

When technology and farming converge

FOOD 2.0

Right: The screens in Scott Wagner's GPS combine track yield data in real time as he harvests corn.

By Hana Medina

DEEP IN NEBRASKA'S CORN BELT, family farmer and Costco supplier Scott Wagner is in the cab of his GPS-guided John Deere combine, harvesting the last of his corn crop. He keeps his hands off the wheel—the combine is driving autonomously. It impressively straddles eight rows at a time, removing corn from the stalks, then shucking and shelling it. Once the storage area is full, the press of a button creates a cascade of kernels from the combine into a separate tractor bed being driven alongside Wagner.

"My grandfather, when he used to do it, well, he'd have a horse and a little box, and he would [harvest] by hand and throw it in," says Wagner. "And then all the neighbors would get together [with] this little machine that would shell it."

Automatically harvesting corn isn't all his combine is doing. Seven different screens blink and flash as they collect all sorts of data points, measuring the productivity of each acre and mapping the topography of his land. These are technologies his grandfather certainly didn't have. The information will ultimately help Wagner operate more efficiently. It's the future of farming, because it has to be.

Farmers face an ever-expanding global population, labor shortages, environmental challenges, sustainability and food safety concerns, and, of course, the pressure to stay competitive. These issues are felt from the smallest family farm to the largest growing operations. Many growers, however, are turning to technology to help overcome many of these obstacles.

Just as the first tractors created efficiencies in the field, so are the new technologies emerging today. iPads, drones, GPS systems, optical sorters, artificial intelligence, data-driven processes and much more are taking their place



alongside shovels and shears. In some cases, technology is eliminating the traditional field altogether. The results allow for smarter labor practices, fewer environmental impacts and safer food-handling processes. In all cases, the introduction of technology is helping farmers grow more with less.

Jeff Lyons, Costco's senior vice president of fresh foods, says agri-tech (a combination of agriculture and technology) is important for Costco, and also for the future of the global food supply. "Not only does the United States count on [the] United States' farmers, but the world does," he says. "The world needs food, and we're the greatest producer in the world on certain products. The benefit to the world is that U.S. farmers are continually technologically advancing to drive costs down so that they can meet the growing need. That means investing in technology and equipment."

The Connection met with several Costco suppliers who are shattering traditional ideas of what it means to put food on your table. Here's what just four of them are doing. ➔

DEE-VIRG INC.

SCOTT WAGNER'S FAMILY FARM is located in Hooper, Nebraska, about an hour outside Omaha. You must navigate several miles of dirt roads, dodging trucks and other farm equipment, to reach it. Wagner primarily grows conventional seed and white corn, and some soybeans. He will soon raise chickens and also provide feed for a Costco poultry facility being built in Fremont, the next town over.

As a fifth-generation farmer, with a sixth coming up in the ranks, Wagner knows this land well, and it isn't just because his family has farmed the

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—Scott Wagner

same soil for 145 years. He explains that technology has given him the ability to gather detailed information about his 1,850 acres: 22 data points on every acre, to be exact.

"The old saying 'If you're standing still, you're running backwards' is 100 percent true in farming," says Wagner. "The technology is changing so rapidly. If you are not keeping up, you are losing money. And you're losing your ability to stay on the farm."

Data gathering isn't limited to his GPS-guided harvester—in fact, that's where the data collection ends for the season. It starts with soil-sampling an empty field. Wagner partners with



OUR DIGITAL EDITIONS

Click here to watch the GPS combine in action. (See page 13 for details.)

Matt Rasmussen, an agronomist (an expert in the science of soil management), who says that learning what nutrients are already in the soil helps determine which corn strains to plant and where. It also indicates how best to care for the crop once it's planted, and which soil nutrients need to be replenished to keep it healthy and thriving. This way, rather than blanketing a whole field with the same amount of water and fertilizer, the information allows Wagner to dole out only specific amounts (ounces versus gallons) of what each acre needs to thrive. The process, called variable rate application, is done via a GPS-guided tractor. He also uses beneficial crops (rye, turnips and radishes) to help replenish the soil when corn isn't being grown. The result? Healthier food, healthier land and higher yields.

"We are better environmentalists because of technology," says Wagner. "We are extraordinarily conscientious of the land, water and resources that we use." He adds that his crops start only 30 feet from his family's well, stressing that conventional family farmers are personally invested in providing safe food for consumers and in creating thriving land for future generations. Farming with data is "as responsible as we

Scott Wagner inspects his GPS combine in his cornfields.

CONTINUED ON PAGE 34



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Top: The bug vacuum works its magic on strawberry fields. Below: Four mercados ease the workflow.

can get,” says Wagner, as his 12-year-old son, Christian (the oldest of five), trails closely behind him.

Environmental benefits aside, there are certainly practical business benefits for a data-driven approach to farming. These technologies allow Wagner to manage the entire acreage with only himself, his father and one employee. The

lygus bugs as easily as your vacuum cleaner sucks up dirt from your carpet. Left to its own devices, the lygus bug creates a misshapen and unmarketable strawberry. The vacuum gently removes bugs from the plant canopy, leaving the flower blossoms and fruit completely intact. This mechanical solution greatly reduces the need for chemical pest control methods and is used in both organic and conventional fields. It’s one of the many innovative approaches to farming that grower and shipper Andrew & Williamson, an early developer of the machine, employs.

