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ROBOTS OUTSTANDING IN THE FIELD

Canadian innovation field testing for robotic broccoli harvesting performed in Quebec.

ANDREW JOSEPH
FARMS.COM

The future is now, as Industry 4.0 in agriculture melds with robot broccoli pickers.

Developed by Lapalme Groupe Conception Mécanique of Varennes, Quebec, the Sami 4.0 is an intelligent multifunctional agri system—a robot—that can perform the work of traditional hand pickers of vegetables utilizing a vision system and robotic arms linked to artificial intelligence. By adding a mobile app, farmers will even be able to manage a harvest on their smart phone.

It can work at the same tempo as a human harvester, except cut more because of the multiple robotic harvesting arms.

Founded by company president Éric Lapalme, he conceived the idea after a visit to his family farm in the summer of 2018, while watching workers harvest broccoli.

"I began to look at the pickers with my eyes as an engineer and to dissect the eyes, intelligence and arms process necessary to carry out the act of picking," explained Lapalme, an engineer by trade. "At that time, I was working on the automation of a factory and the idea came to me to bring robots to the fields."
Simon Belanger, the Business Development Director for Lapalme Agtech added: "On different projects, he had already developed advanced vision mechanics and robotic arms and realized he could develop a technology to fill the labour gap."

Lapalme was surprised to discover, after checking with the patent office, that he was the first to conceive of such a concept.

"In the summer of 2020," noted Belanger, "we wanted to de-risk the technology, so we created a very preliminary prototype to test the vision and the robotic arm. The results were conclusive, and we decided to invest our money and go for it."

Belanger explained that the company received $1.1-million from the Quebec government as well as $500,000 from the NRC (Canada), and created its Lapalme Agtech subsidiary. "We then worked hard to have our RPC 4.0 demonstrator at the Expo Champs trade show in St-Liboire and were the highlight of the show. We've since been in the field finalizing the programming configurations and gaining exceptional results."

Guided by 2D and 3D camera systems, Sami 4.0 uses its vision system to detect, position and qualify the broccoli. Following the detection, an analysis is made by artificial intelligence, which is sent to the robotic arms, telling it to harvest the crop—or not—based on its maturity/ripeness. A waterjet system using 50,000 psi is applied to cut the broccoli.

PHOTOS: lapalmeagtech.com,
Yuriy Bucharskiy/iStock/Getty Images Plus

Using a tablet, such as an iPad, a farmer can choose the size of the broccoli to harvest. "For example, if a five-, six-, or seven-inch broccoli is opted for, the robotic arms will only harvest that size," stated Belanger. "On the other hand, the cameras will detect and count the other sizes so that at the end of the day the farmer will have a complete inventory of the field transmitted to their CRM System.

"This will allow the farmer to increase productivity and to have a better planning of the future harvest," he added.

The vision system has been developed in partnership with both the Quebec-based INO (Institut national d'optique) and the CRVI (Centre de robotique et de vision industrielle).

The Sami 4.0 utilizes artificial intelligence and was taught by engineers to recognize the vegetable broccoli, as well as how to make the required movement to harvest it. To that end, more than 500,000 photographs of vegetables were taken in its environment and in all possible weather conditions. About 50,000 of those images were selected and labeled for the robot to reference—but, said the company, the process has to be repeated for each vegetable type that can be picked by the robotic system, something that was performed per producer requests in 2020.

Initially field tested in 2020 with broccoli, Lapalme was encouraged. "The trial worked very well, and the results are conclusive. Since April (of 2020), our team of engineers has been working on setting up a demonstrator project including four robots."

In September of 2021, the automated broccoli picking system was officially unveiled in field tests at two farms, in Montérégie and Lanaudière, Quebec.

WATCH THE VIDEO

"For the tests, we used four robotic arms in dynamic with the tractor moving forward," related Belanger. "The speed of the tractor was the same as with the human harvesters working behind it—but we (Sami 4.0) managed to have a faster tempo."

"ONE ROBOTIC ARM PERFORMS THE WORK OF ONE HUMAN HARVESTER. BUT WE CAN ADD MANY MORE ARMS."

Benefits of the SAMI 4.0 robotic system, include:

- **Increased productivity;**
- **Increased crop management;**
- **Fills the void of the picking labour shortage;**
- **Performance report provided;**
- **Improved inventory management for the customer;**
- **Return on Investment (ROI) in about three to four years.**

Because of Covid-19 travel restrictions, farmers have experienced and may continue to experience a manual labour shortage. To counter that, a variable quantity of robotic arms can be affixed to Sami 4.0 allowing a single tractor operator to perform the work of 10 pickers.

"One robotic arm performs the work of one human harvester," said Belanger, "But we can add many more arms."

The price of the SAMI 4.0 will be around $1.5-million, depending on the number of robotic arms requested, and can cover up to 40 rows wide.

Right now, SAMI 4.0 has only acquired AI knowledge to harvest broccoli, but Lapalme Agtech is hopeful that future iterations of the robotic system will be able to harvest peppers, tomatoes, and other vegetables, as well as fruits such as strawberries and raspberries. Belanger pointed out that the tested beta SAMI will visually look different when delivered to a customer, as well as configured differently dependant on the number of robotic arms requested by the farmer.

Lapalme Agtech has said that the design will vary according to the type of culture. For example, to harvest broccoli, cauliflower or cabbage, two long conveyors with a series of robots can be provided. But for fruit trees, it is imagined that a vertical machine with arched arms will be required to pick fruits like peaches, apples, pears or nectarines.

Other future itineration may be to use it for sugar bushes where the automation could be installed in front of an all-terrain vehicle, so the vision system could recognize the maple via cardinal points and by old incisions so it can cut at the correct height on the trunk. Ultimately, it could be used to execute other tasks such as weeding, insect and disease detection.

"EVERYWHERE YOU LOOK, AUTOMATION IS GAINING TRACTION AND IS BOOSTING THE COMPETITIVENESS OF BUSINESSES."

"I like to say that the SAMI 4.0 is like a cellphone, and to do more than make a phone call, you need apps," said Belanger. "The SAMI 4.0 is the same principle. We have just developed the broccoli app, and soon we will create other apps for harvesting cabbage, lettuce, asparagus and more, plus one for weeding."
At this point in time, SAMI 4.0 has a proven track record for picking visible vegetables. "As SAMI's technology is based on an application principle, the possibilities are endless. The production will be personalized for the needs of the individual farmer," added Lapalme.

Tested and now deemed ready, Lapalme Agtech has begun to take orders on the Sami robotic harvesting system for delivery in the Spring of 2022.

"Everywhere you look, automation is gaining traction and is boosting the competitiveness of businesses. Today marks the arrival of agriculture into the industry 4.0 era," summed up Lapalme. | pag

GLOBAL PRECISION AG MARKET ONLY GOING UPWARDS

Predictions expect that between now and 2028, the worldwide precision farming market will exceed $20-billion, noting that Canada has been slow to adopt the technology.

ANDREW JOSEPH
FARMS.COM

Pssst... the global precision agriculture market is expected to reach US $16.35 billion (~CDN $20.25 billion) by 2028, expanding from 2021 by a rate of 13.1 percent a year.

That's the prediction contained within the Global Precision Farming Market 2021-2028 report via **ResearchAndMarkets.com**.

We all know just what precision agriculture farming using high impact technology can do—help farmers evaluate their own specific fields to make a more informed decision on how best to proceed—and when—and even more precisely to determine how different parts of the same field may require different ways to maximize it.

The report points out that over the next few years, more and more people will learn of the benefits of precision ag technology and will utilize it. Or at least that's the hope—and why shouldn't it be?

It's like fishing. You could stand on a riverbank and blindly cast about hoping that whatever you have used as bait and whatever fishing style used will attract a fish lurking nearby and that you hopefully are able to hook and then bring ashore. Or, instead of blind luck, one could use technology better, such as utilizing a deep-sea boat with sonar and maps, study weather conditions and water currents, and yes, physical fishing technologies to fill your vessel with a large haul.

