be tossed together in the same bag.

"The lab will be glad to send you results on these samples. The problem is they don't represent anything that's in your field," Nester says. "It will give you a recommendation for variable-rate application, but it would be the wrong thing for the wrong reason."

A soil's exchange capacity is where Nester prefers to start when beginning to sketch in the outlines for soil sampling zones. Exchange capacity determines how many positively charged nutrients a soil can hold.

It generally changes by soil type. Nester compares various exchange capacities to containers, such as a 5-gallon bucket, a 30-gallon drum or a 50-gallon drum. If you manage the 5-gallon-bucket soil with a strategy for a 30-gallon-drum soil, you'll be sacrificing yields and wasting dollars.

Digitized soil surveys make it fairly easy for no-tillers to determine where their different soil types are in the field. But

Nester still recommends that no-tillers "ground truth" the samples.

"When you take a probe, lay it in a dish before you put it in the bag and make sure it matches everything else," Nester says.

Once the initial sampling zones have been penciled in, Nester recommends layering yield zone maps from a well-calibrated yield monitor to get the whole picture. Yield maps can identify transition zones.

Additional sampling sites can then be drawn in where variation in yield is noted in the same soil types. He typically prefers that sampling zones be broken down into 6- to 10-acre polygons for the most accurate results.

Adding in yield data can really highlight specific soil problems. In one case, a field that had mostly the same soil type throughout showed a 20-bushel fluctuation in soybean yield. The yield map was dissected into high, medium- and low-yielding zones for sampling.

"When we sampled this field, every low-yielding zone needed lime applications," Nester says.

Blanket lime applications had been the practice for years based on old soil samples. That resulted in some areas having an abundance of lime, while others still fell short.

Computer Vs. Farmer

Grid sampling gained popularity when GPS went public. But Nester warns that more information isn't always better.

"I feel that grid sampling handicaps me in making a sound fertility recommendation," he says. "It never asks the farmer or the crop what's going on. It's all computer driven and creates more variability in many cases."

When grid sampling, a common recommendation is to sample 2½-acre grids. Those grids are broken into 50-by-50-foot cells, and a computer calculation determines management recommendations.

But only one cell is actually sampled, and that actual sampled area was probably 10-foot by 10-foot. The data comes back from the lab and it magically fills in whatever size the grid was, Nester says.

One 73-acre field Nester worked with was broken into a 5-acre grid for sampling. Those grid sections were then divided into 50-by-50-foot management cells for variable-rate fertility recommendations. Only

"Grid sampling handicaps me in making a sound fertility recommendation…"
— Joe Nester

16 samples were pulled, so of 1,394 cells, 98.9% were estimated.

"I can't make a good recommendation with that data," Nester says.

Plus, he says, the investment it takes to grid sample means most no-tillers will try to live off that data for 4 or 5 years. Nester isn't entirely opposed to grid sampling; he just recommends that it be integrated with additional information.

"Grid sampling can be used as a base, but I think moving on to management zones will create better, more representative data," he says.

And no-tillers don't have to live with the zones that they create forever. They can be adjusted as field and economic conditions change, Nester says.

"We can use those zones for 2 or 3 years and then re-evaluate," Nester says. "As levels are achieved, we may be able to reduce the number of zones sampled."

Accurate Samples

Once it's been decided where the samples will come from, it's time to collect them. Here is another opportunity for data gold to turn into data garbage.

Depth is critical, Nester says. Different labs and different regions use varying depths for soil samples. In the Midwest, the standard sample is 6-⅔ inches deep. More Western states may require an 8-inch soil core.

Either way, it's critical to get the lab exactly what their equipment is calibrated for to get accurate, useful results.

"A soil test doesn't know pounds per acre. It's measuring saturation in the amount of soil that was tested," Nester says.

It's up to the person taking the soil sample to make sure the exact right amount of soil is sampled for an accurate representation when parts per million are translated to pounds per acre.

