New Ag Technology Promotes Sustainability

WESTERN SARE
Sustainable Agriculture Research & Education

See How Western SARE Supports Advanced Research and Agricultural Technology

Innovation and Technology are Improving Sustainable Ag

Darrell Donahue

WESTERN SARE REGIONAL COORDINATOR

Hello Western Sustainable Agriculturalists! It has been just over a year since I started as the Regional Coordinator at Western SARE, and the year has been a great learning experience for me. The folks in the Western Region have been understanding and helpful as I learned about the "Big, Bold West!" It is an exciting time, and we are moving forward – fast.

Western agriculturists – producers, researchers, educators and nonprofits – have consistently led the way with new tools, ideas and practices. Their innovativeness is demonstrated by a keen interest in the adoption of novel technologies.

A recent Western SARE survey helped us understand that learning more about emerging technologies was a top priority in our region. These emerging technologies from new types of controls, new farming methods, to new equipment and use of the "new AI" in agriculture will help our region continue to lead the way in sustainable agriculture.

Our grantees have been on the forefront in researching, providing education about, and demonstrating technologies that improve production, reduce the environmental impact and use of conventional inputs, improve soil and water quality and increase producers' profitability. We have been inspired by the resourceful efforts of our grantees toward understanding and adopting new technologies. This report highlights just a handful of innovative technology-focused projects in the Western SARE grant portfolio.

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Solar panels installed on a farm. Photo courtesy of the American Farmland Trust.

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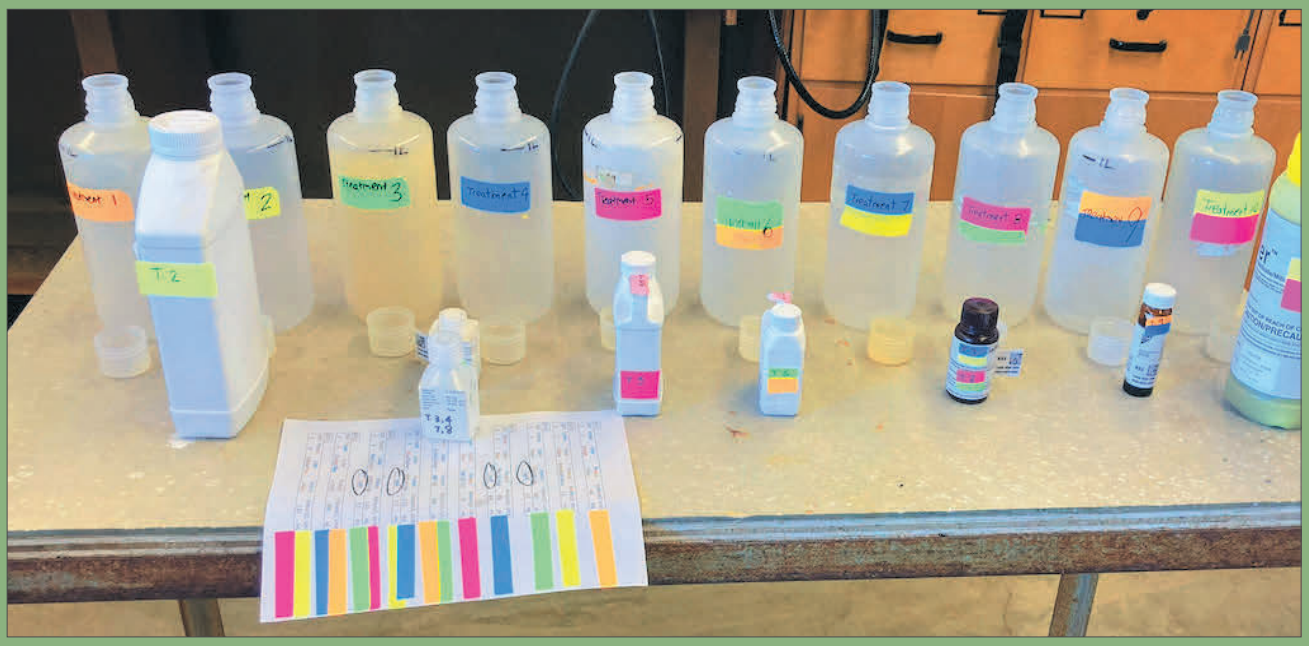
This work is supported by the Sustainable Agriculture Research and Education program, project award no. 2025-38640-45392 from the U.S. Department of Agriculture's National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. government determination or policy.

In this report



Innovation has always driven agriculture. At Western SARE, we help create that innovation by funding cutting-edge research, supporting innovative producers and expanding the science of sustainability. Inside are a few recent examples.

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Where Do Bees in Hawai`i Forage?

Bees gathering lilikoi pollen.

Citizen scientists use environmental DNA to track where bees feed and what they encounter while foraging

At its heart, science is curiosity. What is…? What if…? Combine those questions with technology and technique, and *voila*. Science happens.

On the east side of Hawai`i island, downslope of the unsettlingly active Kilauea volcano, the curiosity of farmers and beekeepers Jim Klyman and Carey Yost inspired their research on the floral resources on the island. It's research that benefits bees, and may also develop into an early warning system to protect the island from invasive species.

The pair are part of a citizen science research team working on a Western SARE Farmer/Rancher project to anaylze the DNA found in honey collected from locations around the island, and then build a database of the species bees use at different times and places.

"For over two decades, we've tended a small but productive tropical fruit orchard growing around 30 different fruits," Klyman said. "Before Varroa mites hit the island in 2009, feral honeybees pollinated our orchard. That year we had to contract with a beekeeper for pollination, and we started keeping our own bees in 2016."

One of the first things they noticed was that the honey their bees produced changed. Frequently.

"The honey varied drastically in color, taste and structure every two weeks," Klyman said. "We got curious about the forage they used year-around, especially because we knew the bees' health is dependent on the forage in their range."

The traditional way of anaylzing what plants bees visits while foraging for pollen was to look at the honey under a microscope and identify the pollen grains. That's a slow process requiring considerable expertise.

"We found that researchers in the UK and Australia were using environmental DNA, or eDNA methods, to look at baseline honey bee forage," Yost said. "That's what this project is doing."

Here's how it works: Bees gather DNA as they forage. The statically-charged, sticky honey bees attract small particles from the environment as they forage for nectar, pollen, plant resins and water. The DNA material becomes entrapped into their honey as they move across the honeycomb in their hive, clean themsleves and transfer honey between bees. By analyzing the honey and identifying all the specific DNA sequences found in it, researchers can reconstruct the picture of all the species the bees encountered.

The most surprising find so far?

"Finding fish DNA in some of the honey sam-

See eDNA, page 21

Beekeeper and citizen scientist Carey Yost in her orchard with beehives.

Virtual Fencing

Technology helps ranchers increase stocking rates and improve ranges

Ranchers across the West are increasingly turning to virtual fencing.

Virtual fencing allows cattle ranchers to manage the distribution of their livestock on rangelands without physical fencing. The emerging technology can contain cattle in one specific area, exclude them from certain areas, and help ranchers more easily move them around the rangeland.