The example cited is an over-simplification of the use of technology, but the notable take-away is that while one is for fun, the other is a better way to run a business.

While farmers are certainly allowed to have fun, the business of running a farm is survival of the fittest. Why not use the best materials available to your advantage to maximize the pluses and to minimize the negatives? This is the allure of precision ag technology.

Per the Global Precision Farming Market 2021-2028 report, it expects to see a continued growth in the application of telematics in agriculture.

Telematics is the broad descriptive term for technologies that are used to capture data from precision ag equipment—like a tractor—via sensors installed on it to monitor how well the equipment is performing, and to then transfer the data to the farmer in a near-real time fashion, who can access by computer, pad or phone from the field or any place on the planet.

PHOTO: Maxger/iStock/Getty Images Plus

Adjustments can then be made via software inputs to alter the farm equipment's performance to ensure best results are achievable.

The telematics aka precision farming technique uses sensors, antenna, access points, automation and control systems to create analyzable data, which is then applied via technologies such as robotics, automation and bioengineering. Voila! Precision ag technology.

Quite naturally, the Global Precision Farming Market 2021-2028 report states that agriculture equipment companies expect telematics adoption to only increase and to drive the market moving forward.

The report says that increased applications of telematics will further drive the demand for more precision farming. It cited the Global Navigation Satellite System (GNSS) being used as being a great way for precision ag farmers to track the positioning of the machinery et al as a key management tool to ensure a larger crop yield is attainable while wasting fewer costly resources such as fuel usage, or by better distribution of seed, water, herbicides or fertilizers.

From start-ups to well-established major firms, agriculture equipment manufacturers are utilizing telematics services to help their customers achieve better farming efficiency.

According to a recent report from the Association of Equipment Manufacturers (AEM), American farmers using precision ag technologies gained:

- **4 percent increase in crop production**
- **7 percent reduction in fertilizer usage**
- **9 percent reduction in herbicide application**
- **6 percent reduction in fossil fuel required**
- **4 percent reduction in water use**

It's a farm management tool that uses information technology to provide a farmer with better assurances of crop health and productivity.

While your performance may vary relative to the reductions in environmental impact regarding fertilizer, herbicide, fuel and water usage, farmers employing telematics will also achieve cost savings.

While we can not state that you will see crop production rise—we are slaves to weather, after all—precision ag telematics dictates that yield increases are in the forecast.

Using precision ag technology—such as an autonomous (no-human driver required) vehicle, farmers will be able to apply seed perfectly in a field, as well as to properly apply just the right amount of plant care items to give you a chance to produce a larger crop over the entire field. By using the precision ag technology, farmers will be able to move their equipment effectively to ensure fuel usage is spent judiciously.

Technology-wise, several platforms exist that provide access to near real-time weather conditions in a farmer's region and across the province, and to see accurate and timely daily and hourly forecasts. Farmers can analyze their field history of tillage and agronomic information to plan for the planting and growing season, with the ability to share data with their agronomist, ag-retail seed or chemical representatives.

And then there's drones—drone technology is taking off.

We're not talking about those old remote-controlled airplanes and helicopters here—we're talking about drones decked with technology and operated with software specific to the ag industry.

Use of drone technology will offer a farmer many different things to contemplate. There are already quite a few ag drone firms out there, with more expected to enter the market over the next few years—with anticipated newer and different technologies.

Canadian firm TerraNova UAV said its UAVs (unmanned aerial vehicles aka drones) use special cameras and software to provide real-time insights on crop hydration, level of vegetation development and sanitary conditions. The ground-level operator will later present a full report or analysis of the inspected area allowing the farmer to provide timely irrigation, fertilization and sanitary treatments.

PHOTO: Maxger/iStock/Getty Images Plus

On the downside, the Global Precision Farming Market 2021-2028 report acknowledged that as of 2021 there is still a low adoption rate of precision ag technologies by farmers in North America and the world, and could, if not corrected, hamper the financial expectations of seeing a +$20-billion industry.

Funding and how to spend available finances were seen as pitfalls to further tech adoption. Yes, purchasing precision ag technology is expensive in the short term, but long-term of even a few years can see an ROI.

But, the report noted that ancillary tools are lacking, such as the lack of independent consulting and advisory services, which it said was due to an absence of validated agronomic models for Variable Rate Technology to allow for best decision on these capital investments.

The report correctly opined that independent services not linked to co-ops, farm associations or the government would allow farmers to gain more information before purchase of the technology, types of technology and what would best suit their own farming circumstance.

The Global Precision Farming Market 2021-2028 report also suggested that both Europe and Asia would see the biggest leap in demand for precision ag technology.

It cited the digital revolution in the agricultural sector and government financial incentives to European farms as a key driver, while Asia might see the fastest growth owing to the availability of the largest agricultural land providing growth opportunities in countries such as China, India, Australia, and Japan.

But what about Canada?

A different 2021 report from the Delphi Group in collaboration with Bioenterprise Corporation said that while adoption rates vary by province, Canada itself has been slow to latch onto precision agriculture technologies relative to European nations and the U.S.

The report examined the tech segment on behalf of the B.C. provincial Ministry of Agriculture – Precision Agriculture Technologies for Nutrient Management in British Columbia.

It said that four chief barriers continue to stop a wider adoption of precision ag technology in Canada:

- **Not enough education or understanding of the tech and its various applications;**
- **High costs to purchase;**
- **General farmer risk aversion;**
- **Data access and data ownership concerns.**

All valid points and concerns, but Canadian agriculture will need to adapt quicky to keep up with consumer demands and regulatory requirements to name just a few.

As stated, precision agriculture technologies help a farmer to apply water, pesticides and herbicides when and where needed in an exacting manner that boils down to fewer wasted resources and less fuel used which means fewer GHG emissions and less environmental impact.

With the need pending, all the barriers noted can be removed or at least lowered.

Having more education can also reduce risk aversion, though some farmers will always prefer to do things as they have always been done.

While the global market for precision agricultural technology seems poised to leap forward over the next few years, it is wholly-dependant on the Canadian agri-retail tech market to ensure its farmers do not get left behind. | pag

PRECISION AG EQUIPMENT IS A HOT TOPIC

Tech component theft is becoming an expensive concern in the ag industry. Precision Agriculture Digital Digest provides advice to protect yourself and your investment.

ANDREW JOSEPH
FARMS.COM

For as long as people have had nice things, others have coveted them, and the truly unscrupulous steal them.

In the days of yore, farmers had to be aware of cattle rustlers, horse thieves and folks trying to poach livestock, crops, equipment and such.

But nowadays, the new kick is stealing components—such is the case when it comes to precision ag equipment. Not only is it a hot topic, but it has become a hot commodity as a lucrative target for thieves.

It's not the outright theft of an autonomous tractor, for example, but rather its parts. Expensive parts, and easily transportable parts—components that can be utilized in other technologies and in other sectors. Or at least that's the feeling among law enforcement agencies, though others believe it's only a matter of a quick, no-questions-asked transaction at an ag equipment fair.

Precision ag machinery uses GPS satellite receivers and a controller in the cab for exacting control of the equipment. However, the biggest targets for theft appear to be auto-guidance monitors and antennas—perhaps because both are easy enough to remove without damaging the components.

Some pundits believe the microchips contained within the monitors draw interest because of a global shortage of micro chips.

It Takes A Thief

Central Illinois Ag, a Clinton, Illinois-based ag shop, recently discovered the theft of some of its precision ag machinery components.

A Degelman Industries, L.P. representative was planning to move a tractor from the ag shop to an event, when it was discovered that the auto guidance monitor and antenna were missing.

PHOTO: sqback/iStock/Getty Images Plus

The ag retailer knew it was present in its vehicle the day before, having calibrated the tractor in anticipation of the demonstration.

Unfortunately, it wasn't the only ag shop to be hit that night. Although the Clinton shop had eight precision ag components—all monitors and antennas—stolen, an additional four tractors and five combines were hit at its Atlanta store. Bane-Welker Equipment and AHW, LLC dealerships were also hit on different dates and locations, as well.

