BY Matthew Wilde



Technology has evolved to provide farmers timely, actionable information to boost yields in-season.

mages captured 5,000 feet above Greg Armes' cotton fields are more than just pretty pictures.

The high-resolution photos taken by Ceres Imaging, based in Oakland, California, are intricate and colorful. The New Home, Texas, farmer often looks at them on his iPad or iPhone as he's spraying or at home after a long day in the field.

But, the vibrant blues, greens, reds and yellows that stand out on the mobile devices are beautiful to Armes in a different way. The colors depict plant health and vigor.



He says aerial imagery paired with analytics provide vital information to make better in-season decisions to boost pounds and profit per acre. It's something the first-time imagery user wasn't able to do before.

"I'll be able to fix problems before it's too late," Armes says. "In today's farm economy, every acre has to pull its own weight."

Farmers and agronomists have used photos from satellites and airplanes for more than 30 years to scout fields and check crop health. Drones were added to the mix the past decade using a combination of pictures and live video to spot drainage issues, weather- and pestrelated crop damage, and plant health.

The information was mostly used to correct problems for future growing seasons. Industry experts say ag imagery and technology have evolved the last few years to allow farmers to be more proactive than reactive when making agronomic and other decisions.

Many people believe this is a game changer, much like the advent of mechanization and biotechnology.

Put Ceres Imaging customer John Vaadeland in that category. The agronomist and crop consultant from Park Rapids, Minnesota, previously used satellites to get a bird's-eye view of potato and row-crop fields. It took weeks to get back pictures with little to no data included. Now, airplanes do the job. He gets some visual and agronomic feedback almost immediately, and more detailed information within hours or days.

"In the 1990s, imagery had potential, but there wasn't a good way to utilize it right away," Vaadeland says. "There

Chance Lewellen, a pilot for D & D Aviation, routinely takes aerial images of farms for Ceres Imaging. This includes high-resolution photos of Greg Armes' cotton fields, near New Home, Texas. JOHIN BOURNE way, value and says. There was a pretty picture that you printed off that showed variations in the field that was maybe nutrient- or diseaserelated, but the technology wasn't advanced enough to make timely decisions.



"Today, we can use high-quality imagery to make variable-rate fertilizer and fungicide applications, and see if our nutrient plans are working right away," he continues. "It's things we dreamed about in the past but are now reality."

BIG DATA, BIG CHANGES

Aerial imagery helps farmers maintain and increase production, explains Matthew Darr, a professor of agricultural and biosystems engineering at Iowa State University (ISU).

Multispectral sensors—RGB (red, blue, green), chlorophyll, thermal and NDVI (normalized difference vegetation index), etc.—can identify distressed plants, often before the human eye can detect problems.

Darr contends imagery's true power was unleashed a few years ago when it was combined with big data structured and unstructured information whose scale, diversity and complexity require new architecture, techniques and algorithms, and analytics to manage and extract value and hidden knowledge. It provides farmers the opportunity to fertilize, irrigate (if available) or spray to kill weeds, and ward off pests before they take a toll on yields.

"You were just buying data or just a picture four to six years ago," Darr says. "[Now] products have been developed providing an easy button, giving us some analytics to go along with the image. The exciting thing today is you can point to in-season solutions."

Darr, director of ISU BioCentury Research Farm and Digital Agriculture Innovations Team, conducts drone and imagery research. He also uses both to keep tabs on thousands of acres cropped by ISU.

Imagery improvement from an acre-by-acre view to row-by-row and plant-by-plant views better pinpoints problem areas in fields, Darr says. Pairing highresolution photos with past and current agronomic data



provides better information to increase precision and efficiency of farming operations. Imagery and analytics are available to farmers in the field to make better decisions.

But, it isn't a silver bullet.

"If you buy a treadmill, it doesn't guarantee you will get in shape," Darr explains. "The probability of it paying is proportional to the producer engaging with the analytics or information."

TURNKEY IMAGERY SOLUTIONS

There are multiple companies operating in this field. Firms like Ceres Imaging and Intelinair, with offices in San Francisco and Champaign, Illinois, are at the forefront of offering farmers turnkey crop imagery and data analysis services.

Ceres Imaging focuses on aerial imagery and analytics geared to help customers improve decisionmaking by providing a comprehensive view of their farm. Founded to help fruit and nut tree farmers, it quickly expanded to millions of row-crop acres.

