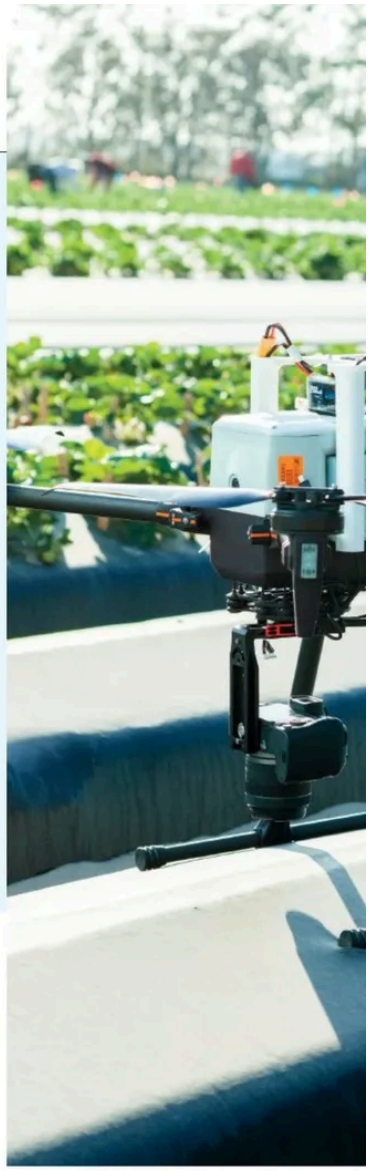
Artificial Intelligence

Agriculture's 'Silicon Valley'

Florida's agricultural sector is embracing artificial intelligence to tackle industry challenges and revolutionize farming.

By Brittney J. Miller



Perched in her lab, Daeun "Dana" Choi fiddles with her computer mouse and keyboard. A video materializes on her monitor: an image of a row of strawberry plants, zoomed in close enough to see the individual golden flecks patterning their scarlet skins. Their leafy canopies — streaked with veins, sun rays and shadows — stretch above the fruit.

The camera pans slowly from above, showing plant after plant and the horizontal stems, or runners, shooting between them. It would take a trained eye to detect that the entire scene — down to the dimpled, blushed berries themselves — was a virtual simulation, one destined to train artificial intelligence to perform tasks and provide insight that will help growers save time and money.

It's part of the sector's latest transformation. First came mechanization, when tractors and other machinery replaced animal power in fields. Chemical usage followed, coating crops with additives like fertilizer and pesticides, along with plant genetic engineering. Now, artificial intelligence promises to catalyze the fourth agricultural revolution.

"Agriculture is at the point that we are transitioning from physical labor to more technology-related jobs," says Choi, an assistant professor of ag engineering and specialty crops at the University of Florida's Gulf Coast Research and Education Center near Wimauma, about 30 miles from Tampa. "It will be a high-tech industry in the future."

Florida's 9.7 million acres of farms and ranches spat out around $10 billion in agricultural products in 2022, according to the U.S. Department of Agriculture. The state leads the nation in bell pepper, sugarcane and watermelon production. It ranks second in oranges, sweet corn and strawberries, and third in cabbage. But it's not immune to the challenges riddling the American agricultural industry, including labor shortages, skyrocketing expenses and an aging farmer population.

Artificial intelligence offers a path forward — one that researchers and producers alike are eager to explore. Products are already making the difficult jump from lab to marketplace, with proponents throwing millions behind the projects. The University of Florida, with its HiPerGator supercomputer and hefty agricultural extension program, is among the state leaders carving the way toward what's expected to become a $4.7-billion niche industry by 2028.

"A hundred years ago, everybody was scared about

electricity and how we were going to use it. I feel like it's very similar (with AI)," says Xu "Kevin" Wang, an assistant professor of agricultural engineering at the UF Gulf Coast Research and Education Center. "We don't have to be scared by AI. It's just a tool for us. How can we leverage this power?"

Potential — and power

Choi's lab is littered with electrical circuits, computer monitors, wires, tools and gadgets. A soldering tool sits on one counter; a 3D printer rests on another. Her petite ground vehicle claims a corner, its wheels still covered in Florida's sandy soil.

It's not the scene of the "traditional" agricultural researchers that comprise most of the UF Gulf Coast Research and Education Center faculty. It's a glimpse into the future of the field.

photo: Jeremiah Wilson

Daeun "Dana" Choi, an agricultural engineer working as an assistant professor at UF's Gulf Coast Research and Education Center, says ag is transitioning to a high-tech industry. Using digital twin technology that recreates machines, fields and plants, she and her team of researchers are able to conduct strawberry farming research even during the off-season.