Because of the large number of thefts, and the distance between the robbery sites, law enforcement does not consider it to be the work of an individual. While unstated, it's either several individuals with the same idea, or the onset of an organized ring or rings, which we know is hardly encouraging.

For a spot of good news for any shop or farm experiencing a theft, although the microchips are not able to be tracked, the monitors and antennas can be disabled to render them useless to anyone looking to reuse—provided the precision ag equipment uses a system that allow that function, such as the AFS Connect from manufacturer Case IH.

Over in the United Kingdom, reports have also surfaced of precision ag component theft, where two monitors and antenna were stolen in north Devon from a tractor, as well as other similar thefts in Wiltshire and Gloucestershire. And there have been reports of more around the globe.

In the US, it was estimated that agricultural crime resulted in some $5-billion in losses annually—and this was data from a 2007 report. The lack of more recently dated reports is also indicative of how little ag crime is considered important in society today.

Of those estimated losses, however, the report noted that only about 12-percent of all ag-related crimes were reported to the police.

When theft of precision ag components does occur, there is a lot of ancillary damage affected to the vehicle such as cut wiring, or scratches or dents.

And because of the specific types of components being stolen, parts replacement may not be quick or simple, meaning the vehicle could be out of service for an extended period of time. Downtime, of course, implies loss for the precision ag farmer, be it in crop yield opportunity, time or income.

While it can be expected that most victimized ag farmers and dealers have some form of insurance to protect themselves, the non-availability to use the stolen products impacts farmers directly in the form of lower profits or costs that are passed down to the consumer in the form of higher prices. It's cliché, but crime affects everyone.

The Simple Solution Is The Best

Short of having guards stationed 24/7 around the farm and in particular the higher-valued precision ag equipment—a costly solution—there are other options.

Deterrent options might include free-roaming guard dogs, such as often seen in auto repo facilities, or the use of motion-detection lighting systems may also frighten off would-be thieves.

Motion-capturing cameras or CCTV systems are also a choice but are probably only good for providing details of the theft to authorities, rather than its prevention.

However, the wide-open nature of the industry—be it ag retail shop or farm—precludes usage of such deterrents unless the valuable tech is purposely moved to a more secure singular area.

Vehicles could certainly be transferred to a lockable shed when not in use, but if someone wants in, they will find a way. And placing everything under one roof can have the unwanted effect of making things easier for the criminal mind.

The most obvious preventative solution is for farm operators to unplug their precision ag components—those capable of being removed by the user—from their machinery after use and place it somewhere secure and then bring it back to reinstall in the morning.

It's simple and obvious. And it is achievable.

So far, the criminals involved in precision ag tech components are looking for the quick and easy theft in lonely outdoor locales—as such, moving the components to a lockbox within a locked room within a locked facility could be a triple-deterrent.

Loss & Recovery

Recommended, though hardly a deterrent or preventative solution, is to cross your T's and dot your I's and make sure you have access to your equipment's documentation.

ENSURE YOU HAVE THE MAKE, MODEL AND SERIAL NUMBER OF ALL YOUR EQUIPMENT...

Ensure you have the Make, Model and Serial Number of all your equipment—whether it's precision ag related or not. It won't stop it from being stolen, but it certainly can aid in you getting it back should the goods be recovered.

Noted earlier in this article was the reluctance to report ag crime to the police. However, regardless of how insignificant you believe it to be, a crime is a crime is a crime, and should be reported immediately, especially in the event of a robbery. Reporting a crime like theft is also important when later dealing with your insurance company—if you don't take it seriously, why should they?

While some individuals may feel personal embarrassment for having been the victim of a crime—don't. By reporting your issues, you provide a local area warning for your peers. The same holds true for retailers—don't be afraid to inform customers to allow them to be better prepared.

Hopefully with common sense prevailing, there are other ways to prepare oneself against theft.

A hi-tech identification mark can be used, such as a forensic marking solution or a forensic marking warning sticker applied to your equipment in a very visible location. You want would-be thieves to see it to possibly prevent a theft from occurring.

An old-school solution is the use of a roll-on theft-prevention stamp. Its purpose is the same as its high-tech brethren—to warn a would-be thief that the component is marked. A knock against it is that it is hardly a practical application on a precision ag antenna.

If your system has a pin number password for input, ensure it is being used. John Deere, for example, use a security pin code system to lock its StarFire 6000 vehicle when not in use. The pin password system will not prevent a vehicle from being stolen nor will not be able to stop a component from being removed—but it can stop it from being used by others.

Having said that, the truly tech savvy criminal enterprise may possess the means of breaking the pin, if Hollywood movies have taught us anything. At worst, you make the thief work for it.

Theft, no matter the scope, is no laughing matter. Even if not directly affected, feelings of being invaded by strangers on or in your property can play on the emotional state of the mind.

To provide more peace of mind, the only solution at this juncture appears to be for the owner/operator of precision ag technology to remove it when not in use and lock it in a safe location.

For future resolutions, it may be up to the precision ag manufacturer itself. Can removable technology be created where a pin number must be first inputted to allow it to be removed, with total equipment failure if not done? How about adding facial recognition or thumb print software to allow the component to be accessed in the same way our wireless phones use that technology?

Will the next generation of precision ag technology provide affordable security features to prevent theft or repurposing of its components? Precision ag owners are willing to embrace the future with open eyes regarding technology and the security it can offer. | pag

PHOTOS: aetb/iStock/Getty Images Plus, zhaojiankang/iStock/Getty Images Plus

KILLING WEEDS WITH ROBOTICS

A look at experimentation with autonomous weeding equipment

ANDREW JOSEPH
FARMS.COM

In the world of autonomous weeding equipment, it's not about acres per day, but rather the number of weeds per day.

That's the sentiment arrived at by Chuck Baresich, General Manager of the **Haggerty Creek Ltd.** and now **Haggerty AgRobotics Company**, as he spoke at the **Farms.com Virtual Precision Agriculture Conference & Ag Technology Showcase** held November 16-18, 2021.

Baresich and his brother Justin have farmed in the Bothwell, southwestern Ontario area for 20 years in a long-term no-till zone system. From the beginning, they have used various forms of precision agriculture technology to farm.

As part of an autonomous 2021 working group involving their AgRobotics biz, and representatives from OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs), the HMGA (Holland Marsh Growers Association) and others, the group included equipment manufacturers to its weekly meetings as the 2021 season progressed.

The Autonomous Working Group 2021 then undertook its own research project. It created a plan to test autonomous vehicles in real-life crop production in Ontario, with an initial focus on autonomous weeding.

PHOTOS: haggertycreek.com, zhaojiankang/iStock/Getty Images Plus

WATCH THE VIDEO

Initially the group explored the following equipment:

- **the GOAT from Nexus Robotics of Brossard, Quebec;**
- **the RoamIO HCT from Korechi Innovations Inc. of Oshawa, Ontario; and**
- **the OmniPower and OmniDrive systems from Raven Applied Technology (Canada) of Emerald Park, Saskatchewan.**

As highlighted by Baresich during the presentation, other equipment was also added, including the Escalquens, from France-based Naio Technologies Oz and Dino robotic systems—distributed in North America by GMABE of St-Liguori, Quebec.

Using robotics, laser visual sensors and artificial intelligence, these autonomous weeders were put through the paces at the Baresich farm.

The Realities of Oz (and Dino)

Baresich applied the Naio autonomous weeders using only GPS for navigation across small, two-acre plots using multi-pass techniques. The Oz maximum speed is 1.8 km/h with an output of approximately 0.247 acres per hour. The Dino, for reference, could run twice as fast and had an output of 2.3 acres per hour.

Where a crop was planted using RTK (real-time kinematic) position, the robots were used to mark A-B lines to navigate. Conversely, if no crop was planted, the robots' RTK receiver was attached to the planter and an app was used to mark the A-B points for the robot to follow.

The fields tested contained Brussels sprouts, cabbage, carrots, celery, onions, peppers, tomatoes, sweet corn, cauliflower, asparagus and tree nurseries.