"We can see proactively what's happening in the field," says Chad Scebold, Ceres Imaging director of sales and strategic accounts. >

YOUR FARM /// COVER STORY

Growers in Australia, California, Hawaii and the Midwest pay \$4 to \$6 per acre to have high-resolution, multispectral images taken from low-flying planes throughout the growing season. Examples include:

➤ thermal imagery that measures plant transpiration to expose the variation between canopy and ambient temperature, detailing moisture, pest and disease stress

> near-infrared and visible spectra combined into a leaf chlorophyll index, a strong indicator of nitrogen content

> NDVI used to benchmark vegetative vigor

> up to six different ranges of light wavelengths, ranging from visible far-infrared.

Images are processed and stitched together with a resolution ranging from .02 to 1 meter per pixel.

Ceres Imaging claims crop-modeling techniques reveal accurate, real-time information about the water, nutrient and health status of every plant. Customers receive information after every flight within 24 to 48 hours.

"Traditionally, we didn't know until the end of the season if we did well," Scebold says.

Intelinair's flagship product is AgMRI. It also uses high-resolution multispectral images taken from manned aircraft, along with environmental and agronomic data. Hyperspectral analysis, computer vision to process images and deep learning to identify patterns ultimately build a precise situational representation of every monitored field for the entire growing season.

- HANDS-ON IMAGERY

Drones and analytics make a powerful, timely pair.



Farmers who prefer to capture their own aerial imagery can now receive better and quicker actionable data than ever before.

Drones, technology and analytics have advanced to the point operators can take high-resolution, multispectral images of hundreds of acres a day. Farmers can get

some feedback on plant health immediately and more indepth analysis within hours or days.

"There's a lot of good cloud-based tools now to do image processing, analysis and stitching," says Matthew Darr, an Iowa State University professor and technology expert. "If farmers have the interest and time, it's a great opportunity to do it themselves or create a side business."

Dennis Bogaards, Pella, Iowa, does both. The corn and soybean farmer uses and sells drones for Flying AG. He's also a drone instructor.

A wet spring convinced him to expand drone use on his farm beyond scouting to crop analysis. He purchased





a DJI Mavic 2 quadcopter from Flying AG. It features a three-axis gimbal stabilized camera housing a side-by-side 4K sensor for capturing visible light and an imaging sensor for thermal data.

Bogaards likes that he can check plant health on most of his 1,100 acres from his

yard at any time. He uploads images to DroneDeploy, a DJI drone software company that processes and analyzes them to detect crop variability, fertilizer deficiencies and pest pressure, among other things.

"I'll get more actionable information to preserve and increase yields," Bogaards says. He lost about 250 acres of corn this season because of prevented planting and standing water. "Keeping what I have is that much more important."

He can fly about 80 acres in 25 minutes. GPS guidance makes it easy, Bogaards states.

"It takes time, but controlling the quality is much easier doing it yourself," he adds.

Farmers, insurance companies and ag retailers make up the bulk of Intelinair's customer base throughout the Midwest, says Josh Thornsbrough, Intelinair vice president of sales and marketing. The company declined to say how many acres it covers. "As we keep introducing AI (artificial intelligence) and machine learning into this, farmers will get very early opportunities to create massive yield increases," he says.

Intelinair's basic package is \$5 per acre, which includes up to 13 flights based on the crop and growing season. Customers receive data back within a day or two after every flight on any device they choose, along with action alerts when a problem needs to be addressed.

"Our customers don't necessarily want to see every image, they want to know when something needs to be addressed," Thornsbrough continues.

EYE IN THE SKY

Ceres Imaging and Intelinair prefer manned aircraft over drones and satellites. Planes can cover more acres quicker and carry more high-tech equipment, officials say. Images reveal disease pressure, parasites and weeds. They show where irrigation and fertilizer are overor underapplied. Irregular distribution of plants also can be spotted. Analytics and algorithms highlight year-over-

year trends during critical points of the growing season. Growers can use the data to develop and optimize management zones.

Ceres Imaging's Scebold and his family farm about 2,000 acres of mostly irrigated corn and soybeans in southwest Iowa and southeast Nebraska, along the Missouri River. They are also Ceres Imaging customers.

"Being able to react in-season and judge the results changed the game for us," Scebold says. "We do a lot of nutrient applications through pivots."

As farmers evaluate providers in the imagery and analytics space, Darr says farmers need to set goals and compare them to packages companies offer.





Maximum flexibility and cost effectiveness

NOVACAT A10 CROSS FLOW – Swath merging without conditioner

- 20% lower power requirement compared to conveyor belt systems.
- Quicker drying cross flow auger turns the flow of forage.
- Intelligent mowing single-side wide placement reduces the number of passes and saves time.
- Wide spread placement for a more intensive drying effect.



NOVACAT A10 CF received "Machine of the Year 2019" at SIMA 2019.

For more information, please call 888-943-3009. www.poettinger.us



YOUR FARM /// COVER STORY



Color-coded imagery indicates distressed plants the human eye cannot detect.

