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SEPTEMBER 2022 | ISSUE 3, VOL 3

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ARTIFICIAL INTELLIGENCE AND AGRICULTURE

Transfarmative Companies Innovating Agriculture with AI

Who should be on your radar?

RYAN RIDLEY
MANAGING EDITOR

The ag tech sector never ceases to amaze with its new techniques, technologies, and processes. It seems almost daily that new innovations and ideas are presented to the market.

It's a daunting task to keep tabs on everything, but the Farms.com team is committed to providing a variety of relevant information to readers of the Precision Agriculture Digital Digest.

One area of precision ag where innovation continues to accelerate is artificial intelligence (AI). According to a research study by Markets and Markets, the global AI market for agriculture is expected to reach USD 4 billion by 2026 with a compound annual growth rate of 25.5%.

There are several areas where AI is used in agriculture—intelligent spraying, yield predicting, crop and soil monitoring, price forecasting, disease diagnosing, aerial imaging, livestock health monitoring, automatic weeding—just to name a few.

Melanie Johnson explores AI's uses in agriculture on page 15, but who are the players?

In this article we explore six companies in agriculture that continue to innovate within the ag tech space by using AI.

FarmWise

Weeds—the enemy of every producer. The FarmWise system uses AI and robotics to mechanically remove individual weeds with sub-inch precision.

PHOTO: gremlin/E+ via Getty Images

The company recently raised $45 million in Series B funding for its line of AI-powered farm machinery, including its popular robotic weeder dubbed Titan. Titan can be used on several vegetable crops including broccoli, cauliflower, and leafy greens.

According to its website, FarmWise uses a database of 450 million images to train its AI system, using machine vision and robotics to cut weeds from the ground. It's adaptable to different crops, soil, and growth stages.

The company currently has a fleet of 12 Titan robots which operate on a pay-per-acre model.

Raven Industries

Producing more with less. We are sure you have heard that saying before, but how can it be achieved? Through technology and innovation says well-known precision ag tech provider, Raven Industries.

The company is dedicated to bringing new innovations and technologies to the market that can help farmers feed a growing population. Artificial intelligence and machine learning are at the forefront of these developments.

Whether its automation, connectivity, or guidance, Raven Industries is using AI to its—and the farmer's—advantage.

CNH Industrial (parent company of Raven) recently opened a **15,000-square-foot engineering center** in Scottsdale, Arizona, that Raven will use to develop artificial intelligence, machine learning and computer vision.

"We are designing, developing, testing and deploying technology solutions that will impact the ability for farmers to feed our growing population amid labor shortages with greater efficiency," explained Senior Director of Engineering for Raven, Phil Corio. "As we continued to consider our growing needs for AI and machine learning development, it became clear that we needed a specialized space to accomplish our goals — and the Phoenix metro area emerged as the ideal place to do this."

"WE ARE DESIGNING, DEVELOPING, TESTING AND DEPLOYING TECHNOLOGY SOLUTIONS THAT WILL IMPACT THE ABILITY FOR FARMERS TO FEED OUR GROWING POPULATION AMID LABOR SHORTAGES WITH GREATER EFFICIENCY."

PHIL CORIO, RAVEN INDUSTRIES

Blue River Technology

Blue River Technology is an ag tech company that uses computer vision, machine learning and robotics to create intelligent farm machinery. The company was acquired by John Deere in 2017 for $305 million.

Blue River Technology's main product, See and Spray—available on John Deere sprayers—precisely targets and sprays weeds in season in corn, soybean, and cotton, reducing herbicide use for farmers (and saving them money) while improving weed control.

It's weed solution "leverages deep learning algorithms paired with a computer vision system to create the ultimate virtual field scout for agriculture. Through 5+ years of collecting millions of images of plants and weeds across hundreds of thousands of acres, See & Spray™ is capable of detecting a variety of crops and weeds to provide weed control throughout a growing season," says its website.

It's dual tank configuration on the See and Spray Ultimate enables farmers to use two independent tank mixes—applying different chemicals at different rates, all in one pass.

CropIn

CropIn is a pioneer in the ag tech sector—it uses artificial intelligence, machine learning, and remote sensing to create an interconnected data platform. Its suite of products enables customers to leverage digitization and AI at scale to make decisions that increase efficiency, scale productivity, and strengthen sustainability.

Its solutions include:

- **Farm Management Solution** — geotagging farms, digitizing farm and farm records, monitoring crop productivity, improving farm efficiency and boosting productivity.
- **Farm Risk & Assessment Solution** — AI-powered crop analytics solution that provides risk mitigation and forecasting intelligence based on historical data, weather insights, and field-level data.
- **Supply Chain Traceability Solution** — oversees the entire production process from field to packinghouse, processing and beyond.
- **Seed to Shelf Traceability Solution** — QR code-enabled farm-to-fork supply chain traceability.

Trace Genomics

Based in San Francisco, California, Trace Genomics use high-throughput DNA sequencing, AI and a growing database of microbial species living in soils to identify and profile the soil microbiome. The company designed the first microbiome test to provide growers with insights on how to achieve more efficient nutrient use—how to reduce input costs and crop disease risk—and which seeds, rotations or biological agents work best for their soils.

"Trace Genomics' platform digitizes and decodes the living soil using genomics, advanced science, and machine learning. Our recent advancements interpreting the soil environment reveals the importance of soil health, advances new product discovery, and informs optimal product placement," said Poornima Parameswaran, President and Co-Founder.

"OUR RECENT ADVANCEMENTS INTERPRETING THE SOIL ENVIRONMENT REVEALS THE IMPORTANCE OF SOIL HEALTH, ADVANCES NEW PRODUCT DISCOVERY, AND INFORMS OPTIMAL PRODUCT PLACEMENT."

POORNIMA PARAMESWARAN, TRACE GENOMICS

Hummingbird Technologies

No stranger to AI, Hummingbird Technologies is an AI business that utilizes machinery learning and computer vision techniques. According to its website, the company uses imagery and data analytics from UAV, plane, and satellite technology, combined with soil, weather and historic management data to provide farmers with actionable intelligence of their crops at a canopy level, and at critical decision-making junctions in the season.

Hummingbird Technologies has a big focus on sustainability — its AI tech models and measures the effect of management practices on the environment, enabling farmers to move toward more sustainable practices.

We cannot possibly cover *every* AI-powered company that is innovating in the agriculture space — there are simply too many of them (which is excellent). If you would like us to cover other companies not mentioned above, send a note to **ryan.ridley@farms.com** — we will do our best to showcase more businesses in the December 2022 edition. | pag

PHOTO: hudiemm/iStock/Getty Images Plus

AGCO ACQUIRES JCA

This acquisition will help AGCO develop precision ag and autonomous products

DIEGO FLAMMINI
FARMS.COM

AGCO acquired a technology company to help the farm equipment manufacturer develop precision agriculture and autonomous products.

In May, AGCO announced its purchase of JCA Technologies, based out of Winnipeg, Man.

JCA's path planning, sensor fusion and remote-control products are already in use by other equipment manufacturers.

