

AUTONOMOUS

High-tech solutions help farmers bridge the growing labor gap

AGRICULTURE

By Matt Alderton

CALIFORNIA'S CENTRAL VALLEY IS full of life. Because of its expansive footprint, fertile soil and Mediterranean climate, it's so prolific that it grows more than half of all of the nation's produce.

Alongside plenty, however, there is paucity, seen in the vast expanses of rotting crops that litter the fields — a salad of shriveled blackberries, withering grapes and expired peaches.

Although California has spent the last five years in the throes of epic drought, the cause for the waste isn't only the scarcity of water — it's the scarcity of labor.

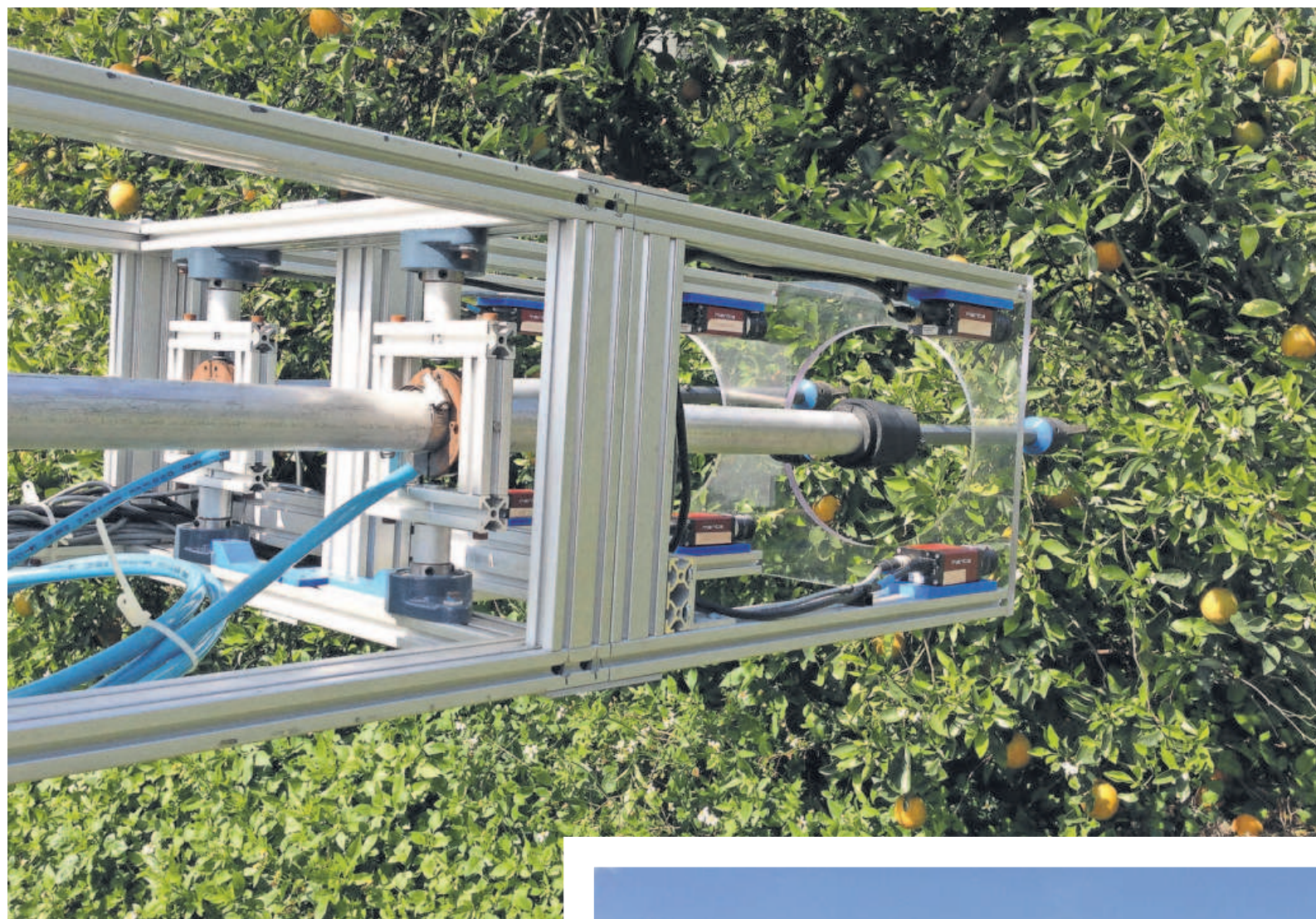
"It's not just a few cases here and there; it's a significant amount of crops that are not harvested because there aren't enough workers to pick them," said Manoj Karkee, associate professor in Washington State University's Center for Precision & Automated Agricultural Systems.