More Acres Fast

AeroVironment, based in Simi Valley, California, has a drone and analytics system that can cover and analyze multiple acres fast and accurately.

Quantix, a VTOL hybrid fixed-wing drone with fully automated vertical takeoff and landing, can cover up to 400 acres in 45 minutes. It switches to horizontal flight to do it.

The craft sports two onboard 18-megapixel truecolor and multispectral cameras. Resolution is down to 1 inch and 2 inches per pixel, respectively. Quantix is integrated with AeroVironment's online data analytics platform that processes images to provide insight to farmers into plant emergence, vegetative health and resource management.

"The system is designed to be turnkey out of the box," says Mark DuFau, AeroVironment director of business development. "From the field to the computer, you have a data delivery system for farmers and agronomists."

Ashley Runholt, an agronomist for Cottonwood Coop Oil Co., in Cottonwood, Minnesota, uses the system to scout thousands of acres.

She was able to spot a nutrient issue in a corn field. It was the width of an anhydrous bar that malfunctioned. Ten acres were sidedressed, which likely saved a 600-bushel loss.

"That was an impressive find," Runholt claims. "With today's market, we'll do whatever we can do to get a good return on investment."

FOR MORE PRICING AND PRODUCT INFORMATION: www.avdroneanalytics.com www.flyingag.com www.dronedeploy.com "If you rotationally farm for 40 years, you only have 20 to plant corn in a field," Darr says. "Adding knowledge and adopting methods to reduce man-made yield losses is a key service that high-resolution imagery and analytics provide."

Texas' Armes spends about every day in his fields. But, he admits there's no way to spot every problem.

"It's another eye in the sky that can help me," he continues. "It helps me sleep better at night not worrying about past problems and things I might miss."

RETURN ON INVESTMENT

Armes has no doubt the \$4.50 per acre he pays Ceres Imaging for a six-flight package is a good investment. He also is a dealer for the company. About two-thirds of Armes' 5,500 acres, of which 65% are irrigated, will be covered this year.

The following are examples of past issues he hopes to correct or avoid:

➤ an irrigator malfunction causing 10 acres out of a 120-acre circle to receive too little or too much moisture

➤ a solenoid on a drip irrigator that's stuck over and under watering areas

> a missed fertilizer pass with a coulter rig

> aphid, spider mite and nematode pressure curtailing yields.

"I'll know if there's a problem early; that's where I think imagery will help," Armes says. "I want every acre to produce like the rest."

Armes' production goal is 1,250 to 1,500 pounds of cotton per acre. The low end of the range, or $2\frac{1}{4}$ bales, is needed to make a profit on irrigated land.

Even spotty problems can turn black ink to red.

"I need every pound I can get," Armes adds.

Three August flights to determine final moisture needs may be the moneymaker, Armes explains. It costs \$1,000 to apply 1 inch of water per 120-acre circle.



"If I can save a couple inches of water, my breakeven goes down to 1½ bales," he explains. "I think it will be easy to get my money back and then some."

Recent Intelinair surveys indicate customer ROI on average per acre includes the following items:

> \$4.51 – proactive in-season decisions including harvest timing, fungicide and herbicide applications, etc.

> \$5.37 – management practices including variablerate fungicide and herbicide applications, irrigator adjustments, etc.

► \$5.34 – whole-farm intelligence, including operation efficiency, chemical effectiveness, etc.

> \$7.48 – equipment optimization, including equipment calibration, irrigator fix, etc.

This is the third year Intelinair has provided imagery and data to Corey Holmes, New Holland, Illinois. He farms a couple thousand acres with his father, Rick, spread out 150 miles east to west and 80 miles north to south.

There's no way to effectively scout that many acres over a wide geographic area, Holmes admits. He conservatively estimates the operation is doubling in return the money spent with Intelinair by timely spraying corn for gray leafspot, finding underirrigated acres and other issues in-season.

"We're making more timely agronomic decisions," he says. "We're seeing all our fields all the time, and that's a big thing. ///

FOR MORE INFORMATION

Ceres Imaging: www.ceresimaging.net
Intelinair: www.intelinair.com

> Follow Matthew Wilde on Twitter: @progressivwilde



LOOKING BEYOND THE HORIZON

BKT's extensive product portfolio comprises specific cutting-edge tire ranges to cater for the most demanding needs in a variety of fields such as agriculture, construction, and OTR, as well as transport and agro-industrial applications.





bkt-tires.com





BKT USA Inc. 2660 West Market St., Suite 100 Fairlawn (Akron) - OH 44333 Toll free: (+1) 888-660-0662 - Office: (+1) 330-836-1090 Fax: (+1) 330-836-1091