"A shallow soil sample will return incorrectly high values," says Ray Ward, owner of Ward Labs in Kearney, Neb.

Collecting a sample to the proper depth can be more difficult after a dry year.

"If the soil is hard, it's essential to make sure a full core is taken even if it's difficult," says John Sawyer, Iowa State University professor of soil fertility and nutrient management.

He notes that tillage systems with little soil mixing, especially no-tillage, result in soils with vertical nutrient stratification. It is critical to collect the same core depth at each soil sampling. Collecting deeper will cause lower test results, and shallower sampling results in higher test results.

Once the core is taken to the right depth, it's also important to make sure every bit of soil makes it to the sample bag — a challenge in dry conditions.

"The soil surface may also be dry and crumble as the soil sample is pulled. That surface soil must stay with the sample. If it doesn't, the analysis will be incorrect," Sawyer says.

He notes that in no-till, the soil tends to stay more intact, but that it's still essential to make sure the entire core makes it into the bag.

Consideration should also be made of where fertility has been banded. When we probe, we don't sample in the 2-by-2-inch band and we don't sample right in the stalk, Nester says.

A lot of translocation occurs near the stalk, he explains. As the stalk senesces, that can lead to a lot of nutrients right in that area, and a misleading test. Sidedress nitrogen bands also should be avoided.

"Sampling in the nitrogen band is going to really mislead you and have you applying lime you might not need," Nester says. "We sample between the starter band and the sidedress band in no-till."

In strip-till, Nester continues to chase the edge of the strip from season to season.

Delay Sampling

While fall is when most soil sampling generally occurs, it may not be the best option following drought.

When crop yields have been crippled

and soils are relating more to concrete than coffee grounds, the best bet may be to delay sampling until after rain, possibly even spring.

Dry fall conditions can result in sampling errors and misleading soil test results, Sawyer says. One affected test is the soil potassium test.

"Part of the reason the potassium test is affected is due to less recycling of potassium from crop residue," Sawyer explains. "If there isn't fall rainfall, there isn't potassium leaching out of crop residues, which can result in artificially low potassium tests."

In addition, the normal re-equilibration of potassium in the soil from slowly available to exchangeable, or available, potassium after crop uptake can be affected with dry soils, he says.

Soil pH also can read lower than normal after a dry year, showing a difference of 0.1 to 0.3 pH units, Sawyer says. Soluble salts, which impact pH, can build up during long stretches of dry weather.

However, as normal rainfall returns, the soil is re-wetted, allowing equilibration of nutrients, such as potassium, and leaches salts from the normal sample depth, Sawyer says.

Soil test phosphorus is usually not as affected by dry conditions.

"Because of these potential issues, it may be best to wait to soil sample until next spring, especially if there is continued lack of precipitation and soils stay dry," he says.

Crop-removal estimates are another option for growers, but Sawyer warns that drought can create a lot of uncertainty and variability in plant uptake, and therefore removal, especially if fields were chopped for silage.

"Depending on moisture availability during different portions of the growing season, there could be relatively more or less grain dry-matter production than nutrient uptake and translocation from vegetative plant parts to the grain, which would result in lower or higher concentrations, respectively," he says.

Obtaining adequate soil samples can also aid in dealing with variable removal.

"Remember, however, that soil sampling/testing should be considered a long-term management practice, so don't overreact to samples from one year or try to determine small changes in removal with one test," Sawyer says.

"My experience is that more nitrate gets kicked out by the soil biology in dry years …"
— Ray Ward

Consider Nitrate Testing

Nitrate tests are usually reserved for those in the dry extreme western edges of the Corn Belt. But after poor conditions in 2012, the central Corn Belt may need to consider the option.

"Nitrate tests are going to be pretty high this year and we will need to adjust nitrogen recommendations quite a bit," Ward says.

He estimates that nitrogen rates in his area will be cut by 20% to 50% in the coming year.