Virtual fencing works like physical electric fencing, training cattle to stay in a desired area. An antenna on the ranch communicates with a computer. The rancher draws boundary lines on the computer. The cattle wear a collar which will give a small shock and make a light sound when getting too close to those lines. This eliminates the need for physical fencing purchase costs, repairs, maintenance and infrastructure.

Jorge Ramirez of Taiban Creek Ranch noted improvements he and other ranchers saw in eastern New Mexico when confining herds to small areas. He says he learned about rotational grazing decades ago, and then intensive grazing using physical fences. This regenerative practice – putting cattle into a single herd in a small area for a brief period – can improve the land as they trample the soil and incorporate urea and manure into the soil. It prevents overgrazing of plants. Both soil quality and moisture holding capacity benefit.

“Virtual fencing is a tool,” he said. “What you do with the tool is more important than the tool itself. Rotational grazing is important, and this tool makes it easier and more affordable.”

Ramirez wanted Taiban Creek Ranch to be a

Rotational grazing on New Mexico’s Taiban Creek Ranch. Inset: boundaries se

demonstration of how virtual fencing can be used in a drought-stricken region to balance livelihood, animal welfare and ecological resilience. He applied for a Western SARE Farmer/Rancher grant and was awarded funding to do so.

"As the ecology recovers from continuous grazing, the grasslands will be able to produce more animal products per acre, at a lower cost," he explained. "That will increase the incomes of the ranchers and include them in economic progress for their communities and regions, and industries that grow alongside the ranching business."

In the project, he and his team demonstrated virtual fencing for three years and compared existing management and animal-condition records with the values after using virtual fencing. They used open source, satellite-based data focused on plant community and bare ground to document changes to healthy soil. Importantly, they shared results through on-ranch trainings, a webinar and a podcast.

"Our ultimate educational goal was to engage enough neighboring producers to share land or leases by using this novel technology and thus build stronger ties among rural food system communities," he said.

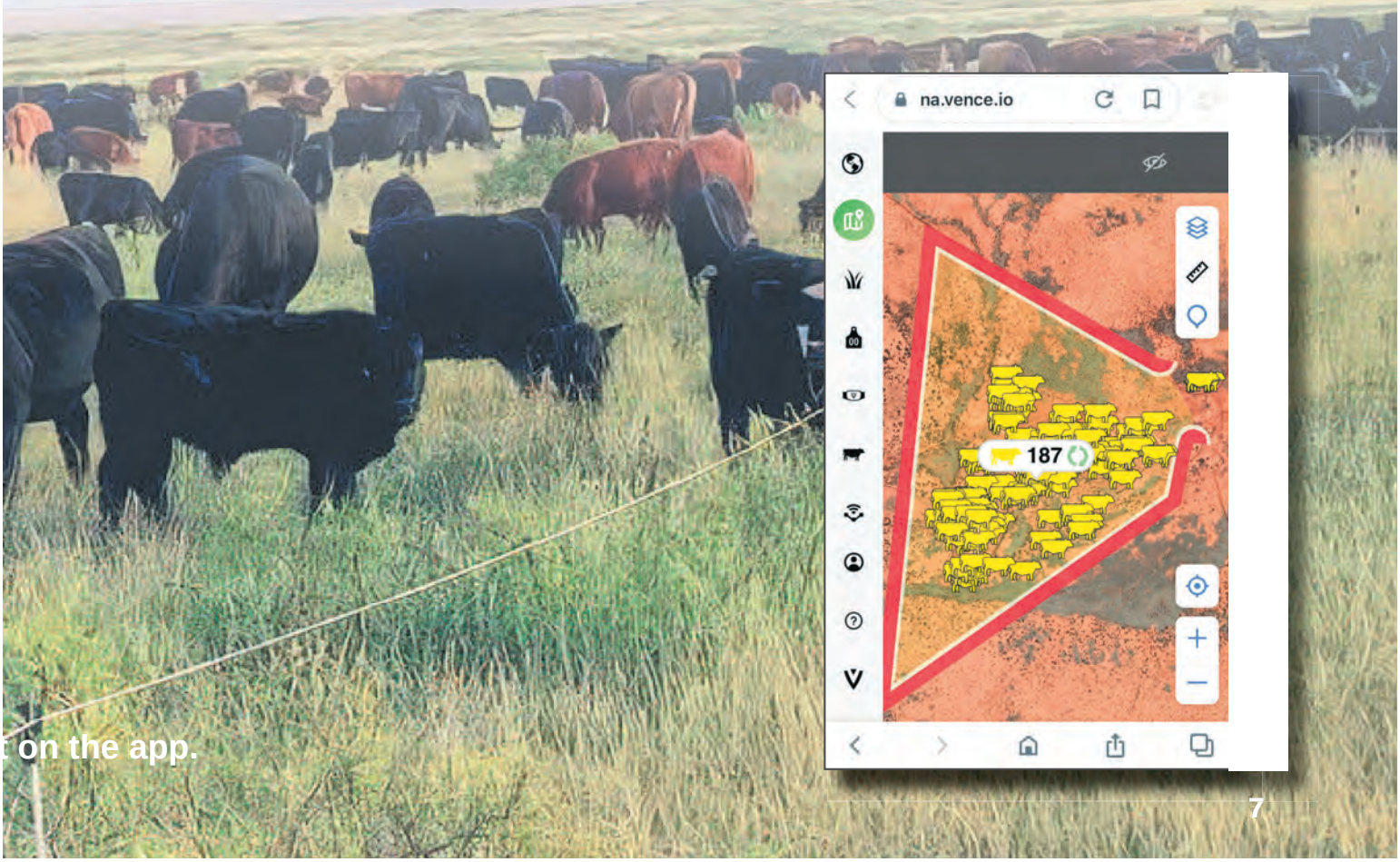
He shares his successes with his neighbors. His land was severely degraded when he purchased it 10 years ago, but now it is in recovery. Meanwhile, neighboring lands are becoming more degraded using conventional grazing methods. Average stocking rates in the area are 12 cows per section, but he can go to 24 to 30.

"I have hopes that I will be able to run four to five times the stocking rate as my land improves."

Ramirez is optimistic about the region's future.

"Ultimately, we want to transform regenerative agriculture into a more community-based experience, with knowledge sharing and support flowing among ranchers," he said. "From that groundwork, we can imagine multiple ranchers sharing a larger plot of land and being able to track and contain their herds precisely. Virtual fencing could change the way land is stewarded amongst different groups of people."

Project: FW23-411



An improved trap in an orchard. Inset: Some of the moth catch.

Improving Insect Traps

Adding UV light to help fruit growers track and manage peach twig borer

Imagine trying to solve a problem with less than half of the information needed to come up with an accurate answer.

For years, that's essentially what peach and other stone-fruit growers in Utah have been trying to do when monitoring for peach twig borer, a small moth whose larvae destroy fruit. There is a commercial trap used by many growers, but its lure only attracts males.

That's because, like many insects, the peach twig borer uses pheromones in mating. Females emit the chemical signal, males follow its scent, they mate and the next generation begins. The monitoring traps are baited with the pheromone and so only catch males.