At its core, artificial intelligence has three broad roles in agriculture. Tech like computer vision and sensors serve as the "eyes" to collect data. The "brains" — machine learning and deep learning — help interpret data and make predictions. And the "muscles" — automation and robots — are used to carry out labor in field operations. Altogether, the tech promises to beef up the industry, making it more automated, more precise, and easier to use.

Choi, for example, is combining several prongs of AI in her research. A small vehicle rumbles over strawberry fields, armed with cameras pointing in every direction. Back in the lab, the thousands of photos are used to create a 3D version of the row — a virtual twin down to the number of berries, branches and leaves on each plant. (The team uses the same animation programs behind vegetation graphics in video games, even using a video game controller to maneuver the field vehicle.)

It's a highly detailed replication of the real world in a slice of time. Choi hopes to add more variables to the model, such as weather and disease and pests, to better simulate realistic field conditions. Ultimately, the alternate reality is used to collect simulated data to teach an AI model how to identify plant characteristics. Her team also uses the virtual twin to test different configurations of the ground vehicle, saving time and money.

"It's a great alternative because real data collection is very expensive, and it will take a lot of time to do," Choi says. "Ultimately, we want to do anything from the screen."

Xu "Kevin" Wang, an assistant professor of agricultural engineering for UF, hopes AI-driven tech can trim a year off the process of strawberry plant breeding. Vehicles armed with cameras take photos of strawberry plants in a field and those images are converted into a 3D replica of the farm.

photo: Jeremiah Wilson

Yiannis Ampatzidis, a UF professor of precision agriculture engineering, and his team invented an AI-enabled system called Agroview that uses drone imagery to assess the health of citrus groves.

For UF assistant professor Wang, AI means slashing the laborious plant breeding behind the sweet, juicy strawberries at your local grocery store.

Traditionally, strawberry breeders start with bulk populations about 50,000 strong. They must scout the ideal seedlings row by row, searching for top-quality varieties, the labor often stretching for more than a week. That narrowing-down process continues in stages — from 15,000 to 400 to 15 plants — whittling down to the most desirable one to two varieties over four to five years.

Wang's team hopes to chop a year from the process. When strawberry plants number into the tens of thousands, he takes aerial photos of the populations with a drone. That imagery is then fed into an AI model trained to recognize certain features — color, visible and nonvisible light, and shapes — and identify the ideal selections much quicker.

"If we give a prediction tool to the growers, they can have better decision support," Wang says. The same formula can be used to reveal other data about crops, like nutrient deficiencies and plant stress.

UF has an expanding toolkit of agricultural AI. In one lab sits a prototype that can autonomously detect and cut strawberry runners in the field. Others are using generative AI to amplify details in aerial photos, or to complete 3D models of fruit for AI training. Researchers are wielding the tech to attack statewide challenges — like autonomously injecting antidotes into citrus trees to combat greening or using precision sprayers to apply pesticides while mitigating waste and chemical runoff.

Other Florida schools are following suit. A team of University of Central Florida researchers, for example, landed a $2.74-million USDA grant to develop AI-driven farming technologies. Its projects span from agricultural field robots to pesticide residue detection, all aiming to reduce labor dependence, shortages and costs.

"It all comes down to the cost issue. We need to basically think about how to really increase the profit margin so agriculture workers can get higher paid jobs," says Yunjun Xu, project lead and a mechanical and aerospace engineering professor. He's developing AI for motion control and scheduling in autonomous agricultural robots used in field operations. Lowering operating costs could make the "younger generation willing to go into the agriculture industry to contribute and make that their career."

Taking it commercial

In 2017, Florida's citrus industry was reeling from disease and the aftermath of Hurricane Irma, which racked up as much as $2.5 billion in total agricultural losses for the state.

To recoup crop insurance, citrus growers had to manually survey their groves to calculate losses. They counted tens of thousands of trees, driving up and down row after row, tapping their clickers nonstop. The time-consuming process could take more than a year for some companies.

Enter Agroview, a product developed by Yiannis Ampatzidis, a UF professor of precision agriculture engineering, and launched by his startup company Agriculture Intelligence in 2020.

It uses a drone to take aerial photos of citrus groves. Those images are then stitched together and fed into an AI model trained to calculate figures like tree count, gaps, size, productivity and disease. It spits out an interactive map of the grove for growers, offering findings from area-wide fertility maps down to tree-level data. It cuts the time of traditional data collection by 90%.