Andrew & Williamson (colloquially known as A&W, not to be confused with the fast-food and root beer chain) grows and ships organic and conventional strawberries (and small quantities of tomatoes and Brussels sprouts) for Costco.

Dave Murray, vice president of operations for A&W, says that automation is “reducing some of the time that could otherwise be used for more-productive activities. We look at farm automation as a win-win. Productivity gains allow us to both increase farm wages and increase value to the Costco member, by lowering cost and improved quality.”

As an example, he mentions the *mercado* (Spanish for “market”), a self-driving machine that straddles several rows and holds harvested berries, empty boxes or anything else farm employees need. Workers set the pace of the *mercado* to match the rate at which they pick strawberries, and can stop it to take breaks.

This may sound simple, but before the *mercado*, Murray explains, workers had to pick berries, then walk hundreds of yards to the sides of the fields to drop off the harvested berries, which were then inspected by a quality-assurance employee to see if they met specifications. It resulted in more time being spent walking and waiting rather than picking. Today, the workers are trained in these quality-assurance skills so they pick the berries that meet specifications from the start. “By removing



ANDREW & WILLIAMSON

time savings from automation also allow him to accomplish other business tasks.

“I’m able to become more efficient and do a better job because I’m able to get information quicker,” says Wagner. “It’s a whole dynamic situation that comes with the technologies that come into agriculture.”

ANDREW & WILLIAMSON

IN A STRAWBERRY FIELD in Oxnard, California, a big yellow machine, known as the “bug vacuum,” straddles rows of strawberries, sucking up harmful



some of those procedures it actually made a better [strawberry] pack for the member,” says Murray.

A&W is also working with robotics company Agrobot to develop a robotic strawberry harvester. It is being designed to automate strawberry picking, but is still being fine-tuned to handle the delicate nature of the fruit. Murray says initial testing has yielded some very promising results, and he hopes to see it in action in the next couple of years. He notes that technology is “an opportunity to improve upon the less ergonomically pleasing jobs and allow humans to do the things that they’re most uniquely suited to do.”

GO GREEN AGRICULTURE

WALKING INTO Go Green’s climate-controlled greenhouse, located in a busy residential area of Encinitas, California, you’re met with endless tables of perfectly spaced, bright-green organic butter lettuce. The ambience feels lighthearted and jovial; it’s warm and bright, and pop music plays on the sound system. A robot rolls by, spraying garlic extract on the crop to ward off any unwelcome bugs.

This isn’t a futuristic movie set—it’s how you get your butter lettuce. And CEO Pierre Sleiman Jr., a software engineer by education, says, “I just thought, ‘How cool would it be to really marry technology and agriculture in a different way?’”

All greenhouse operations are designed to capture the sun while keeping out pests, bad weather and other contaminants that are challenges with land farming. Sleiman’s greenhouse is purposely situated in a populated area to cut down on transportation challenges and to bring fresher products to consumers. His lettuces grow from soil pods (nicknamed “soil sushi,” a proprietary mix of soil compacted in a cornstarch wrapper) in 20-foot channels that look like rain

Go Green’s operations produce no runoff, and use **80 percent** less water than field farming.

gutters. Inside the channels, lettuce roots are submerged in a constantly cycling, closed-loop irrigation system that is closely monitored by computer.

Like Sleiman, his 47 employees (including his parents and sister) do not have agricultural backgrounds, because they don’t have to. But while Sleiman’s base operation is unique, what really sets it apart is what

happens behind the scenes. Sleiman’s pièce de résistance is a cloud-based program he developed that tells his staff what needs to be accomplished for the day when they log in. “It will tell them ‘seed this today, transplant that today, harvest this today,’” says Sleiman. This software, which is intuitive and user-friendly, took six years to develop.

“We’re different in the sense that we seed every day and we harvest every day, whereas most [land] farms seed for the season, and then you wait and harvest it,” says Sleiman. “It means that we have about 40 or 50 different batches of product everywhere. To manage it all and track it is challenging.”

Although some might view employees without

A garlic-extract-spraying robot rolls up and down rows. It used to be one of the worst tasks to perform in the greenhouse, according to Go Green CEO Pierre Sleiman Jr.



HANA MEDINA



ANDREW & WILLIAMSON

CONTINUED ON PAGE 36



HANA MEDINA

A Go Green butter lettuce plant with the root system attached to the “soil sushi.” Typical hydroponic operations do not grow in soil (see “Windset Farms”).

agricultural experience as a challenge, Sleiman says his program makes up for any knowledge deficit. It includes a Wikipedia-style resource section to help identify any plant health issues his employees might encounter. The computer system not only maps out where each and every plant is at any

“We’re almost more of a technology company than a farm or produce company. We’re always investing in it heavily every year.”—Steven Newell

given time, it also details how each plant is cared for; monitors and adjusts greenhouse conditions; and tracks inventory, orders, sales and shipments. Sleiman says he wants his employees to come up with out-of-the-box solutions and not be limited by traditional agricultural practices.