Although weeding and tillage tools were provided by Naio—such as blades, hoes, harrows, tines, brushes and springs, Baresich said that while they sometimes performed extremely well, sometimes they didn't. As such, new tools were fabricated that better-fit the soil types and conditions for Ontario.

Baresich found that while some tools like the harrows performed very well, others could not break the soil up to the degree expected owing to soil type and compaction. He also found that heavy amounts of crop residue posed a problem for the robot systems.

He noted, however, that robots are adjustable via tire alignment and tool configuration and can be adapted to many different row spacings.

Overall, Baresich reported that when the robots used smaller tines, each had difficulty breaking up soil crust in highly compacted soils.

While larger blades left the soil overly clump for Baresich's liking, he found that larger deep-set tines provided the best option on his land.

For weeding itself—just as with standard weeding equipment, the autonomous weeders also had issues with weed roots clogging up the works.

While using a deeper tool could resolve the issue, it was noted that it also caused the robots to veer off course. Baresich found, however, that along with extra weight and a set of dual tires, the issue was resolved. He mentioned that Naio has since developed an additional weight kit to counter that issue.

Overall, the Oz robots were straightforward to operate and understand, said Baresich, adding that the RTK GPS navigation system was "generally sufficient" in keeping the robots away from the crop while just attacking the weeds.

The RTK issues were minimal, he explained, using the Case IH RTK network via VRS.

He said that the Oz worked fine with wet conditions—no issues—and could traverse most ruts.

PHOTO: haggertycreek.com

BUT HOW GOOD WAS IT IN THE ACTUAL WEEDING, YOU ASK?

But how good was it in the actual weeding, you ask? Baresich said that the Dino and Oz performed very well. With regards to intercrop weeds, the robots were great controlling weeds between the rows, though sometimes multiple passes were required.

He noted that weed capture was ideal when the weeds were small—which may imply that autonomous weeders can be applied early and often during the season to stay on top of weeds before growth becomes large and difficult.

Crop growth patterns matter, said Baresich. The crops with a horizontal growth, such as tomatoes, have a limited weeding window, though that window could be extended if leaf guards were attached to the robot.

Still, said Baresich, farms with vertical growth crops, or nurseries and berry farms could see great success with autonomous weeding technology.

After all was said and done, Baresich said the Oz and Dino robots performed very well at the designated weed control assignment—especially since all involved were new to the technology.

He summed up saying that it appeared as though the best process involved tackling small weeds with multiple passes.

The working group will continue its meetings and experimentation in 2022, with plans to formalize the use of robotics systems with farmer cooperators. | pag

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OERS FIELD.

Granular

Granular is Farm Management Software (FMS) that is helping thousands of farmers to build more profitable and efficient farms today and steward their lands for generations to come. As the world's leading FMS, Granular uniquely combines an industry-leading support team with the most recommended suite of easy-to-use powerful software to help farmers and their teams run all aspects of their farm business. From financials to agronomy to operations, farmers are now able to make data-driven decisions with greater confidence in an increasingly challenging environment.

Planet

Planet Labs is the leading provider of global, near-daily satellite imagery data and insights. Planet is driven by a mission to image all of Earth's landmass every day, and make global change visible, accessible, and actionable. Founded in 2010 by three NASA scientists, Planet designs, builds, and operates the largest earth observation fleet of satellites, and provides the online software, tools and analytics needed to deliver data to users.

Soilgenic Technologies

Soilgenic is focused on sustainable and environmental agricultural technologies that will reduce the agricultural impact on C02 emissions and the environmental loss of nutrients. Soilgenic focuses on the development of nitrogen stabilization, phosphate efficiency technologies as well as Climate Smart technologies that improve the soil's health while enhancing food production and quality in agriculture.

MONEY FOR NOTHING

Farmers can get paid for performing land stewardship due diligence by earning carbon credits

ANDREW JOSEPH
FARMS.COM

For centuries, the alchemist's dream was to discover a way to turn lead into gold—a simple enough proposition considering that the much more common lead possesses only a mere three protons more.

While the world awaits that dream, global climate entrepreneurs have found a way to turn carbon into money.

Using land stewardship, farmers can generate carbon credits for carbon dioxide (CO_2) emissions avoidance and sell those for fun and profit, though it assumed the fun is in the profit.

Although "carbon" is the generic term when discussing GHG (greenhouse gases), in the ag sector CO_2 and N_2O (nitrous oxide) are the main concerns.

Wade Barnes knows how to gain the fun for farmers, and revealed how his company **Farmers Edge** helps farmers and furthers agricultural sustainability and digital agronomy at the **2021 Farms.com Virtual Precision Agriculture Conference & Ag Technology Showcase** held this past November 16-18, 2021.

A pioneer in the Precision ag movement, the 2005-founded Farmers Edge has over 550 employees across Canada, the US, Australia, Brazil and Russia.

Barns explained that with Smart Farming—via a digital farming infrastructure—producers can produce more yield with less by turning data into actions to gain high-quality carbon savings known as offsets that can be sold to industries requiring help in achieving their own carbon neutrality.

Data is collected via high tech tools such as: satellite imagery; weather stations; soil moisture probes; telematics devices; soil sampling; irrigation monitoring devices, and; grain cart weighing devices—all of which is then collected and processed to make into useable information for a farmer to analyze and implement for optimal farming, resulting in enhanced crop yields, better soil health, and a reduction of GHG emissions.

Barnes explained that Farmers Edge creates individual farm-specific projects to increase the way carbon credits can be generated.

Although not in principle a physical asset, carbon offsets are, in the agriculture sector, the environmental data records of a farm converted to a number that shows the reduction of one metric ton (2,205 lbs) of CO_2 emissions, N_2O emissions or the combination of both.

Barnes stated that an independent and accredited third-party auditor will verify the digital records and GHG emissions reductions allowing it to then be entered into a Public Registry.

FarmersEdge™

PHOTOS: DaSr912/iStock/Getty Images Plus, powerofforever/iStock/Getty Images Plus

Sold by the tonne, the carbon offsets are sold, and ownership is transferred to the buyer—and to ensure it can't be resold, the offset is retired and removed from circulation.

After the sale, Farmers Edge return the profits to the farm.

Lest you believe that carbon credits will only provide a few nickels, Barnes said that in 2020, customers saw an average of $4 to $5 per tonne, but in 2021 have seen it go as high as $27/tonne.

And again, to show that a farmer isn't just going to make a total of $27 because it's difficult to get more than one tonne, Barnes shared a case study with the Conference audience involving a farm in Saskatchewan with 519 acres of dry prairie and 5,645 acres of parkland.

Between 2018 and 2021, that farm realized an additional total income of $53,673. Note that the parkland had a larger acreage and generates more income than the dry prairie farmland. Regardless, your mileage will vary, but even so—extra income generated.

Now that the prospect of earning real money is clearer, how does one generate these carbon offsets?

Many Canadian farmers are probably already doing it—but Farmers Edge can help you do it better, explained Barnes.

Farm stewardship—you look after the land and it looks after you—a mantra farmers practice and preach.

Using precision agriculture, farms must capture more carbon in the soil—rather than releasing it—via regenerative land management by implementing: tillage, direct seeding, crop rotation and diversification, integrating cover crops or intercropping.

Smart Farming technology will allow a farmer to optimize how a crop is seeded, fertilized and harvested to ensure nutrient loss is reduced to lower nitrous oxide emissions. The more "practices" a farm uses—particular to your specific farming scenario—the larger the number of carbon offsets per acre are generated.

FARMERS: IT'S TIME TO GET PAID FOR WHAT YOU ARE ALREADY DOING.

However, even though efficient equipment usage, water management and better use of crop protection are not qualifiers for carbon offsets, all still help produce a high-quality, low carbon crop. Oh, and it's all better for the environment, while also helping you generate larger and better-quality yield.

If you are wondering just who or what is purchasing the ag-generated carbon offsets, Barnes said that Albert and California are currently the only two North American areas with regulated ag offsets—but that there are plenty of companies looking for help.

