

Farmer and Rancher Research in the West

A Picture of Success



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Western Sustainable Agriculture Research and Education

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SARE's vision is an enduring American agriculture of the highest quality. This agriculture is profitable, protects the nation's land and water and is a force for a rewarding way of life for farmers and ranchers whose quality products and operations sustain their communities and society.

At Western SARE, we serve 13 western states and the four Pacific island territories and are supported by the USDA's National Institute of Food and Agriculture.

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Cover Photo: Jonah Sloven and carrot-crunching Murphy of Idaho's Sweet Hollow Farm, courtesy of Sweet Hollow Farm.

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Using Ducks for Pest Control – and Profit

When it comes to controlling pests, ducks just might be an orchard's best friend.

Recent Western SARE-supported research found that ducks can provide a surprisingly efficient, environmentally friendly way to manage pests such as weeds, slugs, snails and even rodents in orchards throughout the West.

"Ducks proved to be even better at controlling pests than we thought," said grower Peng Sun, who led the project on his 29-acre fruit orchard in northern Oregon. "We knew ducks would feed on weeds and snails, but we discovered ducks are also very good at controlling mice, voles and other rodents."

Orchard managers often use chemicals and spend a lot of time and labor to deal with pests. Though seldom used in America, ducks are a common pest-management tool in some cultures because fowl can feed on weeds, snails, slugs and insects. And, in addition to reducing cost and chemical use, the ducks can then be sold and provide additional profit in the marketplace.

With the help of Oregon State University's Small Farm Program, Sun set out to quantify the economic and environmental benefits of ducks. He divided a portion of his orchard into two sections. He treated one plot conventionally with regular mowing, pest baits and herbicides. In the other section, he calculated his costs for fencing, feeding and stocking three breeds of ducks.

The results were compelling. Sun's orchard netted more than \$8,000 annually from money saved in pest control and profits from duck and egg sales.

"Before this experiment, we sprayed herbicides and mowed between the rows three times a year," Sun said. "Now, with the ducks, we don't spray at all and only mow once a year."

What's more, Sun found that trees in the section managed with ducks suffered less damage and pressure from slugs, snails, rodents and weeds. One example: Before ducks, slugs destroyed all but six percent of the 950 cherry trees Sun grafted, despite use of slug bait. One year later, with ducks and no slug bait, 98 percent of the 893 trees he grafted survived.

Sun now employs ducks throughout his orchard and has inspired neighbors to do the same. Ducks aren't a perfect fit for everyone, though. Sun offers a few tips for farmers considering adding fowl to their orchards and fields:

- Ducks need access to water for drinking and bathing. "They require more than you think. Consider providing a pond or water trough."
- Nourish your ducks. They can't thrive on pests alone, especially during the winter. "If ducks don't get enough nutrition, their legs and feet can become weak and twisted. It's good to supplement their diet with low-grade fruits and vegetables from your orchard." Peng also varies the number of ducks on his farm seasonally, with 100 per acre in the spring and summer for weed control, but fewer in the late fall and winter.
- Protect your ducks from predators like coyotes, hawks and raccoons. Guard dogs help (Sun has a Great Pyrenees) and you can install electric wire atop your fence. "Ponds are nice, too, because ducks can swim faster than most of their predators."

Most domesticated ducks don't fly – they're bred that way. One exception is the Muscovy, which is the breed Sun prefers. Muscovy ducks require more feed and attention, but they are a large breed and garner more profit in the marketplace. To keep them in the orchard like other domestic ducks, Sun recommends clipping their wings.

Sun is active in local farming networks where he offers a wealth of information on ducks.

"I'm happy to help," Sun said. "This research could help farmers provide quality food while reducing costs and protecting soil, water and environmental health."

Project number: FW22-391



Muscovy ducks

Choosing to Farm in Healthier Air

Caitlin Hachmyer transitioned to winter vegetables to avoid unhealthy summer conditions at Red H Farm.



For farmers, extreme and unpredictable weather isn't something to worry about down the road. It's here.

"It's playing out on farms like mine every day, every season and in every extreme weather event," said Caitlin Hachmyer, who owns Red H Farm in Sebastopol, California. "Farmers are nimble and used to working with inclement weather, but the extremes and unpredictability are getting to be too much."

When Hachmyer founded Red H Farm in 2009, her land was often blanketed by cool, coastal fog. Now, she spends much of her summer dragging hoses from bed to bed beneath hot, dry, smoke-filled skies.

It's hard on her health, she says, but how can California farmers survive economically without producing crops in the summer and fall? Traditionally, those are the seasons when Western farmers sell their most lucrative fruits and vegetables. Sales of high-value crops like tomatoes are important to small, diverse farmers like Hachmyer who grows herbs and vegetables on her one-acre, agroecologically conscious farm.