But one area of JCA's business proved to be what drew AGCO towards its acquisition, said Seth Crawford, general manager of AGCO's precision agriculture and digital division.

"What was most appealing for us was their efforts around autonomous software," Crawford told Farms.com. "They were really involved in many of the early efforts of the autonomy we're starting to see in the market today."

Bringing JCA into the fold will allow AGCO to implement a retrofit strategy.

Fewer than 300,000 new tractors are sold in the U.S. each year.

But approximately 3 million tractors between three and 15-years-old are in use.

AGCO's acquisition of JCA allows customers to consider a retrofit autonomous option rather than purchasing a new piece of equipment, Crawford said.

"We're focused on the machines farmers have in their fields, so things like tractors, combines and sprayers," he said. "Farmers are looking at their tractors asking how they can upgrade it without buying a $500,000 tractor. We think this gives us an opportunity to bring some performance enhancing retrofit products to our customers."

One benefit of autonomous equipment is the stress it can help alleviate from farmers.

The U.S. ag sector faces a labor shortage.

Data from the **USDA's Economic Research Service**, for example, shows the number of hired farmworkers has dropped from 2.33 million in 1950 to 1.13 million in 2000 – a decrease of 51 percent.

Finding skilled labor is challenging, but autonomous equipment removes that challenge, Crawford said.

"There's a short window to plant and harvest crops and often a limiting factor of those two is labor," he said. "If we can develop a productive solution that farmers can trust and is easy to use, we can get to a point where farmers aren't concerned about finding labor."

Another potential benefit of autonomous equipment could be seen in a farmer's mental health.

Data from a **2019 American Farm Bureau Federation survey** indicated stress and weather as issues affecting a farmer's mental health.

With autonomous equipment, a farmer may not have to worry about putting in a 16-hour day because the equipment can perform the tasks itself.

"There's nothing more stressful than wanting to get the crop off," Crawford said. "But at the same time, the human body can only go so many hours without extreme fatigue. I do think there's a farmer mental health aspect to autonomous equipment."

Farmers may not have to wait that long before seeing some AGCO autonomous equipment in action.

AGCO plans to release some autonomous software on a limited test basis in summer of 2023, Crawford said. | pag

SOIL, FARM EQUIPMENT, AND DINOSAURS

New study states that heavy farm equipment is responsible for soil compaction at depths below tillage levels affecting crop growth

ANDREW JOSEPH
FARMS.COM

While most dinosaurs were the size of chickens—their size belies the sexiness of it at museums, hence you don't see them being represented—many were as large as a tank and just as heavy.

The sauropods—the heavy cow-like dinosaurs that spent their existence eating vegetation and avoiding predators—were even bigger.

For fans of the ***Jurassic Park*** movies (based on a pair of books written by the late Michael Crichton), they were the first creatures we spied on in the very first movie, munching leaves from the tops of trees—up on their hind legs to reach the tenderest greens.

Whether it's the 26-ton *Apatosaurus*, the 33.6-ton *Brontosaurus*, or the real heavyweight *Argentinosaurus* at 85 tons, there's no questioning that when they moved, the earth shook, and things got trampled.

It's that trampling due to excess weight that has some in the ag community concerned.

According to a recent study in the May 24, 2022 edition of ***PNAS (Proceedings of the National Academy of Sciences)*** researchers **Thomas Keller** (Department of Soil & Environment, **Swedish University of Agricultural Sciences**) and **Dani Or** (Department of Environmental Systems Science, **Swiss Federal Institute of Technology** in Zürich), farm equipment has become so heavy—reaching the weight levels of the largest sauropods—that it is causing subsoil compaction in root zones below tillage depths that affect soil functionality.

Our tractors and combines have indeed become bigger, just as there is no denying that the mechanization of farming has revolutionized farmers' crop yield efficiency. But, as the study points out, a higher capacity has resulted in heavier farm vehicles.

A laden combine harvester in 1958 weighed 4.4 tons, while its 2020 counterpart can weigh just under 40 tons. That's almost 10x heavier in the evolution of the combine harvester.

The farm machinery's weight increase over the years is the result of increased power and capacity combined with wider cutter boards and a larger grain tank capacity, all of which provide an improved harvest efficiency.

It should also be pointed out that tires for the farm equipment have become larger, too, in both volume and width. With greater flexibility, it allows for a lower tire inflation pressure depending on the load for floatation and traction and prevents the whole kit and kaboodle from sinking into the soil.

It's not a unique development, according to the researchers. They point to animals such as camels that must "float" over soft ground (the sand), and have evolved with a relatively high footprint contact area.

The study states that "modern agricultural machinery belongs to the floating category, with a high contact area"—just like the sauropods.

We know that farmers understand that soils are complex ecosystems consisting of fragile structures like pores and pathways that allow water to reach roots and air to circulate and allow beneficial organisms to propagate. With every step we take on our soil, we compact it just a little bit.

PHOTOS: VeremeeV_1980 – stock.adobe.com, oticki – stock.adobe.com

However, the researchers state that with the heavy equipment we have today, soil compaction isn't just at the top, it's down deep within the subsoil.

Soil compaction is occurring at 20 centimeters (7.9 inches)—below where we generally till.

That's important because the compacted depth restricts where a plant's roots can grow as it seeks water and deeper-soil nutrients. The compaction also reduces the amount of oxygen able to permeate the soil, which adversely affects organisms in the soil (and the crops, too).

However, farmers will indeed add fertilizers at a depth where a plant's roots systems can feed from—uh, how much is fertilizer these days?

The weight conundrum leads to a perplexing problem, according to the researchers.

But there is a solution.

AgriBrink has evolved a ***Tire Pressure Adjustment System.***

Headquartered in Moorefield, Ontario, the system is an on-the-go tire pressure adjustment system that allows a vehicle's heavy tires to be inflated when using on road but will perform a rapid deflation upon entering a field.

When the fieldwork is done and the operator is ready to enter a roadway, the tires are inflated again.

A superb idea, that inflates and deflates the tires without the operator having to leave the comfort of the cab, that above all else, lessens a tire's imprint upon the life-giving soil.

As the vehicle's tires are deflated to reduce tire pressure, the tires' footprint flattens out under the weight of the vehicle—not completely, though—just enough to widen and lengthen the tire. This allows the surface area of the tire—the part that touches the soil—to increase.

While it may seem counterproductive, increasing the tire's surface area moves the weight of the vehicle across a larger area and thus reduced soil compaction.

It's simple physics. To reiterate, the wider a tire's area, the less stress is placed upon the corresponding ground.

The *Tire Pressure Adjustment System* from AgriBrink is fast during both inflation and deflation. It's also versatile, too.

The system offers an operator manual override system should any part of the control system suffer a control system failure. The benefit of that is to ensure no downtime is experienced.

Another great aspect of the *Tire Pressure Adjustment System* is that it is removable so that an operator can move it from a baler, grain buggy, manure spreader, tractor, or whatever you want and need. To attach and detach the system, the quick-attach table is only fastened by four bolts.