That the moths breed this way also means that mating disruption can be an effective pest-control strategy and many Utah growers employ it. They hang pheromone-soaked dispensers in trees, flooding the orchard with the scent, so male moths are confused and can't find females.

Other growers manage the moth conventionally. They use an insect-development model developed to determine when the moths first emerge as larvae in the spring – that's when they are most susceptible to insecticides – and spray their fields accordingly.

But that model was developed in 1984 in Washington state and may not be accurate for Utah, so growers relying on it might be spraying at a less optimal time.

When Dr. Emilie Demard joined Utah State University as an extension entomology specialist, she heard from fruit growers that they are seeing increasing fruit damage from peach twig borer and suspected weaknesses in the trap attractants and the model.

Demard and Marion Murray, IPM coordinator at Utah State University, received a Professional+Producer grant from Western SARE to improve moth catch and treatment timing in order to reduce crop losses for fruit growers in the state.

Building on earlier research, Demard included two commercially-available attractants with the standard pheromone lure in the traps, and within some traps, she included a dusk-to-dawn UV light.

"The goal is to see if these attractants plus the light could attract females too, and then we could evaluate if they were mated or not," Demard explained. "In the first generation, we found no females. In the second generation, we found a couple of females in the traps, but only in the ones that have the UV light, so that's very interesting."

The female moths were found in both conventionally managed orchards and orchards using mating disruption. They'll be dissected to see if they've mated, which is one way to see how well the mating disruption strategy is working.

Regardless of trap type, the research documents that the mating disruption works. In mating-disrupted orchards, Demard's team caught an average of 79 to 239 peach twig borers per trap across the season of May to August. In conventionally managed orchards, the trap counts averaged 378 to 956.

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Unhealthy Air Harms Cattle

New project will give producers a tool to protect vulnerable calves

Wildfire smoke and bad air quality have become an unfortunate feature of summers in the West, and scientists know both can be unhealthy for people.

But what about cows?

Logically, you'd assume it to be the same – both species have lungs after all – but science doesn't like assumptions.

So when Amy Skibiel came to the University of Idaho eight years ago as an associate professor in the Department of Animal, Veterinary and Food Science, she started asking the questions.

Mike Kamyabi feeds a calf.

"I'm from the Northeast so wildfires were not something I really had firsthand experience with, but in Idaho it's pretty common we get wildfire smoke every year," she said. "And there's abundant literature in human epidemiology that have linked poor air quality to different negative health outcomes, but nobody had looked in cattle."

And when it comes to wildfire smoke, humans have advantages cattle don't. We can get an alert on our phones and go inside. Cattle can't.

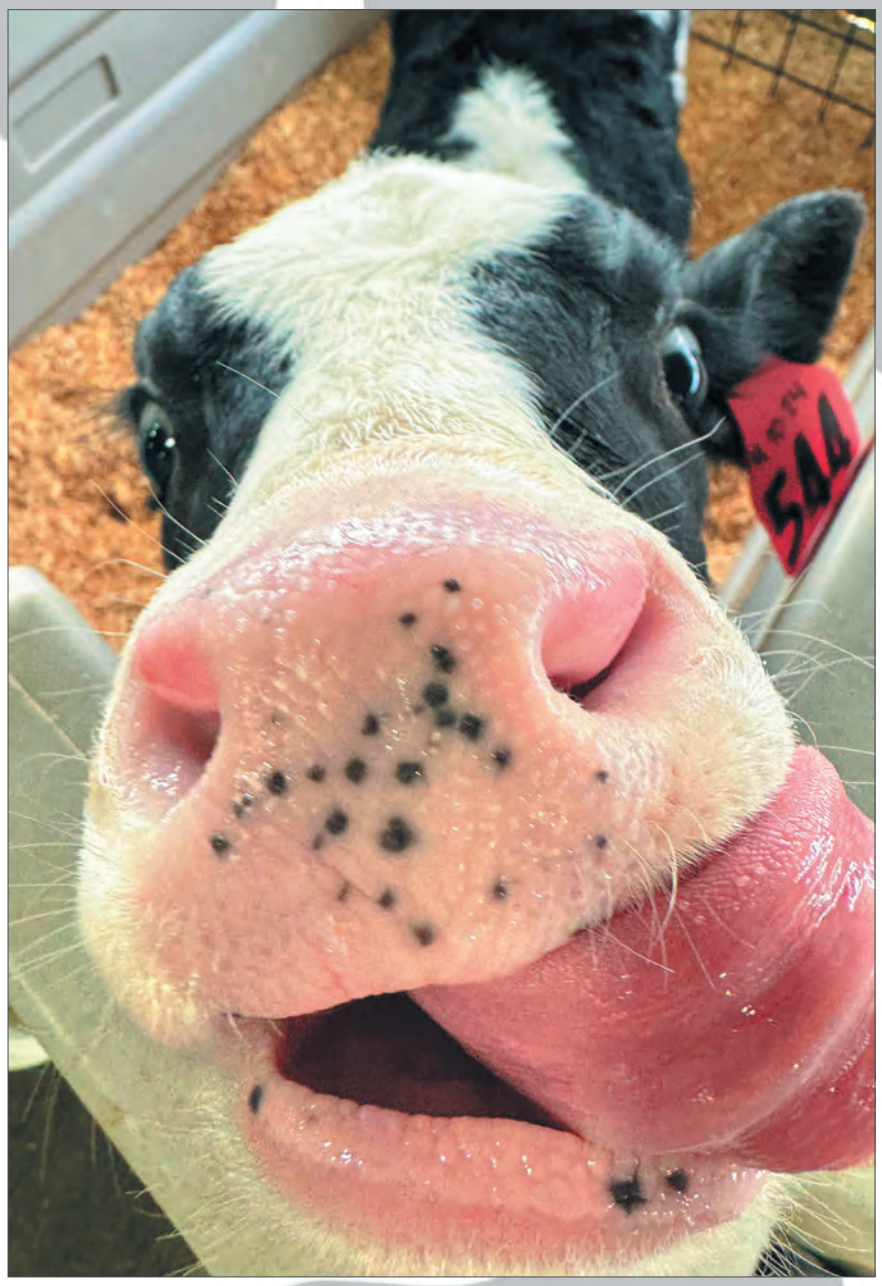
So Skibiel and other researchers began studies to find out if poor air quality affect cattle, and, to summarize seven years of research, the answer is yes. Bad air is bad for cattle.

"We found effects on the inflammatory response and immune function in cows and calves. We have found metabolic effects when animals are exposed to wildfire smoke and for a period of time after exposure," she explained. "We see declines in milk production, up to about nine pounds of milk per cow per day. That number depend on what the exact air-quality levels were, but the effect lasts for at least seven days following wildfire smoke events."

Calves seem to be more susceptible – showing the same ill effects at lower concentrations of particulate matter from smoke or other causes.

"Also in calves, we see overt signs of smoke-inhalation irritation, so more coughing and watery eyes," Skibiel said. "And when we use an ultrasound machine and take a look at their lungs, there's an increased incidence of lung consolidation in calves after exposure to smoke – the air pockets in the lungs where gas exchange occurs gets filled in with other things like fluid or pus."

So the science is now in place. Smoke is bad for cattle – especially calves. Now it's time to do something about it.