But Hachmyer made a plan. With a Western SARE grant, Hachmyer began transitioning from labor-intensive summer crops to vegetables with a longer growing season and shelf life, like beets, onions and winter

squash. That way, she limits her fieldwork when temperatures are high and air quality is low.

Root and long-season vegetables can be less profitable, but Hachmyer hopes to offset that by selling to winter-only Community Supported Agriculture (CSA) subscribers. Most CSA plans are year-around, but Hachmyer is confident the community will support a winter-only bounty of broccoli, beets and more.

"We're excited about the possibilities," Hachmyer said. "As we shift our growing season, we can expand to include radishes, arugula, lemon balm and lots of other crops. This could be a great way to feed the community without sacrificing environmental stewardship, economic viability and quality of life."

As her farm switches from summer to winter crops, Hachmyer is measuring how the transition impacts soil health, CSA-member satisfaction, economic viability and farmer well-being. Hachmyer, who teaches agroecology at Sonoma State University in addition to farming, will share her outcomes with a wide public audience including fellow scientists, educators and farmers. Subscribe to the winter CSA at www.redhfarm.com.

Project number: FW22-392

Farming Kelp in Alaska's Winter Seas



Skye Steritz feeds a spool of sugar kelp seed on to a grow line before submerging it underwater for the season.

Alaska is relatively new to the business of farming kelp, a type of seaweed gaining popularity across the globe because it's healthy for humans and good for the planet, too. Kelp is rich in vitamins, minerals and protein, requires no soil or fertilizers to grow, provides habitat for fish, and balances ocean acidification caused by increased water temperatures. Cultivating sea greens can also support local economies and food security, which is especially important in remote, coastal communities that rely heavily on the harvest of dwindling wild species like salmon.

In many ways, kelp farming is a natural fit for the cold waters of Alaska. But farmers there are grappling with how to engineer their systems to keep profits afloat.

"What works for kelp farmers in the Northeast doesn't always translate to conditions here," explained Skye Steritz, co-owner of Noble Ocean kelp farm in Cordova, Alaska. "Farmers in our region have tried the conventional, single-line approach and it leads to tangled lines, equipment failure and low-crop density. Most small farmers are struggling to achieve profitability."

Steritz and her team recently received a \$25,000 SARE grant to test a novel farming system they hope will maximize the amount of kelp grown in the least amount of ocean space. Experiments began last fall.

Gardening underwater

In theory, setting up a kelp farm is fairly simple. Kelp grows naturally in the sea, and it can also be grown from spore found in adult seaweed. In Alaska, farmers collect seed from the healthiest stock they find within 15 kilometers of their farm, drawing material from at least 50 "plants" to protect genetic diversity. They pack the fertile material in insulated coolers and hurry them off to nurseries where they are seeded on strings and nurtured underwater for six weeks.

Farmers then seed those strings onto larger ropes and submerge them with anchors and buoys to keep the lines tensioned and intact throughout the cold, windy growing season. That's where things can get tricky. Kelp matures during winter when the winds are high and the seas are rough, which can damage the farm's system of lines and bouys.

"We struggle with maintaining adequate tension during large tidal fluxes and weather events," Steritz noted.

The team's technical advisor, Clifford Goudey, has engineered a multi-line system that provides powerful tension using five ropes lined side-by-side. This fall, the team will set up the new system alongside a conventional single-line array. They will measure and compare performance metrics such as kelp growth, cost and ocean space used.

"Nutrient-rich kelp is so valuable to marine biodiversity and food security," Steritz said. "We look forward to sharing what we learn with our community to support both human health and ocean healing."

Project number: FW23-415

Buiding a Better Bioreactor to Create Fungal Compost

A former Chicago science teacher turned Colorado farmer, Rick Bierterman isn't afraid of a challenge. Start with the location of his Watershed Ranch near Buena Vista in central Colorado.

"Soil quality out here is pretty terrible," he said. "Organics are way low. We're right next to the Arkansas River, so most of our fields are heavy in sand. Then it's just so dang dry. Our annual precipitation is only 11 inches. We're high alpine desert and in the areas that aren't irrigated, I've got cactus growing. I mean, 100 years ago nobody probably should have started farming in this desert. Folks made bad choices a long time ago, and now we're all just dealing with it."

Add over 8,000 feet of elevation – giving farmers about 90 to 100 days of frost-free growing season – and a two-hour drive to just about anywhere – it's a challenge. But farming is all about overcoming challenges.

Bierterman, who like most of his neighbors grows hay, got connected with Colorado's Saving Tomorrow's Agricultural Resources (STAR) program, which focuses on soil health practices, and began trying to improve his land.