The problem isn't limited to California. The Natural

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An automated robot called LettuceBot thinned the weeds from this lettuce field in Salinas, Calif.

Energid Technologies' citrus harvester uses a grid of cameras to find oranges; the same arm holding the cameras has pickers to harvest fruit.



ENERGID TECHNOLOGIES

Resources Defense Council (NRDC) estimates that approximately 40 percent of the U.S. food supply goes uneaten, a growing cause of which it says is insufficient labor.

"For agriculture to remain competitive and sustainable, there's a desire and a need to develop long-term solutions to the farm-labor problem," Karkee said.

Which is why Karkee and other experts are betting on a promising, if unorthodox, solution: robots.

MECHANICAL WORKERS

Although they sound like characters in an Isaac Asimov story, robots that till fields, sow seeds and harvest crops are reality — and have been since 1959, when two scientists at the University of California-Davis introduced the UC-Blackwelder tomato harvester. The machine automated picking tomatoes for use in ketchup, tomato sauce and juice, and spawned the mechanized-agriculture movement. Today, mechanized tomato harvesters pick nearly all the tomatoes grown in the United States for use in processed foods.

Today, crops as diverse as almonds, sweet

cherries and wine grapes are mechanically harvested, to say nothing of commodity crops like wheat, corn, cotton and soy, the harvesting of which has been mechanized since the mid-20th century.

"A real success story is the shake-and-catch technology that's used for tree nuts," said J. Edward Taylor, professor of agricultural and resource economics at UC-Davis. "Nuts are no longer harvested by hand. Instead, farmers use machines that shake the dickens out of a tree to remove the nuts."

Another success story is that of self-driving tractors, which leverage GPS to till and plant without much human assistance. "Self-driving tractors have been on fields for a decade or so now," Karkee said. "They still have an operator sitting in the cab for safety and other reasons, but they can very precisely follow a certain path that you give them to follow."

Such machines aren't robots of the android sort, but they're robotic just the same, leveraging computer programming, artificial intelligence and machine learning to automate complex tasks.



ENERGID TECHNOLOGIES

The automated citrus harvester, being tested in Florida, features a hydraulic arm that holds cameras for detecting fruit as well as a picking system that literally strikes the oranges from the trees. It takes just two or three seconds to harvest an orange using this equipment.



AGROBOT

The harvesting of delicate berries such as strawberries and raspberries, generally picked one by one, has been the most difficult to convert to automated harvesting. Currently being tested, the Agrobot analyzes individual strawberries to see whether the fruit is ready to pick, then uses its robotic arm to harvest the berry with little damage.

As technology advances, so do the tasks — and crops — that can be automated. Take lettuce, for example. Blue River Technology of Sunnyvale, Calif., is developing LettuceBot, a “see-and-spray” robot that uses on-board cameras, high-speed processors, computer vision and precision sprayers to see young lettuce starts as well as weeds; as it traverses lettuce fields, it distinguishes between the two and selectively applies herbicides to only the weeds.

“There are a few reasons that’s really appealing,” noted Laura Lee, a research associate at Lux Research, which studies agricultural robotics. “It replaces labor, in the long run it will be cost-competitive and it also reduces significantly the amount of herbicide you need. So, it’s a win-win from an environmental as well as a cost-input perspective.”

In 2014, an interest in robotic solutions inspired lettuce grower Tanimura & Antle of Salinas, Calif., to acquire Plant Tape, an automated transplanting system that sows seeds for crops like romaine, broccoli, cauliflower, celery and onion into strips of biodegradable “tape” that are packed in plastic trays, germinated and nursed into seedlings. They are then transplanted from the greenhouse to the field using a tractor-pulled device that pulls the strips of seedling-spotted tape from their trays and cuts them into individual plants that it deposits in the soil.

During trials, the system — which the company plans to commercialize this year — proved to be six times faster than traditional transplanting, reducing labor by 80 percent.