"In perennial tree crops, accuracy and actionable intelligence are crucial, and that's what we specialize in," says Agriculture Intelligence CEO Matthew Donovan. "It's still in an emerging state. The impacts are starting to be felt, but the transformative impacts of AI, machine learning, computer vision and all the technologies that Agroview is working on — that's still ahead of us."

Two of the nation's seven authorized tree crop insur-

photos: UF/IFAS

Wonsuk "Daniel" Lee, a UF/IFAS professor of machine vision and precision agriculture, is training AI to spot budding flowers, which eventually turn into fruit, on strawberry plants. The drone-based counting could replace manual surveying, helping growers better predict yields and recruit enough labor for harvesting. Lee hopes to integrate the tool into a holistic product that can reveal more data about the crops, such as nutrient deficiencies and plant stress.

ers have secured contracts with Agroview, resulting in close to half a million acres analyzed nationwide so far. It was named the 2020 UF Invention of the Year, and it won a 2021 award from the American Society of Agricultural and Biological Engineers. Donovan hopes to take the tech global and market it to other tree crops, too.

With its foray into the commercial realm, Agroview is a research-turned-product success story — one of the first in the emerging combination of AI and agriculture. The road to commercializing isn't always easy, though.

Initial research and development costs are often high. Other large Florida industries, like defense and medicine, may draw investor dollars away. Even though scaling and commercializing products reduces manufacturing costs, some may be too expensive for growers, especially those at smaller farms, to justify the investment. (One researcher said that $5,000 was the maximum threshold the average grower is willing to spend on new tech.)

"Going from the prototype to a product is a huge step, especially in agriculture," Ampatzidis says. (Agroview marks one of the many agricultural AI applications he's researching at the UF/IFAS Southwest Florida Research and Education Center in Immokalee.) The technology needs to be "robust, almost bulletproof," he says, because the environment it's deployed in is rough.

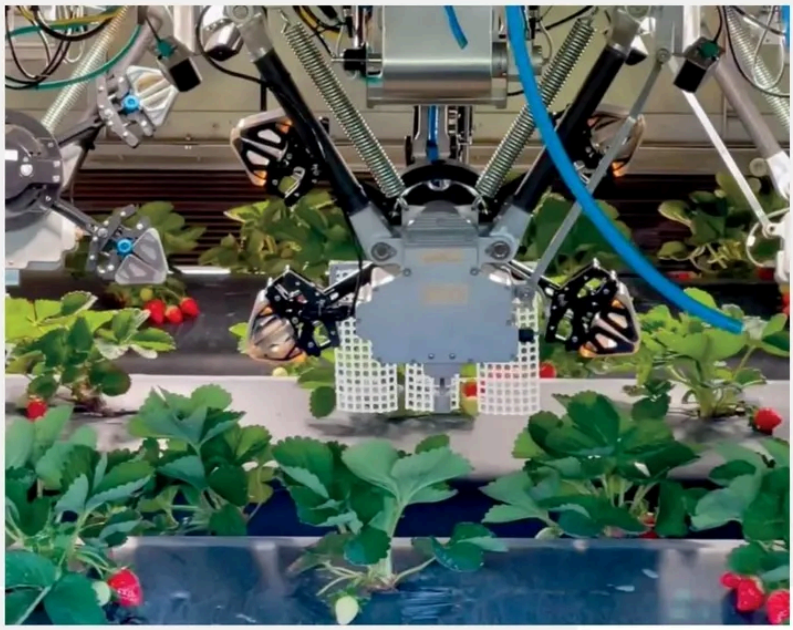
If often takes some help to push research into the marketplace — help that many Florida universities offer.

UF Innovate, for instance, provides resources like tech licensing, market research, investments and funding opportunities, and education to school researchers with a potential product. It has helped start nearly 300 companies based on university research, including Ampatzidis' Agriculture Intelligence.

In fiscal year 2024, UF Innovate assisted with 372 invention disclosures, 279 tech licenses, nine startup companies and 414 filed patents. Agriculture comprises a significant part of that portfolio, accounting for about a quarter of the year's 136 issued patents, says Mingder Yang, assistant director in tech licensing.

UF hopes to make that percentage larger: In 2022, the university announced it would build a hub dedicated to agricultural AI at its Gulf Coast Research and Education Center near Wimauma. The 40,000-sq.-ft. Center for Applied Artificial Intelligence in Agriculture, estimated to cost

photos: UF/IFAS



Gary Wishnatzki, the owner of Plant City-based Wish Farms, utilizes an autonomous harvester equipped with AI-enabled robots to pick ripe strawberries.

around $40 million, would help bridge the gap between research and commercialization by bringing experts together to make affordable AI products at scale.