The sauropods weighed so much and trampled plants and compacted the soil and subsoils that allowed their food sources to grow. Your farm vehicle need not be the dinosaur on the farm.

Although we aren't at the tipping point where our farm equipment is negatively rendering crop yield—if form holds and larger vehicles are forthcoming, then having a *Tire Pressure Adjustment System* will help maintain your farm's soil structure and prevent your farm from going the way of the dinosaurs. | pag

BARRIERS TO ADOPTING DIGITAL AGRICULTURE

Costs and ROI are among the hurdles, a new report shows

DIEGO FLAMMINI
FARMS.COM

Farmers want to adopt precision agriculture practices, but the initial investment is keeping them back.

That's what a new industry report says.

The American Fruit Grower's **2022 State of the Industry Report** surveyed 518 growers, packers and other industry reps about multiple issues.

Forty-five percent, or 233 respondents, said they don't use precision ag and have no plans to do so.

When asked what's preventing them from implementing digital agriculture tools, 42 percent, or 217 respondents, "say the tech is too expensive," the report says.

This is in addition to 155 respondents indicating they're unsure of precision agriculture's return on investment.

And 8 percent, or 41 people, identified new technology as their greatest concern.

There also appears to be a divide based on the size of the operation.

"Smaller growers generally say they can't afford the time or money necessary, but larger growers say they can't afford not to implement digital agriculture because they need to save time and money," the report reads.

Of the total responses, 39 percent, or 202, indicated using precision agriculture.

The top five technologies used are weather software, irrigation sensors, GPS technology, disease prediction software and grid soil sampling.

"SMALLER GROWERS GENERALLY SAY THEY CAN'T AFFORD THE TIME OR MONEY NECESSARY, BUT LARGER GROWERS SAY THEY CAN'T AFFORD NOT TO IMPLEMENT DIGITAL AGRICULTURE BECAUSE THEY NEED TO SAVE TIME AND MONEY."

Some of the reasons cited for adopting precision ag include:

- **Save cost of production**
- **Conserving and the appropriate use of water**
- **Increase yields and reduce costs.**

The United States Department of Agriculture recently started tracking the number of farmers using precision agriculture.

In August 2021, the USDA's **Farm Computer Usage and Ownership report** surveyed 15,000 farms nationwide and asked the following question: "In the last 12 months, did this farm or ranch use precision agriculture practices to manage crops or livestock?"

Only 25 percent, or 3,750 farms, indicated this to be accurate.

The highest number of farms using precision ag, based on the survey, are in North Dakota.

Fifty-four percent of respondents in that state said they're using precision ag.

West Virginia, with 7 percent of surveyed farms indicating using precision ag, was the lowest in the survey. | pag

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CANADIAN AGRICULTURE AND ENERGY: LEADERS IN INNOVATION, COLLABORATION AND SECURITY

A perspective from the Canadian Association of Petroleum Producers

The agriculture and energy industries have more in common than you might think.

Both are national in scope and are essential to Canada's economy; both are continually finding ways to operate with less environmental impact. And both have increasing roles to play in global security and prosperity.

Vital economic drivers

Through its multi-billion-dollar national supply chain, oil and natural gas is truly a national industry. The oil and natural gas sector contributes $100 billion annually to the country's GDP and provides more than 500,000 direct and indirect jobs across the country. Export of Canada's oil, natural gas, and refined products contributed $112.6 billion to Canada's economy in 2020.

Similarly, agriculture is an economic mainstay. In 2020, Canada exported nearly $74 billion in agriculture and food products. The domestic market is also critical – in 2019, Canadians spent $244 billion on food and beverage products.

Innovation and collaboration

Producers in both industries have a clear line of sight to reducing environmental impacts on air, water and land.

Ongoing environmental performance improvement has always been critical to the Canadian energy sector. For decades, the industry has been reducing emissions, managing water more effectively, reclaiming disturbed land faster and enhancing biodiversity. Like agriculture, the energy sector relies on innovation and advanced technologies that offer industry-wide improvements through collaboration and knowledge sharing.

The high degree of collaboration among energy producers is a hallmark of Canada's oil and natural gas industry. Numerous organizations facilitate research, develop new technologies, share best practices and provide funding for environmental initiatives. For instance, since 2012, members of Canada's Oil Sands Innovation Alliance (COSIA) have invested $1.8 billion to develop more than 1,100 shared technologies.

Secure and reliable supply

Agriculture and energy products and commodities also make a difference to importing countries that need a secure supply of energy and food.

Current world events, especially Russia's ongoing aggression in Ukraine, highlight the global significance of energy security. The opportunity to help improve and stabilize global energy security is not just a tremendous opportunity for Canada's oil and natural gas sector, it could also be considered an obligation to assist our allies and trading partners. The same could be said about supplying high-quality agricultural products to a hungry world, especially as supplies of staples such as wheat are coming under pressure due to blocked supplies from Ukraine.

Canada has a clear advantage when it comes to offering safe, reliable, responsibly produced energy and agricultural products to global markets. As a nation, we are poised to play an ever-larger role.

The world needs more Canada!

BITS & BYTES

01

RTK Accuracy That Doesn't Break the Bank

RTK Guidance is no longer a luxury thanks to Agra-GPS' CRG receiver. Named because of its compatibility with several machinery brands, the Chameleon RTK Guidance (CRG) integrates with Fendt, John Deere, CLAAS, CAT and Rogator machinery via a simple plug-and-play setup.

MORE

02

Bloomfield Robotics Wins Future of Life Online Challenge

And they didn't just win bragging rights — the company has landed products and services valued at $1M from cloud service provider, Akamai Technologies. This will help the company move data more efficiently in the cloud, allowing farmers to interact more seamlessly with their data.

MORE

03

Removing the Bad Apples

The shrinking labor force in apple production makes manual thinning economically infeasible. Luckily, Penn State engineers have developed the first-ever prototype 'end-effector' that can remove unwanted apples from trees — it's the future of fruit thinning.

MORE

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Trends Shaping North American Food Production

AEM has released a whitepaper exploring 13 specific trends that are changing how agriculture works today, which will impact how farmers will reshape how food will be produced in the coming decade. No one said it's going to be easy.

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Look Ma, No Hands

John Deere now offers a new AutoTrac Ready option for select full-size Gator Utility Vehicles allowing for precise grid sampling, spraying, and field boundary creation.

MORE

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Taking Drone Technology to New Heights

Introducing the V40 by Sky Ag Tech and XAG, a revolutionary mapping-then-application agriculture drone that sprays 20 acres per hour. This is the first tilting twin-rotor structure ag-drone in the world that provides unique mapping-then-application solution for precision farming.

MORE

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New Bachelor of Digital Agriculture Degree at Olds College

On campus for fall 2023, the program will immerse students in global challenges in agriculture, recognizing the convergence of exponential technologies and diverse perspectives. Students will engage in real-world problems and explore solutions using digital agriculture technologies and practices.

MORE

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Transforming Soil Nutrient Management for Agronomists

Precision Planting has created a new set of powerful, precise tools for agronomists—dubbed Radicle Agronomics. The new suite of tools eliminates manual and error-prone processes allowing agronomists to focus on what's important—agronomic issues their farmers are facing.