“It allows us ... to plant more crops

per acre, which makes us more efficient and more sustainable,” said Brian Antle, president of Plant Tape USA.

In Florida, Cambridge, Mass.-based

Energid Technologies is developing a robotic citrus harvesting system that uses cameras and computer vision to detect ripe Valencia oranges, and a robotic projectile to reach out and knock them off the tree. Supported by grants from the National Science Foundation and the U.S. Department of Agriculture’s National Institute of Food and Agriculture, it’s too rough for fresh citrus — which must maintain a perfect peel — but perfectly suited for fruit destined to be processed.

“Virtually all citrus today is picked by hand, but the day is close at hand that we’ll be able to do it automatically,” explained James English, Energid president and chief technology officer, who added that about 50,000 people are needed to pick citrus in Florida, and 500,000 people to pick it around the world.

“Not only is it hard to find workers, but the work can be unpleasant and dangerous. If citrus harvesting could be automated, imagine what a big difference it would make,” he added.

Among the most difficult crops to mechanize are berries. And even those are

moving remarkably fast toward automation, according to berry giant Driscoll’s and Reiter Affiliated Companies (RAC), companies that work together to grow and market berries.

Together, they have invested in the Spanish maker of Agrobot, which accomplishes with strawberries what Energid accomplishes with citrus: It uses an infrared camera to detect the red of a fully ripened strawberry, then extends a robotic arm that picks the fruit and places it on a conveyor belt, where it’s transported to workers who package it.

Although they would require chemical instead of visual sensors to detect

ripe berries by analyzing their sugar content, similar machines may one day harvest delicate raspberries and blackberries.

“Because berries are so fragile, there’s not much technology out there now that can help us,” said Soren Bjorn, executive vice president of Driscoll’s of the Americas. “But that’s about to change.”

IMMIGRATION VS. INNOVATION

Because they’re still being fine-tuned, robots like LettuceBot, Agrobot and Energid’s citrus harvester won’t be available for another few years, their makers concede. Full commercialization could take another five to 10 years beyond that, predicted Lee.

In the meantime, the labor crunch

persists.

The American Farm Bureau Federation cites deficient immigration policies, including the H-2A program that allows foreign nationals into the U.S. for temporary or seasonal agricultural work.

“The H-2A program is overly cumbersome and bureaucratic, and it’s not working efficiently,” said Kristi Boswell, the Farm Bureau’s director of congressional relations, who has observed administrative delays of more than five weeks — long enough to cause crop loss on farms that lack labor when they need it. “Our priority issue is trying to ensure agriculture has access to a stable and legal workforce through responsible immigration reform.”

Immigration reform might reduce agriculture’s labor shortage, but it won’t solve it, UC-Davis’ Taylor insisted: “That only works if people are growing up to be farmworkers on the other side of the border. They aren’t.”

He’s been studying the issue for the last 15 years, during which time he’s assembled migration histories for members of nearly 2,000 rural Mexican households dating back to 1980. His conclusion: The number of migrant farmworkers from rural Mexico is decreasing at a rate of 1 percent, or about 150,000 people, per year.

He attributes the decline to a confluence of trends. One, women in Mexico are having fewer children, which means there are fewer kids who can grow up to become farmworkers. Two, Mexico has built more rural schools, creating a more educated workforce that is not interested in farm labor. Finally, Mexico’s non-farm economy is growing, which means workers who would otherwise turn to agriculture are now entering manufacturing and service professions, which offer higher wages, better work conditions and year-round, instead of seasonal, employment.

Offering those same benefits in the U.S. can help farmers compete. Driscoll’s and RAC, for example, are gradually moving toward substrate farming, whereby strawberry plants are grown in bags on raised tables instead of in the ground. This allows workers to pick berries standing up instead of hunched over, making the job more comfortable while also expanding the labor pool to include older workers whose bodies otherwise couldn’t do the job. Also, the easier they are to access, the more berries workers can pick, which increases their earning potential on farms where they receive piece-rate wages.

“Our No. 1 priority in the short term is to make it easier for human beings to pick the berries,” said Bjorn.

In the long term, however, it’s clear: Robots will reign.

“It’s a fact: We’ve entered a new era of farm labor scarcity after many years of farm labor abundance,” noted Taylor. “So, the incentive for farmers to invest in robotic solutions is great, and it’s only going to increase.”