Thirteen more faculty members and numerous staffers are expected to be hired for the new center. The university originally recruited 16 employees, including Choi and Wang, in its first wave of investments into agricultural AI.

"As the R&D arm of Florida's second-largest industry, UF/IFAS is heavily investing in agricultural applications of AI as part of a larger effort to make Florida the Silicon Valley of agriculture," said Scott Angle, senior vice president for agriculture and natural resources and leader of UF/IFAS, in a statement. "We're also committed to commercializing innovation so that Florida farmers work smarter, not harder to feed Florida and the world."

Ag-bots and beyond

Gary Wishnatzki's Wish Farms is Florida's top berry marketer, sourcing strawberries, blueberries, raspberries and more fruit throughout the Americas year-round, including from his 2,200 acres of farmland in the state.

Like other growers, he's facing mounting challenges in the industry — mainly, a shortage in berry pickers. Domestic workers are hard to find, so he mostly relies on H-2A farmworkers. But that labor pool is shrinking and growing more expensive.

"If labor costs continue to spiral out of control, strawberries could become a luxury item," Wishnatzki says.

His solution? Automation. He co-founded the company Harvest CROO Robotics in 2013, which has since developed an autonomous harvester with 16 robots. Outfitted with cameras and an AI machine learning vision system, the robots are trained to detect and carefully pick ripe strawberries as they glide over rows of plants.

The tech is now on the verge of commercialization, when it will be serviced to other growers for harvesting, thanks to $20 million in capital. That includes financial support from about 70% of the U.S. strawberry industry — a testament to other growers' support for infusing AI into agriculture, Wishnatzki says.

The future is promising, many producers hope. Certain challenges remain, though.

For one, AI models must be meticulously trained to make correct predictions. That means feeding it a large variety — and a large amount — of quality data, which may be expensive to get or hard to come by. Producers aren't always

photos: Harvest CROO Robotics top and left; Wish Farms right

Jim Strickland manages hundreds of cattle with virtual fences. Bovines who get too close to the boundary get an auditory warning, or if that fails, a mild jolt. He hopes to eventually pair that tech with AI that can scan cattle and report their vitals.

aware of how that data is collected and what its downstream uses may be.

Aside from cost, computing capacity is the limiting factor for what is possible for AI. And it takes a lot: Goldman Sachs estimates that processing a single ChatGPT query requires nearly 10 times the electricity as a Google search.

New tech may also require internet — a luxury not widely available in rural areas, and especially not in most farm fields. Prototypes must be resilient enough to survive the elements.

"Ask yourself why Tesla doesn't build tractors," Wang says. "It's because field conditions are too hard. ... Everything in agriculture is another level of complicated."

Field days, where farmers and ranchers visit their peers' productions to see new tech in action, may be key to industry buy-in for artificial intelligence, says Jim Strickland, former president of the Florida Cattlemen's Association and co-chairman of the Florida Climate Smart Agriculture Work Group.

His Strickland Ranch is home to the first and largest cattle herd in the Eastern U.S. equipped with GPS and cell service, a partnership with Merck Animal Health USA. He currently manages around 400 of his beef cattle over 6,000 acres using virtual fences, where he can track cows and erect invisible fences around them with the click of a button. (Bovines who get too close to the boundary get an auditory warning, or if that fails, a mild jolt). Strickland hopes to eventually pair that tech with artificial intelligence that can scan cattle and their vitals.

"I'm willing and anxious to embrace all the different things that science and research provide us as landowners, ranchers and timber owners to let us be more sustainable," he says. "We have advocated for AI technology, recognizing that we don't know what we don't know yet. ... There are things that we don't even know we're going to be capable of."

Time will tell how other producers, alongside Strickland and Wishnatzki, adapt to the AI tech infiltrating the industry.

Zippy Duvall, president of the American Farm Bureau Federation, wrote in 2024 that AI was a "transformative element shaping the future of American agriculture," one that the Farm Bureau would take a "cautious approach" to. The group voted at its 2024 convention to create a new policy addressing the growth of artificial intelligence in agriculture, focusing on the importance of privacy rights.

"Farmers are facing a lot of uncertainties, a lot of risk. They need help managing them," says Ziwen Yu, a UF assistant professor in agricultural and biological engineering focused on improving data quality and ethical considerations in agricultural AI. "AI is, so far, the most tangible solution for that. But still, I think this progress is not going to be straightforward."

photos: Strickland Ranch