MORE

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Trimble Invests in Sabanto

Sabanto is an ag tech company that focuses on "autonomous workflows throughout the farming cycle being offered as Farming as a Service (FaaS)." The company addresses challenges that farmers face by providing FaaS through various smaller tractors equipped with its autonomous technology to perform in-field operations.

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Building autonomous electric tractors

Foxconn, a Taiwanese company known for manufacturing Apple products and Nintendo gaming systems, will build the equipment and battery packs for Monarch Tractor's autonomous electric tractors out of a former General Motors plant in Lordstown, Ohio.

MORE

PHOTO: FluxFactory/E+ via Getty Images

PRECISION PLANTING SET TO OFFER NEW SPRAYER TECHNOLOGIES

Soon to hit the market from Precision Planting come three new sprayer technologies

ANDREW JOSEPH
FARMS.COM

Precision Planting has three new spraying technologies it said are ready to make their commercial debut soon.

According to **Andrew Feucht**, the Product Marketing Specialist with the Tremont, Illinois-headquartered Precision Planting, its three new products are ***ReClaim***, ***Symphony***, and ***Vision***.

The company develops smart products to improve planting, liquid application, and harvesting for farms across the world using new products capable of being retrofitted onto current equipment, or via a new product using a Precision Planting solution.

ReClaim is a boom recirculation system that ensures the operator is primed with the proper combination of products without a farmer having to test-spray it onto the ground to check the liquid's consistency. It saves the operator both time and money with liquids saved. Feucht said that *ReClaim* is a retro-fit product that can be added to any sprayer and can be used with any traditional type of nozzle.

Symphony is PWM (pulse width modulation) controlled-nozzle system that maintains drop-put size and pressure, according to Feucht, as speeds and rates are changed. This will allow operators to provide a consistent pattern on the crop.

Vision is an advanced camera system—and although farthest away from a commercial sale, per Feucht, it's coming, as the company sees it as part of its see-and-spray technology. By adding cameras to sprayers, it's to provide a precision-ag boom for sprayer guidance, weed detection, crop health, and more. | pag

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HOW AI IS USED IN AGRICULTURE

The main things you need to know

MELANIE JOHNSON
FARMS.COM

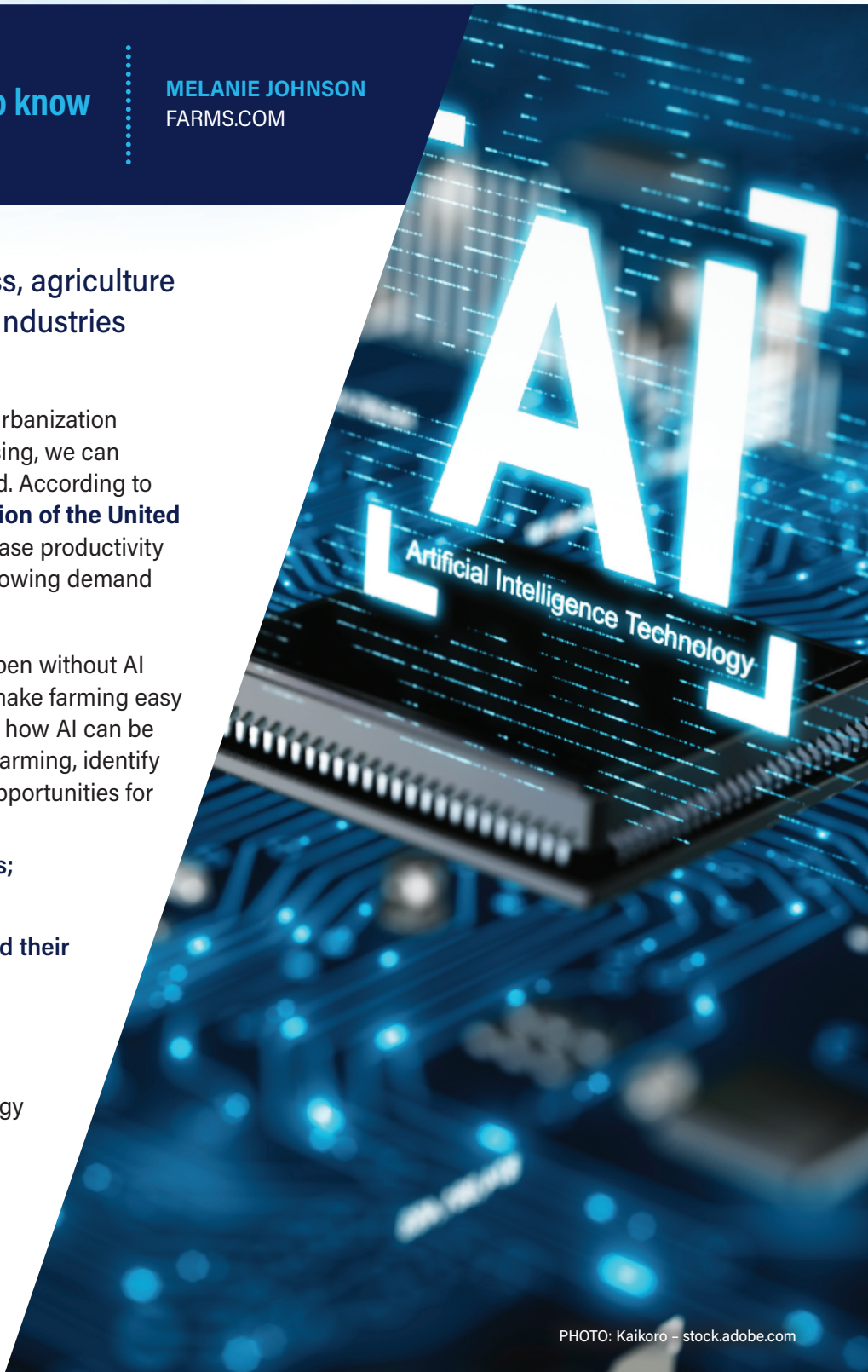


PHOTO: Kaikoro – stock.adobe.com

Despite being a risky business, agriculture is one of the most important industries worldwide.

With our global population growing, urbanization increasing, and disposable income rising, we can expect an increase in demand for food. According to the **Food and Agriculture Organization of the United Nations**, global farmers need to increase productivity by 60 percent by 2050 to meet the growing demand for food.

However, none of this is going to happen without AI (artificial intelligence) solutions that make farming easy and efficient. This article will examine how AI can be used to improve the sustainability of farming, identify current challenges, and explore the opportunities for AI to tackle these challenges:

- **Understanding AI—how it works;**
- **Use of AI in agriculture;**
- **Traditional farming methods and their challenges, and;**
- **AI applications in agriculture.**

The past five decades have seen the highest boom in agricultural technology than the previous 10,000 years.

While our ancestors used to farm with hand-held tools and draft animals, present-day farmers with the means use massive machinery, automated irrigation systems, and advanced plant breeding techniques to cultivate crops on a scale unimaginable just a few generations ago except in far-seeing science fiction.