In the voluntary market, Barnes said that there are many companies looking for ways to contribute to their own mandated goals of net-zero efficiency, such as Amazon, Apple, BP, Google, IBM, McDonalds, Coca-Cola, Microsoft, Walmart, United Airlines, for example.

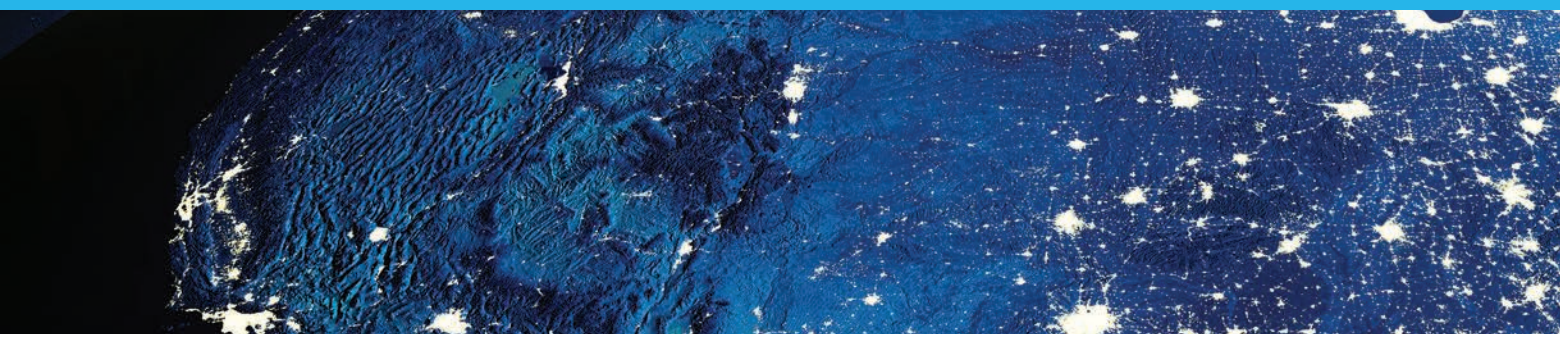
Farmers: It's time to get paid for what you are already doing. | pag

WATCH THE VIDEO

NEW APPLICATIONS FOR SATELLITE DATA IN AGRICULTURE

Satellites can be used to identify planting and harvest dates

DIEGO FLAMMINI
FARMS.COM



Satellites in agriculture have typically been used for variable rate applications, creating management zones and other uses.

But new uses are on the horizon.

Greg Crutsinger, Customer Success Manager at **Planet**, identified multiple new applications for satellite in agriculture.

THEY INCLUDE:

- **Improving yield estimation**
- **Tracking crop phenology**
- **Extracting actual field boundaries**
- **Identifying planting and harvest dates**
- **Improving forage use efficiency**
- **Monitoring best management practices**
- **Following field trials and experiments**

PHOTO: NicoElNino/iStock/Getty Images Plus

When it comes to tracking crop phenology, for example, Planet's satellites can provide a clearer picture of the growing season.

"Being able to smooth out those trajectories and the shapes of those curves in better ways, is really interesting," Crutsinger told the **2021 Virtual Precision Agriculture Conference and Ag Technology Showcase** in November.

Planet captures about 4 million images of the planet every day.

This provides an extensive catalogue for farmers to look at to identify trends or issues on their farms.

"Because we're always on monitoring, you're able to go back and see something that happened last year," added Crutsinger.

WATCH THE VIDEO

Looking even further down the road, Planet is developing a Carbon Mapper tool.

Planet will use it to track methane and other aspects around emissions and climate change.

This tool will allow farmers to make very specific on-farm decisions, Crutsinger said.

"Now we can really start dialing in very custom applications within agriculture related to the chemistry of the plant, or maybe other aspects that we're interested in for disease or soil issues," he said. "I think it'll really raise the level for the future of the science."

Planet is also planning to launch new satellites.

These satellites, called Pelican, will deliver high-resolution, rapid revisit insights, anywhere on the planet.

More news on Pelican is expected in the coming months, Crutsinger said. | pag

"NOW WE CAN REALLY START DIALING IN VERY CUSTOM APPLICATIONS WITHIN AGRICULTURE RELATED TO THE CHEMISTRY OF THE PLANT..."

THE PATH TO AN AUTONOMOUS FARM

Labour constraints are pushing people towards automation

DIEGO FLAMMINI
FARMS.COM

Changes in the world brought on by COVID-19 and other factors are affecting the agriculture sector.

"The pandemic has created a renewed awareness that we have a fragile labour pool in agriculture," Ben Voss, director of sales for North America and Australia with **Raven Precision**, told **2021 Farms.com Virtual Precision Agriculture Conference and Technology Showcase** attendees in November.

"We just can't find workers anymore. There aren't kids growing up on farms like there used to be with natural skills (and) borders have been closed for a while so we can't necessarily have temporary foreign workers to work on farms."

This is where automation can assist the industry. Voss demonstrated a path to autonomy with level 0 as traditional farming with no precision technology and level 5 as full autonomy.

Most farms are operating at level 2, which has coordination and optimization, or level 3, which includes real-time automation.

Getting to level 5 on-farm, however, can be a challenge.

Rural communities often lack adequate broadband access other infrastructure required to use technology on the farm fully.

But today's climate related to food security, sustainability and other topics may lend itself to expedited adoption, Voss said.

"The urgency is different today given the market conditions we're in, the escalated interest in food security and the supply chain issues that are harming our economy," he said.

He described the move towards automation as a "war-effort."

Farmers may need to learn new skills and push through obstacles to ensure they're positioned for an autonomous future.

"If you don't know how to diagnose electronics then you're going to struggle," Voss said. "The grower is going to have to be okay with more technology."

Many farmers are already using some sort of automation, like GPS and boom controls.

But these forms of precision ag still require a driver in the cab.

That is likely to change in the future, Voss said.

"We're heading toward full autonomy where you can imagine equipment running and you're remotely monitoring it," he said. "It's not that far away." | pag

PHOTOS: DS70/E+ via Getty Images, stefann11/iStock/Getty Images Plus, hudiemm/iStock/Getty Images Plus

THE EVOLUTION OF PRECISION AG

Looking at how precision ag presents new opportunities

DIEGO FLAMMINI
FARMS.COM

For many people in the ag sector, precision agriculture is defined as tools available to make better on-farm decisions to save costs.

But what if these tools can identify additional opportunities?

Personalizing conservation and agronomy practices at or after harvest can help producers with this, said Anastasia Volkova, CEO and cofounder of **Regrow Ag**.

"Sustainable agronomy is a path to more longer-term resilience and revenue on the farm," she told the **2021 Virtual Precision Agriculture Conference and Ag Technology Showcase** in November.

Producers should do their research before making any changes.

Learn about carbon markets, connect with supply chain partners, and consider goals and interventions.

"The onus is on the farmer to make the decision," she said.

"THE ONUS IS ON THE FARMER TO MAKE THE DECISION."

Volkova identified three tailwinds for sustainability in agriculture.

They include net-zero goals, regenerative agriculture and farm resilience, and accessing capital.

Farmers should be looking to take advantage of these industry opportunities, Volkova said.

"The downstream players are very much incentivized to work with farmers to improve the situation upstream," she said. "Growers can position themselves as much more attractive suppliers because they have lower emission factors."

Supporting the sustainable ag lifecycle requires different tools.

THE FIRST TOOL IS FOR BASELINING.

"Where are things at? Where have they been? Where can go we go from here?" Volkova said.

THE SECOND TOOL COMBINES BASELINING WITH AGRONOMY.

"This is the interplay between agronomic decisions and environmental outcomes," she said.

THE FINAL PIECE IS REDUCING CARBON EMISSIONS.

"Maybe this makes you a preferred supplier to a food company who wants to associate itself with adopters of good practices," Volkova added.