Many of the repetitive and undesirable jobs are automated, while Go Green’s employees ensure quality. Machines create the soil sushi, plant the seeds and water the seedlings and growing plants. Pesticides are never used. Humans move the product around the greenhouse and hand-harvest the lettuce. Two machines box and label the product



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Click here to watch automation at Go Green. (See page 13 for details.)

(see video for demonstration). Due to these efficiencies, Go Green’s 6 acres produce 20 times the annual yield of equivalent field acreage.

“Our employees are able to earn more because they are able to be more productive per capita by using technology,” says Sleiman.

Go Green is currently developing a second greenhouse, a 20-acre facility that will be even more high-tech: Seedlings will be planted and grown on a conveyor belt that will take five weeks to move from start to finish. The product will emerge full-grown, ready to pack and ship.

Sleiman says, “Every decade there are statistics that say, if we keep going the way that we’re going, there will be a food shortage. And every decade we solve it and we do produce enough food. The way that happens is through technology. It is technological breakthroughs that allow us to produce more with less ... in a smaller footprint and do it faster.”

WINDSET FARMS

THE CONVENTIONAL STRAWBERRY industry has come under scrutiny in recent years for high concentrations of pesticide, chemicals used in land fumigation and issues surrounding water usage and runoff. While Costco’s conventional strawberry suppliers, such as A&W, utilize methods that mitigate or eliminate these concerns, Windset Farms decided to look inside for an answer. Literally. The company is among the first in the United States to grow strawberries hydroponically.

Windset Farms operates a 168-acre hydroponic greenhouse (aka hothouse) operation in Santa Maria, California. It’s one of their four greenhouse operations in North America. Like Go Green Agriculture but on a much larger scale, Windset grows produce in massive, climate-controlled greenhouses bursting at the seams with technological advances. This setup allows them to bring fresh produce to tables year-round, using minimal resources to boot. During a tour, a quick glance up at the rooftop solar panels revealed only the tip

of the technological iceberg.

“We’re almost more of a technology company than a farm or produce company,” says Windset CEO Steven Newell. “All of farming has been impacted by technology, but I think in the greenhouse it’s even more applicable. It’s soup to nuts, quite frankly, when it comes to what we get out of technology. We’re always investing in it heavily every year.”

While tomatoes, bell peppers and cucumbers are the main crops grown on-site among the five greenhouses in Santa Maria, the smallest one (if you consider 10 acres small) houses the strawber-

ries. It. Smells. Divine. Planter boxes hover in midair, suspended by movable cables that the employees can adjust to make harvesting more ergonomic. The greenhouse buzzes with the activities of the daily harvest; employees trim ripe berries that overflow the sides of the planters, placing them directly inside the plastic clamshells that Costco members will place in their carts.

Claire Vasquez, sales and marketing assistant for Windset, pulls up a reddish-brown mixture from a planter, explaining that all of the produce grows in a “soilless medium,” specifically ground coconut husk. Vasquez explains this helps keep disease from spreading to plants, which can occur more easily when plants are grown next to each other outside. Newell elaborates that the coconut husk is a clean, organic matter that helps them to avoid soil fumigants that other land growers have used to sterilize soil for strawberry growing. Windset’s growing medium is composted after a year and tilled with soil for use in land growing.

According to Newell, Windset’s water consumption is up to 10 times more efficient than land farming, depending on the crop and other factors. Their closed-loop irrigation system continuously recycles water until it is completely absorbed by the plants. Windset has its own on-site water treatment system that filters, sterilizes and recirculates waste- and rainwater. “We, quite frankly, epitomize the future of sustainable water management,” says Newell. “It’s not just an environmental thing—it’s an economic thing. Fertilizer is expensive, water is expensive to pump up and filter, so we want to use it until it’s consumed by the plants.”

Another crucial earth-friendly growing method is Windset’s lack of pesticides. While the

In 2017, Windset grew **72 million** pounds of produce in its **168-acre** greenhouse operation in Santa Maria.



TOM MEINHOLD PHOTOGRAPHY

greenhouse by nature keeps out most pests, it is still affected by bugs and insects that are naturally problematic for all strawberry crops in California. “Our first line of defense is beneficial bugs to target the bad bugs,” says Vasquez. The beneficial bugs feed on other bugs that harm the plants (in the case of strawberries, a prime suspect is spider mites). In addition, sticky yellow sheets are placed around the greenhouse to trap any other harmful bugs that make their way into the crop. This reduces and/or eliminates the need to use any pesticides on the fruit.

Windset has also invested in an impressive amount of automation for harvesting and packaging their tomatoes, cucumbers and peppers. Newell says all of these efficiencies add up to big dividends for the consumer. “There used to be a season for peaches, and a season for cherries, and a season for tomatoes,” he says. “Now people can get these things year-round, and that’s the advantage of the [greenhouse] technology. You get a better-quality product, at a better price, with better flavor and better food safety. And you really can’t beat that.” **C**

Above: Hydroponic strawberries grow in Windset’s greenhouse in Santa Maria, California. Below: Windset grows its produce in ground coconut husk.



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