Mike Kamyabi, a PhD student in Skibiel's department, recently received a Western SARE graduate student grant to develop a practical tool for dairy farmers to protect their cows – specifically young, unweaned calves in their first months of life – from unhealthy air.

"Our ultimate goal is to provide producers with a tool so they can keep their herd profitability high and promote their animal health and welfare," Kamyabi said. "We need a kind of monitoring rubric, a decision-making tool, so producers can analyze the health of their animals in relationship to what air quality is at the moment."

To develop that tool, Kamyabi is working with two commercial dairies in Washington and Idaho, monitoring on-farm environmental conditions including temperature, humidity and particulate matter, as well as calf-health indicators like respiratory rate, temperature, nasal and eye discharge and cough.

The goal is to find the level where poor air quality is having a health effect and to develop a way to communicate that to dairies in real time.

"That's what's missing now," Skibiel said. "This tool would help producers make decisions about what management activities to do, or which to postpone, when there's a risk to their animals' health. For example, maybe postponing weaning until conditions get better, or postponing transporting animals from one facility to another."

That information could save dairies money – unweaned calves frequently have respiratory or digestive diseases that require veterinary treatment, so avoiding activities that increase those problems is prudent.

Kamyabi will collect the data through next spring and plans to have the tool available sometime next summer.

"It'll look like what we're used to seeing with the Air Quality Index, but it'll be specific for calf health," he said.

Project: GW26-014

Plasma-Activated Water

Shows promise to promote growth and protect plants from insects

Inspired by lightning, plasma-activated water is water treated with ionized gas which infuses the liquid with reactive molecules like hydrogen peroxide, nitrates, nitrites and ozone.

The use of plasma-activated water – or PAW – in sustainable agriculture is gaining interest in both its ability to reduce pests and as a more sustainable source of nitrogen fertilizer. Imagine, large-scale production of nitrogen fertilizer out of air!

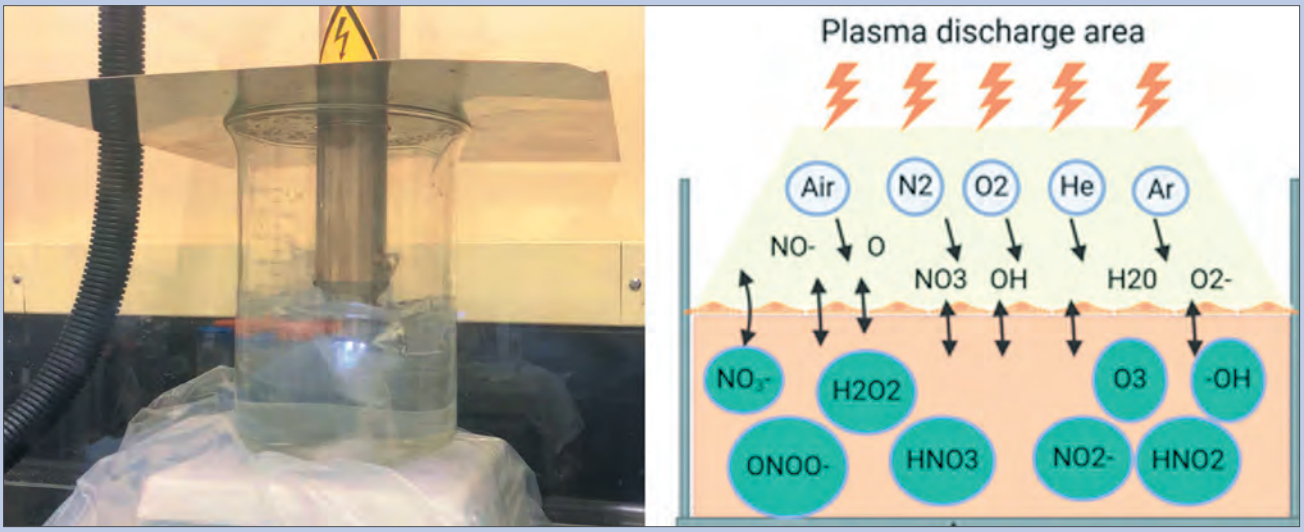
By applying electrical energy to a gas and adding it to water, PAW can be used in irrigation or sprayed onto leaves. In doing so, researchers are seeing that PAW possesses important antimicrobial and growth-stimulating properties.

Both researchers and farmers are optimistic about the impact this innovative technology could have on sustainable crop production.

Dr. Christian Nansen, professor at the University of California, Davis, is leading several projects with a team at the Nansen Lab, where PAW is being studied. With Western SARE funding, his team is deploying PAW with low-risk and organically certified pesticides to manage spider mites and western flower thrips in greenhouse crop production systems.

According to Nansen, the PAW works as a "booster," enhancing the performance of organically certified pesticides. Thus, PAW use could better promote the use of these insecticides and provide growers better pest-management results, all while reducing environmental and health risks to applicators.

"Growers, consumers, industry partners, and researchers – we are all in agreement that organically certified pesticides will likely play a key role in modern production of most crops," Nansen said. "It is paramount to have a range of options with different modes of actions, otherwise resistance evolution is inevitable. So, industry-university research partnerships must deliver what growers need, and our PAW research falls



An electrical discharge infuses water with reactive molecules beneficial to plant growth.

Growth chambers measure PAW benefits.

squarely in that category."

Seeing promise based on previous data, the Nansen Lab was awarded a three-year Research and Education grant to study PAW in conjunction with organically certified pesticides as an innovative tool for sustainable pest management in greenhouse crop production. If successful, the application could reduce both pesticide use and costs for producers. A large experimental data set on combinations of PAW and low-risk and organically certified pesticides has been collected and will be combined with green house validation soon.

To effectively share results, Nansen is leading extensive outreach through videos, a website, grower and academic presentations and publications.

Their website is regularly updated with findings and seven videos have been produced.

In its long-term projects, to date the Nansen lab has demonstrated, in a published study, how PAW irrigation of tomato plants leads to reduced susceptibility to spider mites. They are finalizing a study showing that PAW irrigation can also reduce susceptibility to western flower thrips, and they are examining to what extent PAW irrigation may positively affect performance of biocontrol agents, such as minute pirate bugs.

In addition to biological and agronomic aspects of PAW, the Nansen lab is conducting studies on how to stabilize PAW over time.

"Generating chemical reactions is needed so that PAW has the desired characteristics that positively affects plants and enables pest management," Nansen explained. "But we also need to be able to control the reactions and be able to store PAW over time."

Nansen is also working with UC Davis graduate student Pamela Andrade on a project aiming to boost nitrogen efficiency in greenhouse transplant production by integrating insect farming by-products as soil amendments with plasma-activated water. If successful, the information gleaned can deliver practical, science-based decision-support tools that help producers reduce synthetic fertilizer dependence without compromising commercial performance.

"There are several exciting aspects of PAW and sustainable crop production. It is a clear example of why and how industry partners, growers and researchers need to collaborate in multi-disciplinary teams to find solutions to societal challenges, such as, how to generate enough nitrogen fertilizer to meet the demand of crop production," said Nansen.