While some of that is due to crops not pulling all applied nitrogen, Ward says the soil may provide an extra boost of nitrogen during a dry year, too.

"My experience is that more nitrate gets kicked out by the soil biology in dry years because the microbes are still working, but the plant isn't picking it up and the rain isn't leaching it away," he says.

The bottom line is that with an abnormal year, it's a bit of a guess as to what's happening in the soil, at least concerning nitrogen, without some soil sampling.

Ward notes that nitrate testing costs around $4 per sample and can save a no-tiller a lot of money by giving an accurate read on how much to reduce nitrogen rates in the coming year.

Timing of nitrate testing is critical, though, and varies by region. In the West, dry conditions make nitrate testing in the fall acceptable.

However, further east where more rainfall is likely, it's a test that should wait for spring for the most accurate results, Ward says.

Many Eastern labs do not offer the test, so no-tillers that want an accurate read on available soil nitrogen may have to seek out a Western lab.

Rounding Out Data

Soil sampling can provide a cascade of information for no-tillers to use. But Nester notes that there are some things a soil test can't reveal.

"Soil structure and soil health don't show up anywhere on that test you get back," he says.

That additional information can greatly impact how crops react to and use the nutrients applied.

"A soil with good structure, ample microbial life and a decent water infiltration rate requires less nutrients on paper," Nester says. "The key is recoverability."

Focusing just on the chemical aspect is a mistake, Nester says.

No-tillers need to pay attention to the biological and physical aspects as well. There is no simple test.

Collecting that data requires years of onfarm observation and soil tests to get the big picture of how a field system actually works.

"My toughest call as an agronomist is after the first year that I soil test because I don't know how good that data is. I do know it's not perfect," Nester says. "If I can stack soil tests years behind each other on top of management zones, then I can be comfortable making the call on $1,250 phosphorus."

Stakes are high with fertilizer prices consistently climbing. Stress can quickly build as no-tillers struggle through all their data and try to make educated decisions that will make sure those expensive inputs are going to the right places in order to maximize yields.

Not everyone is up to the challenge.

"If you can't do it yourself, hire somebody," Nester says. "The toughest thing for me on my farm is marketing, so I hire someone else to do it."

And they'll likely do a much better job as they see and manage a lot of acres.

"When you hire someone, they have usually had the opportunity to see a lot of different farms and a lot of other techniques," Nester says. "Most of what I've learned hasn't come from books. It has come from experiences in the field."

The Next Frontier In Seed Placement Technology

From seed meters to ground sensors, new equipment coming on the scene can help no-tillers achieve more consistent stands and raise yields.

By Clair Urbain, Contributing Writer

Planter experts agree that achieving optimum seed spacing, consistent planting depth and adequate seed-to-soil contact, without creating compaction in the seed slot, are the prerequisites to a healthy crop stand.

"Once you meet those three conditions, that's when varying seed population and fertility levels to match the soil's potential will help reduce input costs and increase yields," says Luc van Herle, global sales and service manager at Kinze.

Crop experts at Precision Planting report that even a 1% improvement in seed placement can result in an additional $5 per acre in return — even more as corn prices climb.

"Higher populations mean that the placement of every plant — and every seed — is critical," says Sean Arians, product marketing manager at Precision Planting. "For example, corn plants that are closer than 4 inches sense high-population pressure and react to the high-stress environment. But with a little effort, today's planters can achieve spacing accuracy of 97% of more."

University research bears out these findings. Ron Heiniger, a cropping systems specialist at North Carolina State University, says because newer hybrids are more stress tolerant and less likely to lodge under high plant populations, corn growers are increasing seeding rates with the goal of increasing yield.

As plant populations increase, so to do the chances of inter-plant competition.

"But achieving a perfectly uniform stand with equidistant within-row spacing is impossible to achieve under actual field conditions," Heiniger says.

A survey of 16 fields in North Carolina found plant spacing variability ranged from 2.77 to 6.54 inches, with an average of 4.84 inches.