Because of our growing population, today's farmers are under more pressure to meet skyrocketing food demand while facing factors that threaten harvests: unpredictable weather patterns, unknown diseases and pests, volatile markets, and consumer trends.

Fortunately, new technologies like AI, big data, and the internet of things (IoT) can help farmers deal with these challenges by automating tasks and standing practices that reduce waste and enhance efficiency at every stage of production—from sowing seeds to harvesting crops.

Understanding AI: How it Works

AI is the art of making machines think like humans. It refers to the ability of computers or machines to mimic human capabilities such as learning, reasoning, and self-correction. In practice, the term "artificial intelligence" can be applied to a combination of activities, such as strategizing a game plan or playing chess.

AI encompasses various tasks, from computer vision to robotics, translation, and predictive analytics to transfer learning (**https://blog.superannotate.com/speed-up-labeling-process-using-transfer-learning/**). Artificial intelligence has the potential to transform industries and solve some of the world's most difficult problems, including agricultural activities.

Use of AI in Agriculture

AI is one of the most promising fields in agriculture, having the potential to revolutionize the industry.

Used in many different ways, including yield growth and soil mapping, the demand for AI is increasing as farmers are constantly looking for innovative solutions that help them overcome challenges posed by weather, pests, and plant diseases.

Via the use of advanced technologies such as machine learning, computer vision, object detection, robotics, and IoT sensor-based surveillance systems, AI offers tremendous potential for improving the farming experience.

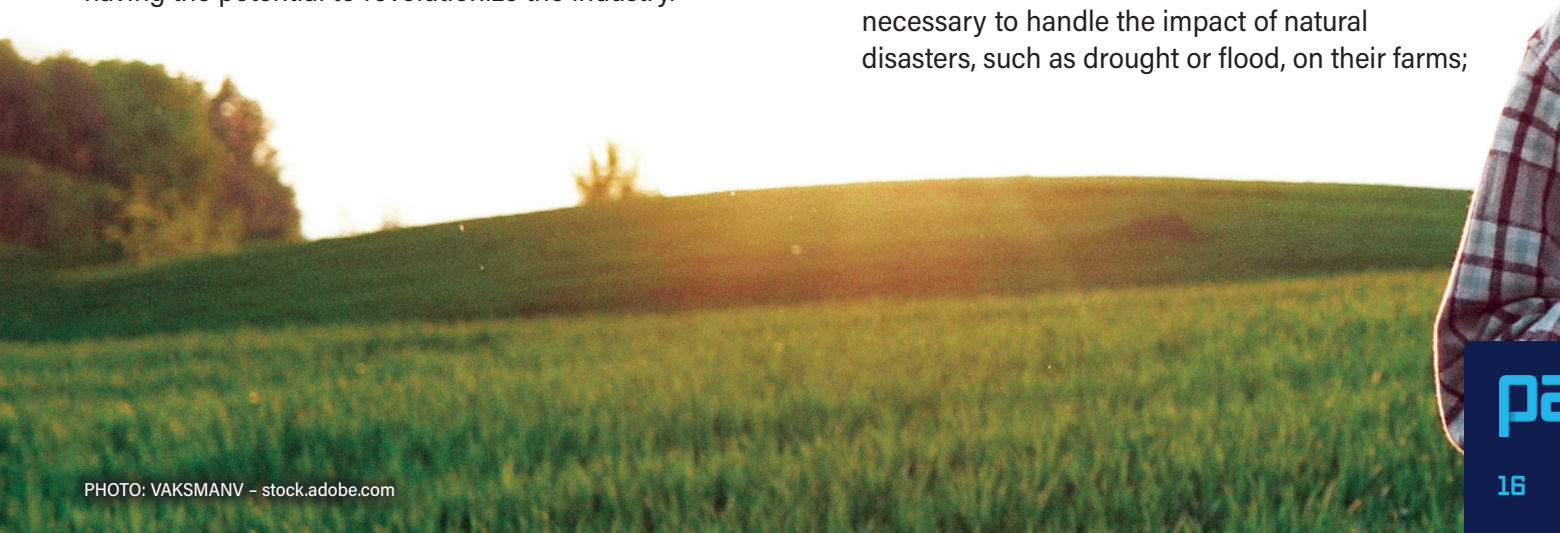
For example, by using an AI system to manage crop irrigation and fertilization, a farmer could reduce costs and waste while increasing yields. Farmers can keep track of each step in crop cultivation, and improve farm production by monitoring various factors such as soil quality, water management, and other weather conditions.

Traditional Farming Methods and Their Challenges

Traditional farming methods are inefficient, ineffective, and unsustainable.

Some of the challenges faced by farmers are:

- Climate change is a big challenge for a farmer, as changing weather patterns have affected the soil quality and crop yields. Climate change is causing droughts and floods that affect the production of crops;
- Lack of technical knowledge leads to poor farming practices. It is important to provide nutrients in the soil with a specified ratio, as the deficiency of nutrients can lead to poor quality of crops;
- Not having access to information and technology, small-scale farmers often lack access to capital (money). As such, they may lack the funds necessary to handle the impact of natural disasters, such as drought or flood, on their farms;



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- Another challenge for farmers is saving water by reducing evaporation and diffusion of water. It becomes difficult for farmers to supply sufficient energy for irrigation pumps, fans, cooling towers, cars, and tractors;
- The cost of cultivation is high—and thanks to such factors as the Covid pandemic, poor weather, and the invasion of Ukraine by Russia—farmers can't afford to buy seeds and fertilizers, tractors, and other machinery, irrigation equipment, pesticides, and insecticides resulting in low yields per hectare.

AI Applications in Agriculture

Modern farming techniques have made it possible for farmers to grow more crops in a shorter period, thus increasing agricultural productivity. The more developed countries are reaping the benefits of modern farming methods, which have enabled them to boost their agricultural production capacity.

With fewer resources needed to grow healthy crops, farmers can focus on innovation. They'll be able to develop new products with higher quality ingredients while keeping up with changing consumer demands.

As a result, farmers can compete globally against other businesses that may not have access to these technologies or resources.

And these benefits aren't just limited to growers; they extend throughout the supply chain, from seed suppliers through delivery at grocery stores.

Some applications of AI used in agriculture are:

- **Increase in yield:** The use of smart farming technologies can help farmers increase the yield per acre and thus increase the revenue from their farms;
- **Cost reduction:** Smart farming reduces the cost of production, which means that consumers pay less for their food while farmers make more profit at the same time;
- **Reduction in labour and water consumption:** Smaller farms do not require as much labor or resources to operate as larger ones, so they are more efficient and thus more environment-friendly than large-scale operations like factory farms (which tend to be heavily mechanized). Another advantage for small-scale producers is that they do not need to invest as much money into buying expensive equipment like tractors or harvesters because these tools become obsolete after a few years anyway; instead, they can invest more money into improving quality control methods such as testing soil samples before planting crops so that nothing goes wrong later down the line when those same seeds begin growing into plants with poor results.