Nansen Lab: https://chrnansen.wixsite.com/nansen2

Projects: SW24-012; GW26-015

Upskilling Urban Farms

Demonstration install at 100 Elk Outdoor Center near Buena Vista, Colorado. Left: Dave Bailey, 100 Elk program director Right: Ian Acksland, Colorado State University.

Project showcases AI automation benefits to community agriculture

The benefits that agricultural automation and artificial intelligence can bring to growers are immense, but it's the human factor that makes the systems work.

A recent Western SARE-funded project in Colorado designed to "upskill" urban agricultural professionals with AI-powered irrigation systems proved that point. The AI-planned irrigation absolutely worked – producing more fruit and healthier plants than a manually programmed alternative – but it took a team of people to design, refine, install, train, troubleshoot and scale the technology to make that happen.

The idea, said Deana Namuth-Covert, director of the Ag Upskilling Program at Colorado State University, was to help urban food producers, their volunteers and visitors become more aware of agricultural technology and its benefits.

"These aren't just community gardens," she said. "They're also doing community outreach and youth training, and since this technology is becoming more and more important in agriculture, we asked how we could help them be aware of that and explore new careers."

Irrigation was a natural place to start. The Front Range cities in Colorado – which include Denver, Loveland, Boulder and Fort Collins – don't get a lot of rain and water is expensive.

One of the demonstration sites.

Jay Ham, a professor of crop sciences at CSU, designed the unit.

"Jay has a background in field-based agriculture and extension, and knows that before farmers adopt new practices, like cover crops back in the day, they have to see it first. So he designed these units as a demonstration so people could see them work."

It's a simple setup to visualize: a water tank sits between two sets of potted tomato and pepper plants. An electronic controller sits atop the tank. Each plant pot has a moisture sensor near the root system to trigger auto-irrigation when the pot is dry and a second sensor at the bottom of the pot to show when water has filtered all the way through to shut off the system.

The urban farmers programmed the controller to irrigate one set of the pots, using their experience to set the irrigation time and duration. Irrigation setting for the other set of pots were determined by an open-source AI program.

Both worked, but the AI-irrigated plants produced more and grew better. The AI-driven system didn't realize the water savings the team anticipated, but the water it used was more efficient.

The benefits of the project weren't just better tomatoes and peppers, though. The real benefit was the learning that happened for both the urban growers and the university team.

Take training. Namuth-Covert planned for a half-

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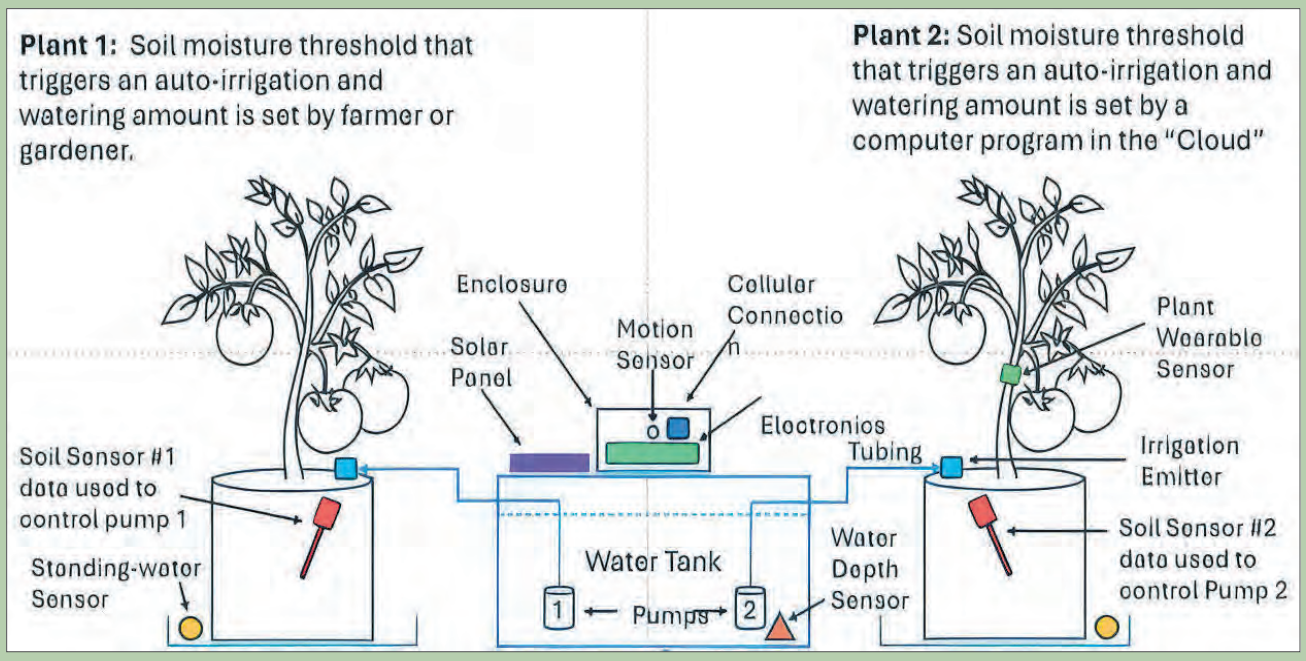


A diagram of the irrigation demonstration project.

Drones Detect Disease

Aerial scouting and AI models give growers insights into their fields

Agricultural engineering once meant building a better tractor.

Today, ag engineering also harnesses huge data sets, machine learning and AI tools to help farmers make better, faster, more profitable decisions.

At Montana State University, Ph.D. student Muhammad Shehzore Hashmi is leading a Western SARE-funded project that combines drone remote sensing and artificial intelligence to improve early detection and management of potato virus Y. The virus, which is transmitted by aphids, is a significant challenge for seed-potato production because it can affect seed certification, increase growers' costs and reduce the quality and market value of seed lots.

Hashmi's project builds on a decade's worth of previous research. Paul Nugent, an assistant professor and the Whitney and Elizabeth MacMillan Endowed Chair of Precision Agriculture, knows the history.

"The general idea of using drone aircraft to find diseases in potato fields started around 2016," said Nugent, who was in private industry at that time. "The idea of being able to fly and survey a whole field was there, but the technology wasn't ready."

In 2022 Nugent came to MSU and began working with Bradley Whitaker, an associate professor of electrical and computer engineering, and some of Whitaker's students. Drone technology had improved. Sensing technology had improved. Flights over potato fields could detect the disease, but not with enough precision or confidence for growers to take action.

Hashmi's project aims to make the technology real-world ready.

"We're developing a drone-plus-AI system that captures field imagery and produces maps showing where disease risk is high, medium or low," Hashmi explained. "The goal is to help growers know where to concentrate their scouting, aphid monitoring and roguing – removing unhealthy plants. We want to help growers identify where timely and targeted insecticide treatments may be appropriate."

A big part of the project is improving the confidence level of the results. Earlier versions of the disease-detection model had a roughly 75 percent confidence in its disease identification. The aim now is for 95 percent.

"An element of machine learning models is they tell you how confident they are in the answers they're providing," Whitaker said. "It kind of judges itself based on the data it sees and tells you how confident it is. And that we can use that to kind of say, 'Oh, does a human need to go check this, or is the model so confident that we can just take it as truth?'"