NEW HEIGHTS. The latest innovations in seeding technology — including Vaderstad's new Tempo planter, should help no-tillers improve the consistency of seeding depth and spacing and improve crop emergence and overall stands.

"We project growers lose 5 bushels per acre if the crop stand deviates on average just 1 inch away from consistent plant spacing," he says. "These losses could be reduced by careful planter calibration, particularly in rough no-till conditions."

Down pressure plays a key role in cutting through residue and keeping the seed tube in the zone for proper planting depth. Developing planter innovations makes that down pressure more dynamic, adjusting to changing residue and soil conditions.

"Use enough down pressure to get good row cleaner performance and consistent seed-slot depth," says van Herle. "Too many farmers believe that if a little is good, more is better. Backing off down pressure will extend component life and reduce compaction in the seed slot, which can affect seedling growth."

Equipment manufacturers continue to tweak planters to help no-tillers place seed quickly and accurately. Here are some of the latest innovations.

Precise Seed Placement

Vaderstad, a farm equipment manufacturer based in Sweden, recently began testing its new Tempo planter in the U.S.

The six- or eight-row units can seed corn at 11 mph in conventional fields, and no-tillers in Europe report being able to run at 8.8 mph with excellent results.

"That's nearly twice the speed of conventional planters," says Lars Thylén, product manager for Vaderstad. "Making planters even wider to cover more ground is becoming impractical, so speed is the next way to improve productivity," he says.

Vaderstad tests show the Tempo planter can consistently maintain less than 1% skips and doubles at 11 mph, while competitive units had an almost 7% skip-and-double rate at these higher speeds.

The Tempo planter uses positive air pressure to move the seed from the seed meter, which is designed to prevent dou-

GROUNDED APPROACH. Dawn Equipment recently introducted its Foresight ground-harness sensor with GFX floating row cleaners and RFX planter downforce actuator, allowing for real-time sensing and automatic feedback control of multiple planter attachments.

bles and skips, independent of kernel size or weight.

"It works like a pea shooter. The seed exits the seed short tube at about 30 mph and when it exits, the press wheel stops the seed from rolling or bouncing," says Thylén. "That allows for good seed-to-soil contact for rapid and even germination." .

It's not only the seed meter and the seed transport that makes it possible to drive faster. The planter has walking tandem gauge wheels that trail, instead of lead, the toolbar. The tandem gauge wheels flex over rocks and debris, keeping the planting slot depth consistent.

A torsion spring can increase down pressure with 330 pounds, to a total of more than 700 pounds of down pressure.

The tractor PTO powers a fan that generates pressure to move seed and fertilizer.

The seed meters are powered by a direct-drive internal electric motor powered by an alternator that's also driven by the PTO.

The seeding rate is controlled by row with a control station in the cab. This allows individual row shut-off, reducing double planting in odd-sized fields.

Thylén recommends row cleaners in no-till or high-residue fields.

"We have not used the planter to plant many soybeans, but that will be part of testing in 2013," he says.

Sense And Adjust

Dawn Equipment has unveiled its new Foresight ground-hardness sensor, with GFX floating row cleaners and RFX planter downforce actuator.

The Foresight offers real-time, ground-hardness sensing, along with automatic feedback control of multiple planter attachments. The Foresight sensor accounts for forward planting speeds, letting the planter anticipate changes in soil conditions and adjust prior to reaching that location in the field.

Foresight takes hundreds of measurements per second and averages them over 0.25 seconds. This information stream is processed algorithmically by a processor and outputted to the GFX and RFX to control row-unit down pressure, resulting in optimized planter depth control and ride characteristics.

"If you're looking at a guy with a 24-row planter who's out there planting and the rain is coming, they're not going to fuss with row cleaners. They've got to get their corn in," says Rodney Arthur of Dawn. "With this setup, at any given time they can always have the exact row-cleaner setting that's needed."