If you are investing in precision agriculture, be sure to get the maximum from your investment by following Volkova's suggested tools. | pag

PHOTOS: Neustockimages/iStock/Getty Images Plus, BrianBrownImages/iStock/Getty Images Plus

WATCH THE VIDEO

ARE YOU A SMART SEEDER?

It is no secret that farming is hard – from uncertainty of fertilizer use, margins, seed prices going up, climate change, drought, floods etc.

"Field profitability is not necessarily driven by creating the biggest yield in a field" states Colin Rush at the well-attended **2021 Farms.com Virtual Precision Agriculture Conference & Ag Technology Showcase**.

Colin Rush is the Chief Operating Officer at **Clean Seed Capital Group**. He is a senior executive leader with 25 years' experience in the global agricultural equipment and ag technology industry. Rush has held senior positions with John Deere, Case IH/CNHi and JCB Canada, so he definitely understands the challenges farmers face.

"Doing things differently is not advice, but rather an exploration of how you can push and drive yield profitability on your farm by reducing operating costs and increasing yield in a sustainable matter," explains Rush.

Rush unveiled the next-generation machine from Clean Seed, The SMART Seeder MAX, a unique seeding tool that operates effectively in all field conditions. The SMART Seeder MAX allows producers to place seed, fertilizer, and amendments in a single pass, using a coulter and shank combination.

With the SMART Seeder MAX, you can achieve the four R's (right time, right place, right source, and right rate) of nutrient stewardship to align the economic, environmental, and social components of nutrient management. The scalable planting machine will improve yields, reduce input costs, and reduce the environmental impact of modern planting and seeding.

RIGHT TIME

One of the biggest value propositions of the SMART Seeder Max is that it offers a true no-till single pass coulter shank combination with cutting action. Unlike a regular shank, which may rake and drag trash, the coulter vertically separates furrow fertility, cutting residue and trash material between rows and preserving organic matter.

In addition to the shank part of the SMART Seeder Max, a triple shot blade opener can fracture soil below the furrow. This breaks up compaction, increases soil aeration and improves water infiltration which results in deepening rooting depths, better moisture storage and better drought tolerance.

RIGHT PLACE

The SMART Seeder Max offers up to 5 independent products, as well as 6 different product furrow placement options per row. With a total of 60 independent rows, this patented technology provides highly advanced digital, singulation and volumetric metering systems.

RIGHT SOURCE

The SMART Seeder Max delivers high resolution seed and fertilizer prescriptions down to the square foot across every row of the drill. It provides an opportunity to merge up to five individual products and blend single nutrients accurately without losing efficiency at seeding.

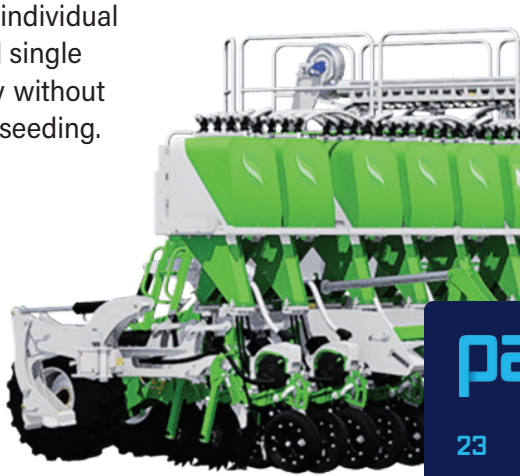


PHOTO: smartseedermax.com

Introducing the Smartest Seeder on Earth

AINSLEY ANDRES
FARMS.COM

RIGHT RATE

The SMART Seeder Max has 300 different product control points with 5 individual meters per row using stepper motor technology.

"These motors are very power efficient and allow us to be infinitely variable right over top of the row – from essentially ounces per acre that we can put on, up to hundreds of pounds per acre, 250+ pounds, at field speed of 5 mph," explains Rush.

The SMART Seeder Max offers additional value through the following features:

- **Singulation**
- **Seamless intercropping and cover cropping**
- **Carbon farming programs**
- **Dual/tri hybrid planting**
- **Foot by foot traceability**

Clean Seeds' brand-new facility in Saskatoon is on schedule for occupancy before calendar year-end and will be the bedrock of its operations for both sales and operations in 2022.

The company is expecting to grow nationally and internationally, evaluating licensing and distribution opportunities to demonstrate the scalability of its technology in a variety of key markets.

"In the upcoming year, we are sending out small prototype demonstration units to different markets, to ensure the SMART Seeder MAX Technology works in global areas – some are to more developing markets, and some are to more established markets here," says Rush.

Clean Seed's SMART Seeder technologies is the only seeding and planting platform offering VR control, according to Rush. It utilizes the synergy between sophisticated digital electronic metering and intuitive software control, putting row-by-row variable rate technology at the forefront of agricultural innovation.

"We call the SMART Seeder MAX, the smartest seeder on earth for a reason" states Rush. "There's tremendous value here, and not just in the features and benefits, but how this technology can generate significant value for you on your farm and at your producer level."

To learn more about the SMART Seeder MAX, visit: **www.smartseedermax.com** | pag

CLEAN seed capital GROUP

WATCH THE VIDEO

DIGITAL AGRICULTURE TECHNOLOGY A 1-2 PUNCH FOR FARMER BENEFITS

Utilizing software and analytics, digital agriculture tech helps farmers run stronger businesses, according to Granular

ANDREW JOSEPH
FARMS.COM

It may sound like science fiction—something made up—but digital agriculture is very much a real thing and is being utilized by farmers around the world, including the US and Canada.

Digital agriculture uses digital technology to gain information they possess but may not have easy access to that allows farmers to make more informed decisions to improve their fields' productivity.

In a November 17, 2021 presentation by Jay Nauta, Digital Business Manager and Krista Klompstra, Digital Business Leader both of **Granular** (a subsidiary of **Corteva Agriscience**) at the Farms.com-organized **2021 Virtual Precision Agriculture Conference & Ag Technology Showcase**, they described the impact digital agriculture has and will have, and how their company's Granular Insights tool can help farmers become even better producers.

Digital agriculture is generally considered to be the combination of precision ag technologies, such as robotics, biotechnology, weather monitoring via satellite imagery, precision application of water and chemicals, and using it all for wireless and digital data management.

But simplified, digital agriculture is all about using information to be able to get the right product at the right rate on the right location to maximize outcomes.

The technology is available, so utilize it to your advantage and don't get left behind.

Nauta and Klompstra both indicated in their presentation that farmers who utilize digital farming technology will be able to farm smarter—not harder—and earn larger yields and gain better farm management to improve their bottom line.