Monsanto Spraying Systems

The **Monsanto Company**, founded in 1901 and headquartered in St. Louis, Missouri, is an agrochemical and agricultural biotechnology corporation, whose best-known product is perhaps the glyphosate-based herbicide, ***Roundup***.

The company's development of crop spraying systems demonstrated impressive results in reducing chemical run-off. When sprayed directly onto weeds it can kill them off even when fertilizers are added afterward.

Instead of spraying thousands upon thousands of individual fields of crop seedlings, a Monsanto spraying system only needs to spray three or four specific areas, leaving the rest untouched.

But it's not your typical spraying system. It utilizes a drone that flies above the fields with small devices that do the actual spraying.

As it flies, drones collect information such as soil moisture levels and other factors and the exact area where the spraying is needed. It then transmits images of those areas back to the control station to show the spraying location.

From there, a determination can be made whether to spray or not. If yes, the technology determines the air distance needed for accurate spraying.

The whole process takes seconds, and afterward, farmers can examine the results to better understand how to boost crop growth.

Artificial Intelligence and IoT Increasing Agricultural Productivity

AI and the Internet of Things (IoT) have a significant impact on agricultural productivity.

According to an article published by ***Tech Target*** (**https://www.techtarget.com/searchenterpriseai/feature/Agricultural-AI-yields-better-crops-through-data-analytics**), AI is making its way into agriculture, with applications including autonomous tractors that can take over many of the tasks currently performed by farmers.

With this technology, farmers will make better decisions about soil health and crop yield while saving time and money.

With AI integrated into equipment such as tractors, farmers have access to information about their fields.

They can use this data immediately for making decisions about fertilizer application rates or irrigation schedules based on weather conditions like rainfalls or heat waves that affect plant growth rates differently depending on when they occur during growth periods.

This efficiency helps farmers produce more crops per acre while reducing costs associated with manual labour for methods like plowing fields manually versus automated machinery to monitor soil moisture and prevent overwatering crops.

Other AI uses include:

- **Crop Health Monitoring**—a crop health monitor is used to detect diseases or pests and alert the farmer to take action. This system can help farmers save time, money, and resources by notifying them of problems before they become too severe;
- **Crop and Soil Analysis**—AI systems help analyze crop growth patterns about environmental factors such as weather, and soil conditions, which may lead to a better understanding of how certain crops grow under different conditions worldwide.

With regards to Irrigation and Water Management, there are several ways AI is used in agriculture for irrigation purposes.

1) Using sensors attached to pipes that send data directly into cloud platforms where machine learning algorithms are applied;
2) Using drones equipped with cameras capturing images from above ground level plus other information such as soil temperature measurements taken at regular intervals from sensors planted beneath the ground. This information is then used as training data for platforms where machine learning and AI algorithms operate.

Artificial Intelligence is used to increase productivity, reduce costs, and improve the quality of agricultural products.

As noted by the applications discussed, this technology is already making a difference in the lives of farmers around the world.

It will be interesting to see how this area continues to develop over time with innovations like drones, robotics, and even autonomous vehicles. | pag

CLAAS BRINGS NEW COMBINE TO MARKET

The TRION 740 is a Class 7 combine

DIEGO FLAMMINI
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CLAAS has brought a new Class 7 combine to market.

The TRION 740 is a departure from typical industry trends, said Greg Frenzel, combine product manager with CLAAS.

"It's kind of on the smaller end," he said. "We've seen industry go to the bigger machines, but we came to the realization that the larger equipment doesn't fit everybody.

"This machine was built on three things: reliability, affordability and performance."

CLAAS markets the TRION to farmers who farm between 1,000 and 3,000 acres.

These sizes of farms make up more than 30 percent of all combines sold in North America.

Specs on the combine include:

- **430 maximum horsepower,**
- **341-bushel grain tank capacity,**
- **Unloading rate of 3.8 bushels per second, and**
- **A Cummins L9 engine.**

The combine is available with wheels or with tracks.

Opting for the tracks does increase the combine's weight from 40,500 pounds to 47,000 pounds.

One key feature of the TRION 740 is its single rotor.

Most combines in North America have two, but removing one has its benefits, Frenzel said.

"Instead of having two rotors in the separation, we now have one bigger rotor (13.75 ft. long x 22.5 inches in diameter) for better crop flowability," he said.

The threshing drum is 56 inches wide with a 24-inch diameter.

In terms of attachments, the TRION can handle corn heads and drapers up to specific sizes.

"We can go up to as 12-row, 30-inch spacing corn head and it can be a chopping model," Frenzel said. "If we're talking about a draper or platform head, we can go up to 40 feet."

Another innovative area on the TRION is the cab.

CLAAS has redesigned the cab for a better operator experience, Frenzel said.

"We've redesigned the front pillars in the cab for better visibility, we've moved some monitor brackets around so not everything is on the right-hand side. The unload auger will be on the left-hand side, there will be a swivel seat and an active refrigerator." | pag

"THIS MACHINE WAS BUILT ON THREE THINGS: RELIABILITY, AFFORDABILITY AND PERFORMANCE."

PHOTO: claasofamerica.com

AGCO PARTNERS WITH APEX.AI FOR ROBOTIC PLANTING

New Apex.OS software from Apex.AI being used by partner AGCO to drive new precision ag technology solution

ANDREW JOSEPH
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Apex.AI, a developer of safety-certified software for mobility and autonomous applications, announced on June 9, 2022, that partner **AGCO** is adding new capabilities to its autonomous farming robot, the **Fendt *Xaver*** concept vehicle, by incorporating the easy-to-use ***Apex.OS*** software development kit.

AGCO, headquartered in Duluth, Georgia, USA, is a global manufacturer and distributor of ag machinery and precision agriculture tech.

Apex.AI has enabled AGCO's engineering team to integrate several autonomous driving components into the Fendt *Xaver*, such as lidar object detection, collision checking and planning, all using the state-of-the-art framework and developer tools within the *Apex.OS*.

PHOTO: fendt.com

This technical partnership expands upon an existing relationship between the two companies when AGCO announced a strategic investment in Apex.AI, a Palo Alto-based company, in December of 2021.

"Apex.OS is a foundational software framework and development kit for rapidly developing advanced autonomous capabilities," stated **Christian Kelber**, the director of engineering with AGCO. "The technology has helped AGCO shorten R&D timelines of our smart agricultural solutions and for the future of highly automated robots. Coming from the automotive industry, Apex.AI enables us to implement safety-critical applications from autonomous driving that can be deployed across our range of solutions globally."

The autonomous robot concept was developed by Fendt as part of a research project. It is capable of planting seeds on a farm 24 hours a day with centimetre precision thanks to the *Apex.OS* software.

Featuring a lightweight electric design that produces zero emissions, the Fendt *Xaver* uses 90 percent less energy than conventional machines.

AGCO has leveraged *Apex.OS* in order to develop a software stack for *Xaver* based on automotive industry standards, extending its real-time autonomous functions.