Row-By-Row Accuracy

Precision Planting is further refining its AirForce down-pressure system with the 20/20 DeltaForce system, which delivers row-by-row rapid response adjustment for Deere, Kinze and Case IH planters.

"The 20/20 AirForce system was the first system to provide automatic down-force control on planter toolbars," says Arians. "While it's still the right system for many farmers, 20/20 DeltaForce further fine-tunes down pressure to the row."

The DeltaForce system is controlled by Precision Planting's 20/20 SeedSense system, which is a simple retrofit that replaces airbag or spring down-force systems. It uses the tractor's hydraulic power to actuate the dual-acting cylinders that are installed on every row unit.

The operator sets a target margin of weight the gauge wheels will carry. Weight sensors on the gauge wheels monitor changing down pressure and the SeedSense system adjusts cylinder pressure to maintain down pressure in the predetermined margin, row by row.

"The margin of down pressure can be maintained at near zero pounds, and the rapid, constant adjustment means each row unit is running at optimum force for depth control — with no excess weight," says Arians. "It takes the controlled zone down from the width of the toolbar to the row width, compensating for variations from row to row."

Arians says Precision Planting also offers advances in meter technology.

"The disc used in eSet vacuum meters for John Deere planters is designed to accept a wide variety of seed sizes and shapes. You can get 99.5% or more singulation without adjusting vacuum or pressure or double eliminators," he says.

The eSet disc has a raised platform that releases seeds in the center of the seed tube, minimizing ricochet.

Precision Planting has also introduced a new vSet vacuum-meter system that can be used with Kinze planters for similar results that farmers get with eSet meters on John Deere planters, Arians adds.

He says seed tubes can cause misplaced seeds skips and doubles.

"Seeds often hit the seed sensor as they travel down the seed tube and ricochet off the sides of the tube. That's why we designed the BullsEye seed tube that has an offset seed sensor. It minimizes ricocheting and subsequent misplaced seed issues," Arians says.

The BullsEye seed tubes have carbide wear tips that prevent the double-disc opener from wearing through the tip of the seed tube.

"It prevents a lip from wearing into the tip of the tube that can send seeds flying causing uneven spacing," Arians says.

8 Game-Changing Precision Products For No-Till, Strip-Till

From spraying to planting to implement guidance, growers have more choices than ever to make their farm operations more efficient and effective.

By No-Till Editors

Raven Multi-Hybrid Planter Control

The ability to change hybrids to accommodate different soil types has long been a hope for farmers. In 2013, Raven Industries introduced its first multi-hybrid planter-control system, which lets growers automatically switch between different hybrids on the go based on a variable-rate prescription maps.

The multi-hybrid control is an enhancement to Raven's OmniRow advanced planter-control technology. When combined with variable-rate seeding, the multi-hybrid control could increase yield potential and profitability.

No-tillers can choose offensive or defensive hybrids for highly productive or less productive soils, or select hybrids based on moisture and disease resistance. Features include optimization for interplant and twin-row planter configurations, automatic shifting of tractor- or implement-guidance lines to keep rows in line, and integrated liquid and granular product control for each hybrid.

Web Site: ***www.ravenind.com***

Spectrum Technologies FieldScout GreenIndex

Crop sensing is an emerging precision tool to get in-season nutrient readings and ensure a healthy crop come harvest. The ability to record and analyze readings instantly can cut down on time no-tillers spend in the field scouting and lead to better nutrient management practices.

Spectrum Technologies, Inc.'s FieldScout GreenIndex+, is an iOS app that instantly captures and processes images from an iPhone, iPod Touch, or iPad and computes the DGCI (Dark Green Color Index) of leaves, using technology licensed from the University of Arkansas.

No-tillers can compare leaf color to get nitrogen recommendations at the knee-high sidedress stage.