And where the models aren't confident, humans learn something.

"As someone building these systems, when we find areas where it essentially shows us it's struggling, maybe we have some data we can look at and understand what's actually happening in those conditions," Nugent explained. "We can look to see what it is that is causing this. And then ask, 'How do we make our detection model stronger?'"

The research is being built into a decision-sup-

port platform called VirusEye that uses drone imagery, artificial intelligence and uncertainty information to produce actionable disease-risk maps. VirusEye recently advanced to the top six, a semi-finalist, in the Deep Tech/University-Based Research track of Montana State University's $100K Venture Competition, which highlights its potential to translate the research into a practical agricultural technology.

The economic implications for growers are significant. Not only may they be able to get a better, faster understanding of their crop conditions without the time and labor expense of in-person scouting, they may be able to reduce crop losses to the virus.

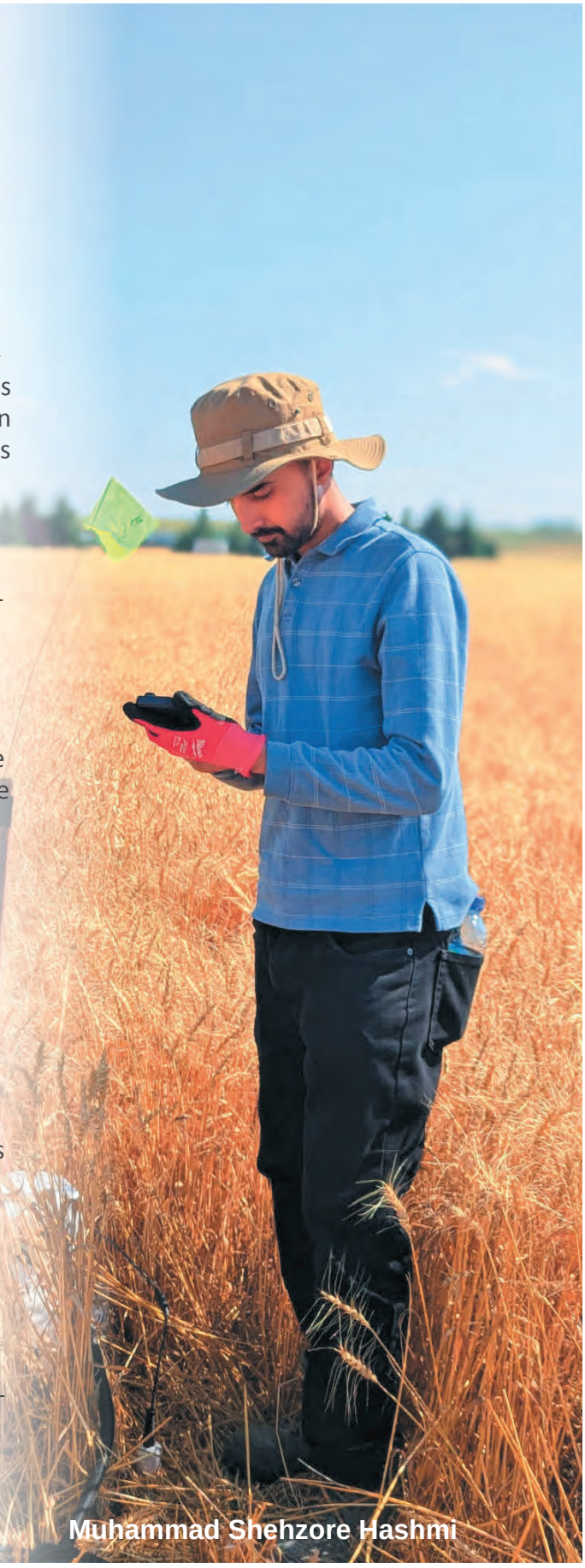
"For potatoes that are going to be seed stock, the infection rate found in a field has to be incredibly low – much less than one percent," Nugent said. "The certifier walks through the field in a 'W' pattern, and if the infection rate is too high the whole field fails certification and can't be sold. With this technology, the grower could fly the field and if they found disease just in one portion, they could remove those plants and the rest of the field would pass certification."

Another potential benefit of the project, and others like it, is a more formal linkage between agricultural and engineering research at Montana State.

"On the academic side, a big portion of what I'm doing is creating an ag engineering program at MSU," Nugent said. "And this project shows exactly why that type of program is needed." For Hashmi, success will be seen in potato fields in Montana and beyond.

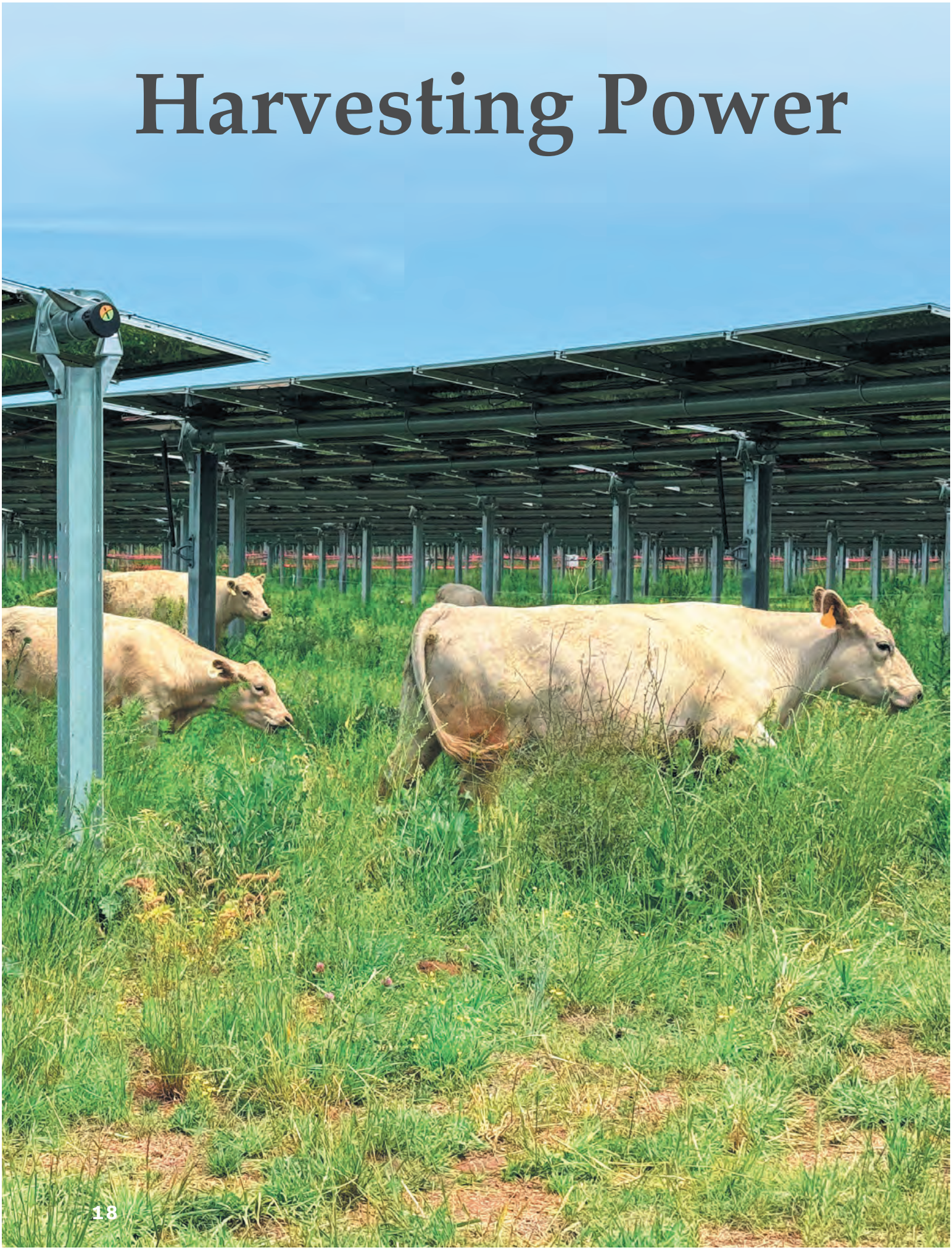
"Success means translating advanced research into a practical tool that helps growers identify disease risks earlier, use their resources more efficiently, make more precise management decisions, and protect the value of their crops," he said. "If successful, the approach could eventually benefit potato producers in additional U.S. states and support disease-management research in other crops."