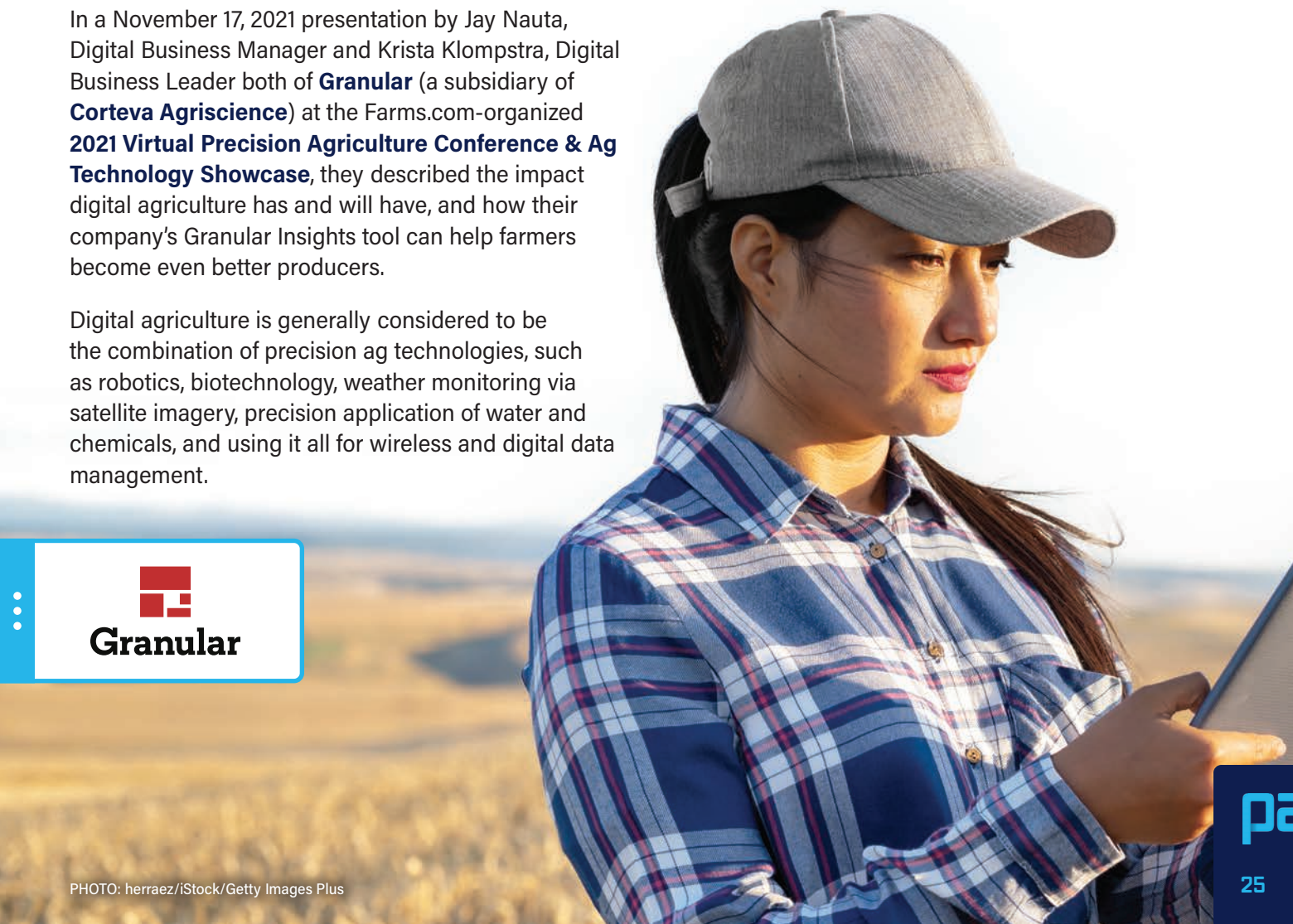


PHOTO: herraez/iStock/Getty Images Plus

Right through the growing season, digital agriculture technology uses data and scientific modelling to create agronomic, financial and operational decisions, said Nauta, such as crop planning, scouting and monitoring, and even harvesting.

He cited former boxing champ Mike Tyson who said: *"Everybody has a plan until they are punched in the mouth."*

Although we can be sure that pugilist Tyson was not referencing an "ear" of corn in his infamous adage, the takeaway is that farmers always have a yearly plan when it comes to how they want to farm—but aggressive weather, such as droughts, wildfires et al have a nasty way of throwing the best laid plans atop the garbage heap.

It doesn't mean that farmers shouldn't plan, however. Rather Nauta said that the use of digital agriculture technology will enable farmers more of an advance notification to enable them to react quicker to issues.

He said that farmers need to "get planning done as early as possible to enable them to react better to those punches" as the Granular tool works with the farmer from the beginning to the end of the season.

With Granular's software, farmers can plan a smart, detailed and flexible crop. The tool will enable farmers to input the type of crop in every field, the variety of crop and the expected yield, noting via its algorithms just how much of the planned harvest is, for example, canola, lentils, corn, wheat or mustard, while also calculating how much of the acreage has yet to be accounted for.

It provides farmers with the knowledge to plan for field usage, as well as how much fertilizer, herbicide, etc., is required.

THE GRANULAR TOOL COMBINES INFORMATION FROM MULTIPLE SOURCES, SUCH AS WEATHER PATTERNS, SOIL COMPOSITION, MACHINE DATA AND EVEN LAND RECORDS TO BUILD VIEWABLE DATA MODELS OF FIELD ANALYSIS.

The Granular tool combines information from multiple sources, such as weather patterns, soil composition, machine data and even land records to build viewable data models of field analysis.

Via the software tool viewable from a phone or other digital device, farmers can view imagery to determine, for example, if crops should be harvested or chopped—whether a field's conditions are an anomaly or more widespread viewing in-season changes or field variability.

Nauta cited the example of early Granular adapter Marc Hutlet Seeds Ltd., which used the system's In-Season Change tool to assess field value as a means to monitor every acre to make confident proactive decisions as needed rather than being reactive.

It's all about collaborating and communicating, agreed Nauta and Klompstra. By examining imaging, farmers can see how a fungicide application, for example, is performing. Or it enables farmers to see where there is an issue and apply a fungicide when the imagery recognizes a thin or spindly crop.

It may not be necessary to respray an entire field when Granular informs you that it's only a small area that is in trouble. It helps save time and resources.

Easy to use and understand, the tool helps a farmer make their own confident decisions after being presented with the data.

WATCH THE **VIDEO**

And, as crass as it may sound, its whole purpose is to positively impact the farmers' bottom line—driving profits with data already present.

It combines a farm's planting and yield data with the estimated revenue and costs to view in real time just how each individual field is working, or which fields are not performing as expected.

It doesn't make decisions for the farmer, but it does present all the data in an easy-to-utilize format.

Klompstra noted that farmers can compare field profitability in minutes without having to go through miles of spreadsheets, allowing farmers to understand what is going on in their fields to, if necessary, make the best decisions going forward.

She added that the Granular tool can also provide an analysis of land rental costs versus profits, to see if it is worth the effort to rent or not.

As for the all-important topic of ownership, Klompstra noted that the grower is the owner of all data compiled, that it is treated in the same manner as a financial institution would treat a farmer's financial data.

For those who require help, experts like Klomstra and Nauta are part of the Granular team who have farm experience and can explain how to first capture the data and how to read the data to make informed decisions.

Trainers are available to lead a farm through the initial setup—live customized training—to ensure that what data is being mined will align with the farmer's individual business goals.

Coaches are also available to help streamline data recovery efforts, and product and agronomic specialist support is also available.

The key to digital agriculture, summed up Nauta and Klompstra, is to determine what data works best for your fields and your needs. | pag

THE BENEFITS OF TILLAGE PRESCRIPTIONS

It's another way farmers can optimize their fields, a Case IH rep said

DIEGO FLAMMINI
FARMS.COM

Case IH is studying another area of precision agriculture.

Farmers have adopted prescriptions for other parts of their operation, but tillage usually isn't part of that equation, said Chris Lursen, tillage marketing manager with **Case IH**.

"Throughout history, soil management has kind of been this peanut butter spread concept with one setting and doing a whole field at that setting," he told Farms.com. "We can create prescriptions, just like with seed and fertilizer, to optimize each area of the field."

Case IH agronomists experimented with prescriptions using the True-Tendem 335 VT last summer.

Taking soil characteristics and topography into account, they created a custom tillage plan on the test field.

They set the tillage tool to a 2.5-inch depth in some areas, 1.5 inches in others and zero-inch depth in additional parts of the field.

Each setting showed different results, said Alison Bryan, a research agronomist with Case IH.

"At 2.5 inches, we looked at residue coverage before and after running, and saw a reduction in residue there," she told Farms.com. "At 1.5 inches, where we wanted some incorporation but didn't want to be as aggressive, we did see a reduction in coverage, but it was more maintained. And at zero inches, we were able to knock down residue. By knocking it down, it still had the root there and maintained it in that area and increased the percent (of) residue coverage."

Another experiment used the Case IH 875 disk ripper to alleviate soil compaction.

Bryan and her team set the tool at multiple depths.

> **"WE SAW A 10 PERCENT HIGHER PRODUCTIVITY ACROSS FIVE DIFFERENT FIELDS WITH OUR PRESCRIPTION."**

"We ranged from five to 14 inches," she said. "We saw a 10 percent higher productivity across five different fields with our prescription."