AGCO Your Agriculture Company Apex.AI

A Cloud-connected fleet of Fendt *Xaver* robots is controlled through an app and providing the user real-time data from each unit, including its location, status, and diagnostics.

"We are leveraging our success in the automotive and autonomous driving industry and applying it to areas that have similar functional safety needs such as agricultural, industrial, mining and construction," explained **Jan Becker**, the co-founder and Chief Executive Officer of Apex.AI. "Apex.OS allows the software architecture to be modular, scalable and safe, enabling customers to transition their R&D projects to commercial-ready products in record time."

Year after year, there is more technology being utilized by the global agricultural sector. Because of this demand, there is a clear need to design and deploy a safe autonomous system even when it is a complex and time-consuming task.

"APEX.OS ALLOWS THE SOFTWARE ARCHITECTURE TO BE MODULAR, SCALABLE AND SAFE, ENABLING CUSTOMERS TO TRANSITION THEIR R&D PROJECTS TO COMMERCIAL-READY PRODUCTS IN RECORD TIME."

The goal of Apex.AI is to help agriculture, automotive and industrial customers extract the complexity of software-defined vehicles and machines with the *Apex.OS* software—a software the company is proud to state has achieved the highest level of automotive software safety *ISO 26262 ASIL-D* in 2021.

By bridging the gap between R&D and production quality solutions, customers using *Apex.OS* can overcome real-time and reliability software challenges at a record pace. | pag

01

Understanding the Value of Fungicide Applications

A Climate FieldView digital integration specialist demonstrates how to utilize Climate's field health imagery and yield analysis tools to show how a fungicide application of Delaro® Complete yielded higher than the untreated check.

WATCH

02

Setting Up Measurements in AutoPath™ — How To

It's imperative to take the correct steps and use key measurements when it comes to a successful AutoPath™ source operation recording. John Deere provides an overview how it should be done in this video.

WATCH

03

FarmDroid: Fully Autonomous Robotic Planter

A Haggerty Creek rep explains how the fully autonomous FarmDroid planter works on sugar beets. Autonomy in agriculture is amazing!

WATCH

04

Partners in the Field: FieldView & FarmTRX

Farmers with older combines that do not have a CAN bus connection to FieldView can use the FarmTRX system to make the connection for complete harvest insights.

WATCH

pag TECH CLIPS

05

The Benefits of Precision Ag Tech

Woolliams Farms shares how precision agriculture technology helps their operation save time and money — all while improving planting practices. Watch and learn how this farm utilizes precision ag to increase their bottom line.

WATCH

06

Monosem ValoTerra

The ValoTerra planter's 100% electric architecture, unique seed metering box and planting accuracy and uniformity guarantees improved emergence and productivity.

WATCH

08

See & Spray™ Ultimate — Dual Product Tanks

John Deere's dual tank configuration on the See and Spray™ Ultimate enables farmers to use two independent tank mixes—applying different chemicals at different rates, all in one pass.

WATCH

WHAT'S NEW IN THE WORLD OF PRECISION AGRICULTURE?

WATCH & LEARN TO FIND OUT

09

Optimize the value of every bushel with Combyne

Combyne ties together the crop marketing information you need to make the best decisions for your farm. This crop marketing management tool tracks and traces your inventories and digitizes all your trade documents— contracts, load tickets, settlements.

WATCH

07

How Satellite Data Can Help Farmers Capitalize on Regenerative Agriculture

NASA satellite data applications can be useful for you when making field-level decisions, particularly in the context of the regenerative agriculture revolution.

WATCH

10

Grain Quality & Quantity Tracking Made Easy with VeriGrain

Knowing exactly what's in your bins is crucial for maximum profits. VeriGrain's product puts detailed analysis of your grain in the palm of your hand so you can find buyers willing to pay maximum prices and have confidence in what will be delivered.

WATCH

AN EYE ON LIVESTOCK FERTILITY APP DOMINATION

The sad truth of business, is that it takes money to make money.

Fortunately for **Verility Inc.**, an ag-tech business started in 2018 and headquartered in Maxwell, Indiana, money is being found to help it commercialize its new livestock fertility analysis program—***Fertile-Eyez***.

Verility is already well-known for its development and marketing of a technology that assesses livestock semen and ovulation samples, called *Fertile-Eyez*, which recently closed a US$3.5 million Series A round of funding, that was led by **Mountain Group Partners** of Nashville, Tennessee—an investor dedicated to guiding transformational businesses in the life sciences, animal health, and technology sectors—and a previous investment from **Purdue Foundry**, an entrepreneurship and commercialization hub whose professionals help Purdue innovators create start-ups.

Fertile-Eyez is a mobile smartphone livestock sperm analysis and ovulation detection app. Using image recognition and AI (artificial intelligence) technology, it provides a highly accurate visual of animal fertility and is correlated with current gold standards.

Rather than testing first being done on animals on behalf of humans, the *Fertile-Eyez* concept was licensed from the intellectual property of Brigham and Women's Hospital, a non-profit teaching affiliate of Harvard Medical School, where it was created and validated in humans.

Verility is lead by co-founder and Chief Executive Officer **Liane Hart** and co-founder and Technical Advisor **Hadi Shafiee** Ph.D., who invented the technology as the Head of the Shafiee Lab and faculty member at the Engineering and Renal Division of Medicine and Brigham and Women's Hospital.

It was at the hospital, where *Fertile-Eyez* was created and validated in humans and is now the first true AI fertility device in the animal health industry.

The technology was created by Shafiee to improve user experience—it allows sample testing to be done at home, rather than having to travel to a clinic.

No one is suggesting people are akin to swine, but the technology was recently confirmed accurate in boars at Purdue University and has recently been accepted for publication in the ***Translational Animal Science Journal***.

Improving ovulation detection and improving sperm analysis are two critical ways to increase production and the quality of the meat produced.

According to Hart, the animal conception rate is a known fact of correlation between producer profitability and food sustainability.

"The Series A funding will allow us to develop our product for swine producers and breeders in a major segment of production," stated Hart, who has earned a Bachelor of Science degree in animal science and a Master of Science in breeding and genetics, both from Purdue University.

VERILITY

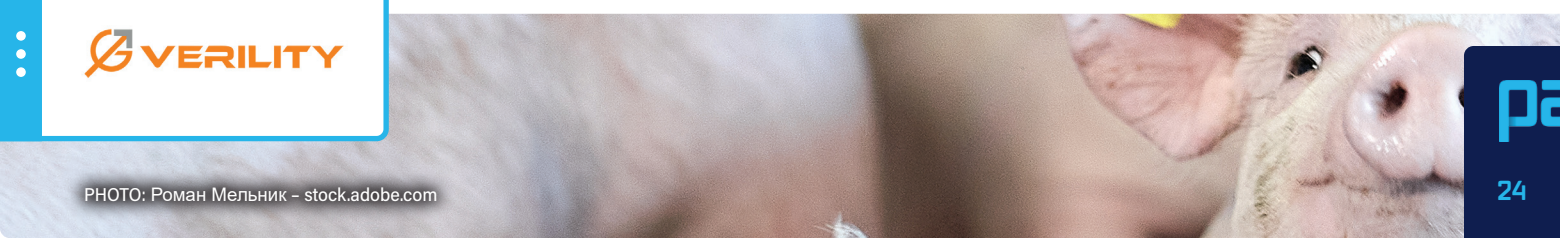

PHOTO: Роман Мельник – stock.adobe.com

Ag tech start-up Verility closes its $3.5 million Series A funding round led by Mountain Group Partners and includes a previous investment from Perdue Foundry

ANDREW JOSEPH
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She continued: "The investment will allow us to reach the point of preparing for commercialization, which we anticipate in late 2023. It's extremely exciting to have the ability to bring automated mobile breeding technologies into a segment of the animal health industry that normally does not see much innovation."