Project: GW26-011



Muhammad Shehzore Hashmi

Harvesting Power



Project helps growers understand the benefits and risks of leasing land for solar energy development

With rapid scaling up of solar energy development and the need for millions of acres to place solar projects, agriculture lands could play a significant role. The American Farmland Trust (AFT) estimates that over 80% of the land used for solar projects could be sited on agricultural land. This provides both opportunities and risks for producers.

While they generate revenue for a farmer or landowner, solar leases can last up to 30 years and be difficult to back out of. In addition, soil compaction and disturbances are among the significant impacts to the land, due to the installation processes and can limit future agricultural production.

“This makes it essential that producers and landowners understand the risks and challenges associated with leasing land for solar energy,” says Chantel Welch, AFT’s Pacific Northwest Deputy Director.

To help producers understand solar leasing risks and to equip them with the tools and skills to evaluate whether solar leases are right for them, AFT’s Pacific Northwest team published “Solar Leasing: A Guidebook for Agricultural Landowners in the Pacific Northwest” in 2022 and designed related workshops. This work was made possible with a grant from the Western Extension Risk Management Education Center.

Welch and Addie Candib of AFT’s Pacific Northwest Regional Program noted an increasing demand for information and technical assistance related to solar energy on agricultural land from producers in their region. In 2025, they successfully applied for a Western SARE Professional Development Program grant to adapt the solar leasing guidebook for producers in California, and to separate the guide into two parts: Understanding Solar and Negotiating a Solar Lease. Their project will also develop and offer a train-the-trainer program for agricultural service providers in California, Idaho, Oregon and Washington. The training will prepare ag service providers to help producers and landowners make informed decisions about solar energy investments. They have also received additional funding from a private foundation to extend this work to Wyoming and Montana.

“This project aims to equip agricultural service providers with resources and information to help farmers and ranchers understand the risks and challenges associated with solar energy infrastructure development, the potential financial benefits, and the opportunities with agrivoltaics,” says Welch.

They intend on educating 50 agricultural technical service providers from conservation districts, the Natural Resources Conservation Service, extension offices, non-profits and other entities in Washington, Oregon, Idaho and California to better provide technical assistance on solar development and how to use the newly developed California Solar Leasing Guide.

According to Candib and Welch, at least 200 Washington, Oregon, Idaho and California agricultural landowners will have increased knowledge and ability to protect the long-term viability of their farmland through access to clear, concise, and regionally specific solar leasing information.

Project: WPDP24-017

UPSKILLING: Demostrating AI technology

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day workshop to train the growers on the system. None of them could align their schedules and spare a day away, so to teach this high-tech system, the CSU team went old school.

"In the end, it was the traditional extension model of the agent in their pickup going to the farm," Namuth-Covert said. "When Jay or his team would install these systems, it would take two, three, sometimes four hours and they'd spend that time one-on-one teaching people all about them."

The university also provided online training and resources people could access at any time, and Namuth-Covert stayed available to answer questions and troubleshoot over the phone.

"People were grateful there was this effort by Colorado State to go to them and meet them were they were, along with having the online tools and people you could always connect with," said external evaluator Connie Reimers-Hild, the founder and chief futurist at Wild Innovation in Nebraska. "One thing we heard over and over was their confidence increased because their understanding of what it could do for them and their operations increased."

Thousands of visitors and school-aged children saw the demonstration units and were exposed to the technology. It's hard to know the full impact of that. One measure is easier to judge: this summer, two of the half-dozen urban producers who trialed the system adopted it in their production areas.

Project: WPD24-021

The control box sits at the heart of the AI demonstration.

A bee forages on a lime blossom.

eDNA: May detect invasive species earlier

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ples," Yost said. "They were from apiaries near the ocean and all of the DNA belonged to pufferfish species. That's a fish that normally washes up on shore and skeletal parts are often found in tidepools, so possibley this DNA was picked up when honey bees needed to forage for water in those tidepools."

To date, 62 honey samples from beekeepers around Hawai`i Island have been analyzed and entered onto the project website and database. They recently shipped another 27 samples to the analytical lab, and plan to continue a second year of sampling in 2027.

The DNA data is being archived at the Bishop Museum Pacific Center for Molecular Diversity, and the project team are working on an educational brochure for other island beekeepers.

"The results so far have millions of sequence reads across so many living species," Yost said. "This has given us insight not only on a broader spectrum of plant species on the island, but we have found DNA from crop-related agricultrual pests and pathogens, invasive species, and even species of concern for researchers dealing with the unique ecostystems on Hawai`i Island."

The 'species of concern' DNA discoveries include a few locations with prelimiary species identification for Solenopsis invicta – the large red imported fire ant. Those reports are being carefully checked and the project team is cooperating with the Hawai`i University system, the Big Island Invasive Species Committee, the Hawai`i Ant Lab and U.S. Department of Agriculture researchers.

"These are species that were not on anyone's radar for potentially being here," Yost explained. "If these DNA reads are determined to be true, this early detection could avert these species establishing on Island."

For more information, vists hawaiibeekeeper.org/pollen-studies

Project: FW25-015

Donahue: Technology a top regional priority

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These projects address a wide range of topics, from calf health and air quality, pest management, managing lands via eDNA, virtual fencing, flying drones and assessing plasma-activated waters usage. These are cool topics which accurately show that agriculture is on the front edge of applying new and emerging technologies to move sustainability forward.

Some takeaways from my reading of the stories.

In the West wildfires are a fact of life. We know how it affects humans, but what about our animal friends? Well, it does impact them too. The University of Idaho has been looking at these effects in cattle. And they see that calves are the most effected by being exposed to wildfire smoke. I believe you will find this information useful – read on.

What about a little pest called the peach twig borer? This little pesky moth impacts stone fruit growers. Everybody likes peaches and other stone fruits – let's manage this pest. And that is what Dr. Demard at Utah State has been working on. She is modeling and managing the pest to help growers have better management. Grab a peach and read the story.