Web Site: ***www.specmeters.com***

TeeJet Technologies Sentry 6120 Droplet Size Monitor

Regulating droplet size isn't something no-tillers may think much about when spraying fields. But doing so lets them more precisely place fertilizer where it's needed and save money, says Tim Stuenkel, global marketing communications manager with TeeJet Technologies.

The Sentry 6120 Droplet Size Monitor provides real time, in cab droplet size information. The control can be plugged into any new or existing sprayer and it will, based on a pressure tranducer mounted on the boom, sense system pressure.

The monitor includes image-based tip-series and tip-capacity settings for one-touch selection of spray tips, and alerts indicating when system pressure drops below or rises above the current pressure setting.

Web Site: ***www.teejet.com***

Ag Leader Technology Hydraulic Down Force

Research has proven that poor planting depth can leave plants vulnerable to poor germination and herbicide or frost injury, as well as uneven emergence and growth.

Ag Leader's Hydraulic Down Force technology is designed around a single acting cylinder that adjusts row-unit down force instantaneously based on field topography and soil conditions.

The systems uses up-lift springs if less than zero force is needed, allows for proper planting depth regardless of soil conditions or topography, and has two control channels to maintain down force across the entire width of the planter.

Web Site: ***www.agleader.com***

Precision Planting vDrive

Single-row control of planters lets no-tillers more accurately place seed at higher speeds and compensate for field contours and different prescription zones.

Precision Planting developed vDrive, a new electric drive system for use with the company's 20/20 SeedSense and vSet meters. The system replaces existing clutches, hydraulic motors and chains or cable drives.

An electric drive controls each row individually, as needed, for more precise planting, which eliminates chain or cable maintenance.

Web Site: ***www.precisionplanting.com***

Trimble Connected Farm

Fleet management, and the ability to monitor, record and analyze farm operations, remotely, can save time in the field and allow no-tillers to run their operations more efficiently.

Trimble's Connected Farm lets growers wirelessly transfer guidance lines, coverage maps, and point/line/area features between vehicles operating in the same field.

The mobile application also lets users map field boundaries, mark flags, take geo-referenced photos and enter scouting information for pests.

Web Site: ***www.trimble.com***

MBW ProTrakker Hydraulic Hitch

Implement steering is an emerging technology no-tillers and strip-tillers are beginning to explore to keep implements precisely in line with tractors.

MBW's ProTrakker Hydraulic Hitch automatically adjusts to correctly steer pull-type implements on slopes, contour rows and variable soils to keep implements from swaying into and damaging crop rows.

The system's GPS guidance works with most tractor-guidance systems on planters, strip-till rigs and other precision applications, and reduces operator fatigue on sidehill slopes and contours.

Web Site: ***www.protrakker.com***

Dawn RFX+ Modular Individual Row Down Force Control System

Flexibility to control a planter's row units to compensate for changing field conditions can help no-tillers conserve seed attain better placement.

Dawn Equipment's RFX+ Modular Individual Row Down Force Control System extends automated row-control to the company's RFX hydraulic down pressure system.

No-tillers can chose the level of control they want on their planter, whether it be sectional, every single row or a combination of the two.

The module bolts directly to the RFX down force actuator and allows farmers to scale up or down, the level of control needed in their fields.

Web Site: ***www.dawnequipment.com***

It pays to emerge with Precision

Seeds that germinate at the same time emerge and grow at the same time. There are no stragglers to lower your yield.

To make sure you get uniform germination, you need to make sure seeds are planted at a uniform depth for uniform access to moisture.

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Take charge of germination

To plant – and germinate – with precision, you need to know what your planter is doing.

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The trench is ready. You're ready. The seeds are ready to reach their potential.

"The ability to automatically adjust down force was really nice for the different soil types we farm in." Gary Horn, Ohio

To make your way to uniform germination, turn to your local Precision Planting representative, to secure your 20/20 SeedSense with FieldView & 20/20 Airforce today. *You'll find that it really pays to plant with Precision.*

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