According to Verility, *Fertile-Eyez* is akin to having a skilled lab technician and a microscope in the palm of your hand. The cloud-based mHealth, or mobile health, technology has, said Hart, the potential to change how testing is done in the breeding industry across all major livestock species, with increased performance of livestock production facilities and furthering superior genetics.

The tool avoids any subjectivity of sperm analysis and ovulation detection, according to Verility. The person reading the sample is completely removed as it no longer requires a highly-skilled technician or someone to send samples to a third-party lab or a different part of the farm for analysis.

Verility believes that the *Fertile-Eyez* mobile fertility platform will change how testing is done in the breeding sheds, which will better increase the performance of livestock production facilities and help improve the desired genetic benefits.

Because estrus detection is a very labor-intensive and time-consuming procedure, it relies on people having to check on heat detection, usually only once a day. Because users can only really check infrequently, errors can occur as to identifying when ovulation will actually occur—leading to missed cycles and opportunities.

But that is avoided with the *Fertile-Eyez* technology, which Verility said is very affordable, at only a fraction of the cost of what is currently on the market.

Veterinarians, producers, and breeders around the world will be able to utilize cell morphology fertility parameters to improve their animal production systems.

Said **Brian Kopp**, the company's Chief Financial Officer, "We are extremely pleased that more investment is finding its way into animal health innovation to bring more efficiency to animal production. We have a real opportunity to make a significant improvement in animal fertility, an area where more innovation is needed."

Added Shafiee, "This Series A funding will help us to commercialize our first AI-enabled product for accurate, affordable, and real-time ovulation prediction in swine."

Rob Readnour, the Managing Director at Mountain Group Partners who invested in the tech was impressed with *Fertile-Eyez*.

"Producers are facing challenges from rising input costs and labor shortages only exasperated by the pandemic. They need innovation like Fertile-Eyez to help them meet the important mission of producing animal protein in a sustainable way," related Readnour.

Riley Gibb, director of business development at Purdue Foundry, said the company is a strong example of start-ups that bring Purdue-supported innovations to the market.

"Liane Hart is one of many high-quality entrepreneurs bringing Purdue-supported start-ups to market," he said. "Verility and other companies are already making an impact in plant sciences and animal sciences." | pag

"THE INVESTMENT WILL ALLOW US TO REACH THE POINT OF PREPARING FOR COMMERCIALIZATION..."

TRIMBLE TO PURCHASE FRANCE-BASED PAG SPRAYING COMPANY

Bilberry's new AI and camera system for identifying weeds

ANDREW JOSEPH
FARMS.COM

Trimble Inc., a Sunnyvale, California-based software, hardware, and services technology company supporting agriculture and other industries, is purchasing **Bilberry**, a Paris, France-based manufacturer of selective weed spraying systems.

Founded in 2016, Bilberry has designed the ***Intelligent Spot Spraying System***—an AI (artificial intelligence) and camera system—to identify weeds in real-time, which the company said will allow "certain sprayers" to be retrofitted with technology to target weeds in a growing crop, via "green-on-green" spraying technology.

Bilberry said that its *Intelligent Spot Spraying System* reduces the usage of herbicide by more than 80 percent while protecting the environment and lowering the costs for farmers. The system can work at all crop stages and has provided Australian farmers with up to 97.5 percent in chemical savings.

Although this green-on-green technology has already seen commercial deployment in Australia, Bilberry had been looking to bring it to the North American market, which is why earlier this year it was testing it on farms in western Canada.

It was there that the system targeted broadleaf weeds in cereal crops, grassy weeds in canola, and broadleaf and grassy weeds in corn.

Trimble already has a weed spraying system—***WeedSeeker***—capable of identifying plants on bare soil before a crop peeks out of the soil (*aka* green-on-brown spraying), the company believes the Bilberry acquisition will complement its lineup perfectly.

"Our planned acquisition of Bilberry builds out Trimble's crop protection portfolio by adding green-on-green selective spraying capabilities and supports our development of autonomous solutions," stated **Jim Chambers**, the Vice President of **Trimble Agriculture**.

He continued: "The Bilberry solution is brand agnostic and compatible with a broad range of spraying equipment manufacturers, which is ideal for mixed fleet operations. This capability, together with existing Trimble competencies, will enable us to expand our role in the growing market for precision agriculture solutions that can reduce input costs, create efficiencies for our customers and drive sustainability in farming." | pag

"OUR PLANNED ACQUISITION OF BILBERRY BUILDS OUT TRIMBLE'S CROP PROTECTION PORTFOLIO BY ADDING GREEN-ON-GREEN SELECTIVE SPRAYING CAPABILITIES AND SUPPORTS OUR DEVELOPMENT OF AUTONOMOUS SOLUTIONS."

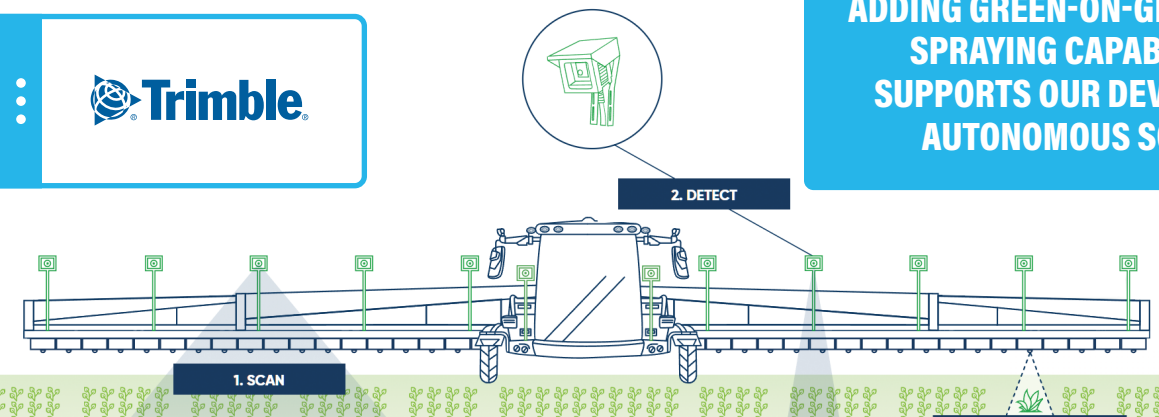

PHOTO: bilberry.io

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