I thought DNA was only for humans, but bees carry DNA on their knees. On Hawai'i Island two researchers are investigating the environmental DNA (eDNA) to see how it affects their honey product. I love honey, but I won't spoil it, you'll have to read this story to see how bees forage and find out what types of eDNA they have found – it's a sweet story.

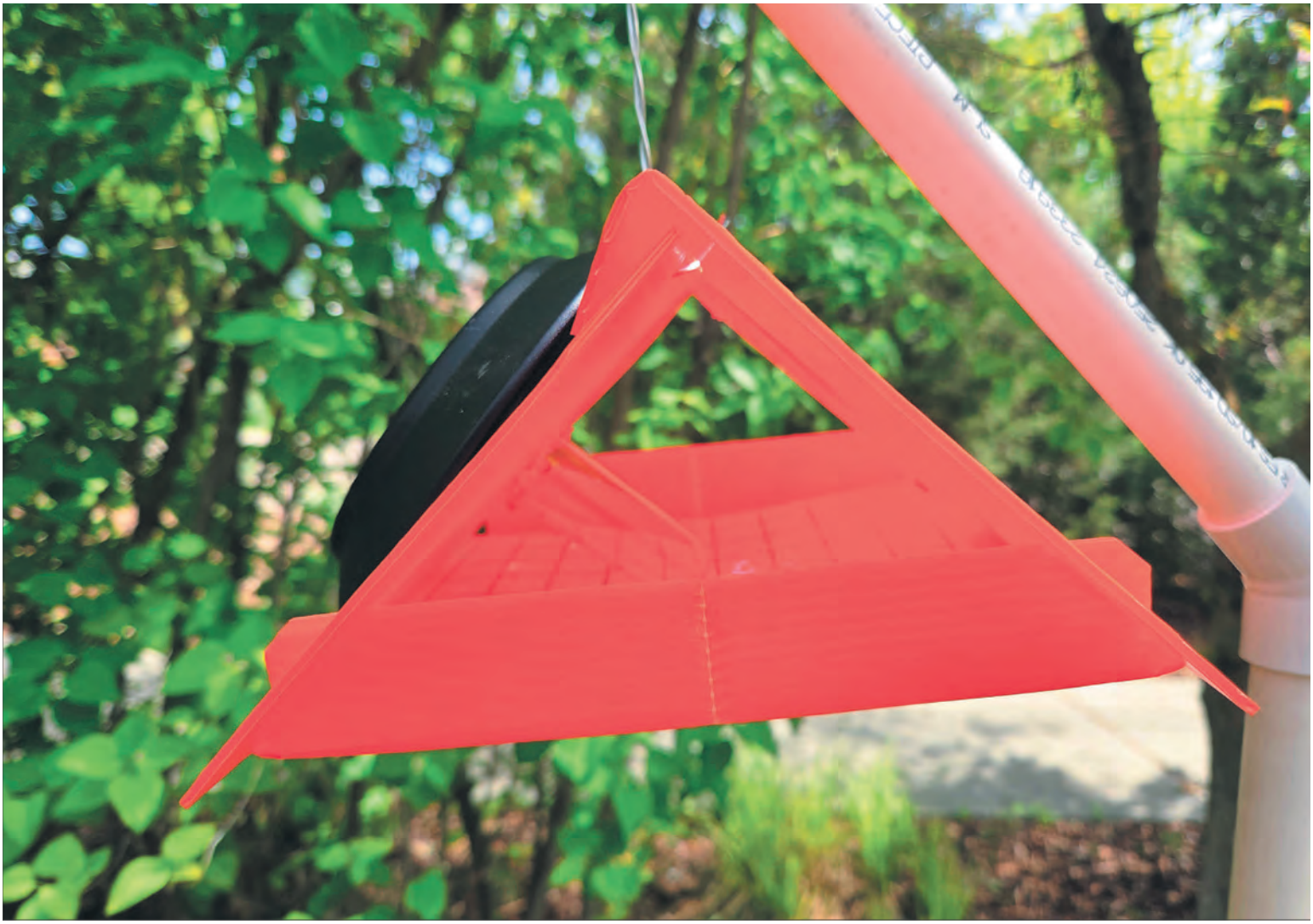
No more ridin' the range to mend fences, just use virtual fencing to help you manage grazing animals! A project in New Mexico is using this technology to not only mange animals better but to improve soil health, thereby increasing environmental resilience of the lands – ensuring the lands will be able to support grazing well into the future. This is a huge leap in technology that offers many positives – read on!

These days we see and hear drones flying everywhere, but when we hear them near agriculture fields, we know that they are doing interesting things. In a project at Montana State University a graduate student and his advisor are using drones + AI tools to help producers control potato viruses and doing it economically through identifying targeted areas for spraying. When you hear a drone fly near, know that it might be improving agricultural operations for the future; read the story to find out more.

PAW – that's what my dog has, paws! Well, that's not what plasma-activated water (or PAW) is. At UC-Davis Dr. Nansen and his team are investigating the application of PAW in agriculture and how it can reduce pests and/or improve growth. In their work they are looking at the use of PAW in increasing effectiveness of insecticides as well as using air to make fertilizer – these applications are exciting and useful for the future agriculture. Get your favorite furry friend beside you and read this story.

Solar energy can be seen across the Western U.S. landscape – are we doing it right? The American Farmland Trust is doing some research and education to help inform producers about solar installation, contracting, and technical assistance. Put your sunglasses on and read this story to learn about solar energy's place in sustainable agriculture.

These stories emphasize a range of emerging technologies that are being studied to meet our Western SARE goals of good stewardship of our lands and positive impacts on the trio of economic, social, and environmental implications for sustainable agriculture's future.



With the addition of the UV light in traps, researchers caught female moths for the first time.

TRAPS: Better information; better management

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"It is definitely about 90 percent of the moths we trapped are from conventional growers, and 10 percent from mating-disrupted," she said. "We need to convince more farmers to use mating disruption and stick with it."

Many conventional growers, she said, had tried mating disruption in the past but gave up after a couple of seasons or didn't hang enough dispensers per acre.

"Mating disruption works for orchards 10 acres or larger, but you need to set it up correctly," she explained. "That means respecting the recommended dispenser rate per acre and setting it up for at least five years. Populations will decrease slowly, therefore the pest pressure will go down slowly."

Demard's team will collect two more years of data and conduct an extensive outreach program to growers, making recommendations about the most effective monitoring traps, any Utah-specific enhancements to the insect-development model and, of course, mating disruption.

"I'm hoping this project will demonstrate the efficacy of mating disruption to farmers," she said. "I am also hoping this work will allow the development of more efficient monitoring traps and ultimately help us update and improve the development model for this pest."

Project: OW26-005

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Highlighting Advanced Technology

In their quest to make agricultural production more environmentally and economically sustainable, farmers, ranchers, Extension agents and researchers in the West are incredibly innovative.

At Western SARE, we are proud to fund their research and support their invention and industry.

Extracting DNA from honey on Hawai`i Island provides insights into the entire island ecosystem.