Creating a tillage prescription can be as simple or complex as an individual farmer wishes.

Farmers already have their field information available. It's a matter of setting the equipment up to perform accordingly, Lursen said.

"Generally, farmers are going to do maybe two or three settings, but they can do much more if they want," he said. "It's about allowing farmers to use the knowledge they have to implement it." | pag

PHOTO: caseih.com

BITS & BYTES

01

Ag-Analytics acquires AcreValue from Granular

Ag-Analytics, a leading farmland data technology software provider has acquired AcreValue, a farmland information and evaluation platform, from Granular. Ag-Analytics' expertise in precision farm analytics, sustainability metrics and GIS mapping technology will advance AcreValue's capabilities to deliver enhanced land management tools.

MORE

02

Reducing environmental impacts and increasing yields is the game, and we have several winners

The winning concepts of the Next Gen Fertilizer Innovations Challenge, created by the USDA and EPA, include several solutions that reduce the impacts of fertilizers on the environment – all the while maintaining or increasing crop yields.

MORE

03

Clemson students develop system to minimize crop waste and help farmers save money

Two Clemson university students have developed an unmanned ground vehicle, Argus UGV, that can travel down crop rows taking reliable and autonomous measurements of plant density and volume. Sound expensive? You'll be pleasantly surprised. The Argus systems model is designed as a subscription-based service – the estimated total cost per day of operation would be only $75.

MORE

04

AGCO streamlining support for farmers with mixed-fleets

Although there are some, not all farmers bleed only green, red, blue, etc. – often it's a combination of colors that make up a farmer's inventory of equipment. In a push to streamline support services for farmers with mixed-fleet operations, AGCO is piloting its Precision Ag Line program, which will support John Deere, Topcon, Trimble, Precision Planting and Raven technologies.

MORE

05

New biological breaks down resilient crop residue

Frenchman Valley Coop recently announced a new biological designed to break down difficult crop residue, CARBON CYCLE™. The product triggers biological activity using a unique collection of bacteria and amino acids that quickens residue decay and releases nutrients faster.

MORE

06

Productivity and agronomic flexibility essential for this new vertical tillage tool

Case IH kept farmer productivity and agronomic flexibility top of mind when designing its new-ish (announced in late September) VT-Flex 435. Its variable gang angle adjustments allow producers to meet soil management needs with greater precision and flexibility. Operators can also seamlessly adjust the tillage tool setting from the cab on-the-go.

MORE

09

The largest greenhouse in the U.S. yields 30x more per acre than open fields

According to the UN, when we reach 10 billion people on Earth by 2050 we will need to produce 70% more food to feed them. But how can we achieve that? One option involves AI-powered greenhouses. AppHarvest currently operates a 60-acre state-of-the art facility in Kentucky that uses 90% less water to produce 30x more per acre than open fields.

MORE

07

Robotic harvesting technology lands this company $25M

Advanced Farm Technologies raised $25 million in a series B investment round to support the company's growth in robotic strawberry harvesting, as well as the adaptation of its technology to apple harvesting. The Advanced Farm TX Robotic Strawberry Harvester automatically senses and picks ripe fruit from in-soil strawberry beds.

MORE

10

Tire pressure adjustments on the fly benefit farmers and the environment

John Deere has rolled-out a new fully integrated tire pressure monitoring system for its 8R Series tractors with ILS, allowing farmers to adjust tire pressure at the touch of a button. Learn how tire pressure adjustments can work in your favor: higher yields and lower operating costs – all while lowering CO_2 emissions.

MORE

08

Autonomy, Robots, & Wine

Meet YV01, an autonomous spraying robot that will soon transform vineyards. YANMAR has created an advanced spraying system that ensures vines are precisely sprayed with a specific amount of droplets... less spraying = less costs. Oh, and it can navigate slopes up to 45% without compressing soils, in any weather conditions.

MORE

PHOTO: FluxFactory/E+ via Getty Images

GROWING YOUR OWN FEED FOR LESS

Little water—no problem. Learn how farmers can produce their own animal feed year-round.

ANDREW JOSEPH
FARMS.COM

The famous literary complaint by poet/artist William Blake "Water, water everywhere, and not a drop to drink", was summarily dismissed by Thierry Perrotin when he discussed "Livestock Nutrition Ag-Tech as a Solution to Land and Water Scarcity" at the Farms.com-sponsored **Virtual Precision Agriculture Conference & Ag Technology Showcase** held November 16-18, 2021.

Perrotin is the Vice President of Business Development, HydroGreen for **CubicFarms**, and a pioneer in the usage of automatic milking robots on global dairy farms.

Within the DeLaval Group, over the past 20 years he held leadership roles in Canada, Switzerland, Germany, Sweden, and the US.

With HydroGreen, Perrotin and CubicFarms—a company founded by farmers—help farmers and ranchers grow their own quality animal feed without the need for farmland capable of producing it year-round regardless of weather or season—and all the while utilizing a fraction of the water compared to traditional crop production.

Intrigued? So were we.

CubicFarms is an automated indoor growing technique capable of producing commercial-scale quantities of animal feed via its HydroGreen nutrition technology business, and also plants and fresh produce for the retail market through its CubicFarms AgTech entity.

Perrotin said that HydroGreen is driven by the perils facing farmers—unpredictability. If it's too much water, such as the floods that confronted British Columbia in mid November, or it is too little with the drought going on for years now affecting most of the western US, noted Perrotin. Then there is also the scarcity of arable lands, with it getting worse owing to erosion, and the increased dependence on feed suppliers and commodities and being at the whim of economic upheaval affecting pricing.

And, he said, beside all of that, there is still the need for fresh, nutritious livestock feed—something that is required on a daily basis.

Perrotin explained that for farmers, sustainability actually means profitability—the type that allows a farm to stay in business now and for generations to come, as well as the use of a limited amount of natural resources.

"We want to create consistency on the farm," extolled Perrotin.

Based on hydroponics, HydroGreen offers two tiers of simple feed growing technology, both of which are automated and scalable to provide the amount of feed an individual farm requires on a daily basis—the six-level DGS 66 and the larger eight level GLS 808 Grow Systems.

Each tech can grow feed from seed to super seed sprout in six days, using the hydroponic technology, clean water, air and light. Grown within a controlled environment—yes, you may have to construct a building for it—Perrotin said the system will produce 365 harvests a year that is unaffected by weather and does not require the use of pesticides or herbicides.

A single unit of the DGS 66 Grow System will be able to feed approximately 100 cows—but because it is scalable, more units mean more feed grown for larger numbers of cows.

PHOTO: djgunner/E+ via Getty Images

However, the use of the GLS 808 Grow System provides feed for up to 2,000 cows—again scalable, so that four units would feed 8,000 cows. Perrotin provided the example of 12 modules of the GLS 808 Grow Systems, capable of producing 25-million lbs (11,339,809.25 kgs) of feed each year for 2,000 cows.

The Grow Systems create live, green feed of barley or wheat—depending on the farmer preference or budget—that allows the farmer to harvest after just six days. Of course, the idea is to not have to wait six days for the next harvest, but to have a constant daily harvestable feed available to provide the freshest sprouts for the cows. It's why the HydroGreen systems work best with multiple units.

But will the cows eat what is grown, and is it nutritious? High in sugars, low in starch, enzyme-rich to promote digestion, low potassium, the six-day feed is both highly palatable and digestible.

After several trials at Crosswind Jerseys Inc. jersey dairy farm in Elkton, South Dakota, Perrotin said HydroGreen found data to support favourable increases in milk production, cow health and cow fertility after calving, such as increases of:

- **12 percent rumination activity and dry matter intake;**
- **13 percent milk weights; and**
- **17 percent conception rates.**

Peak nutrition cow feed available in six days—and every day should the farmer seed the units that way—regardless of the weather. Sustainability-wise, he said that HydroGreen sees itself as part of the circular farming program, and is always looking for partners to become even more involved.

Perrotin summed up: "It's more than a feed grow system. It's also about looking to provide net-zero farming (opportunities), and feed is a part of it." | pag

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