"My goal when COVID hit was to try to figure out how to get off synthetic fertilizers," he said. "Prices

soared. Synthetic fertilizers were something I just wanted to get away from and be more self-sustainable. With the STAR program, my goal was to figure out how to do that."

He found a grower four hours south who was producing high-fungal-content compost and bought some to test.

"The idea is that you figure out how to use that compost on large acreage," he explained. "I've used it on our large pivot, a 35-acre plot of land. What I did was purchase his compost, and then I turned it into a liquid and then injected it through the pivots onto the hayfields."

He tried different concentrations and a control plot of standard synthetic fertilizer, testing both soil samples and yield data.

"But I was driving eight hours round trip and paying \$3 a pound for this guy's compost," he said. "That's what led to the SARE grant, thinking, 'Why don't we just try to make our own?' Let's try to make our own and do it in a cost-effective manner, with only supplies that you have on the farm. I wanted to cut costs and also try to use things that are better for the planet."

So last year, Bierterman built two compost piles.

"They're both about 20 yards long by about eight feet high and about 10 feet wide," he said. "One of them is what I would consider a traditional wind-row shape. It's got about two to three feet of Aspen wood chips on the bottom, followed by a manure straw slurry, and then topped off with hay."

The other pile is a modified bioreactor that looks similar to a traditional compost pile but with breather vents built into it.

"The idea of the vents is that it stays aerobic," he explained. "The goal is to keep a high moisture level in order to produce a fungal- versus bacterial-dominant compost. Then you infuse it with worms, I do red wigglers, and the worms continue in there for a year straight and do well. At the end of the year, you break it down and there's about 10,000 worms that are thriving in there, and they did their thing over time."



Red wiggler worms



This “modified bioreactor” compost pile uses air vents to produce fungal-dominant compost. It’s also infused with red wiggler worms.

First-year results were mixed, with the traditional compost pile doing well but some freezing in the bioreactor pile due to the added moisture.

“Even though it has a border of hay, as an insulation barrier and then a topcoat of hay, it froze over on one side,” he said. “The worms migrated over to the other side because they were still living when I broke it down, but they didn’t spread throughout the entire pile and it didn’t produce as good of a fungal-dominant compost as the traditional wind-row.”

There was one unqualified success in year one.

“I did a cost effectiveness comparison vs. driving down to the San Luis Valley and paying three bucks a pound for the compost,” he said. “I was able to create my own for about 30 cents a pound. So that’s exciting to me. I know every rancher up and down this valley complains about costs of fertilizer, and I have a lot of neighbor farmers who are intrigued by what I’m doing.”

In year two, Bieterman repeated the experiment

and gathered more data. He plans to test the application of compost liquid vs. spreading solids. And perhaps change his forage mixture to find synergistic benefits between the plants and fungal-forward compost.

The challenge will be getting yields high enough to compete with synthetic fertilizer, at least on a net-profit basis. And while compost may not come out ahead, he hopes to make it close.

“If you can farm more in line with your own values and the way you want to farm and do it successfully – even if it’s not optimally – that’s a win.”

Project number: FW23-416

Water Sensors and Connection Help Farmers Face Drought

Droughts happen. And for some farmers, reducing water use isn't an option, it's a mandate.

"When drought is especially severe, they shut off irrigation to farmers in our region," explained Katie Swanson, who grows vegetables on seven acres in Klamath Falls in south-central Oregon. "We have to get creative to find ways to adapt and conserve water."

Swanson used a \$30,000 grant from Western SARE to explore whether low-till practices can help conserve water on small-scale farms east of the Cascades. She learned that yes, in many cases low-till and no-till practices can save water. But even more important, she discovered the value in providing farmers connections and new tools.

"The farmers became more intentional and observational in their irrigation practices because of this study," Swanson said. "The farmers felt empowered because they helped design the project and were given water sensors, technical support, and compensation for their time. We all struggle with water issues in our isolated region, and working together on this project helped us feel less alone."

Five small-scale farmers from eastern and central Oregon participated in the year-long study, which began in 2022. Each farmer prepared one control plot and two test plots using the low-till or no-till practices of their choice. Farmers selected which annual vegetable or herb they wanted to study, but each of their plots had to contain the same crop and receive the same amount of water. Throughout the season they measured how much water was available to their crops using water-tension sensors installed at different depths in the soil.

Water tension indicates how hard a plant is working to extract water from the soil. A low reading means the plant root is getting all the water it needs while a high reading signals that a plant is exerting a lot of energy to find moisture in the soil.

Interesting findings

In general, plots prepared without tilling held the most moisture. The study also suggested that no-till farming is more feasible for single-season crops rather than those that require many quick successions.

"The farmers felt empowered because they helped design the project and were given water sensors, technical support, and compensation for their time. We all struggle with water issues in our isolated region, and working together on this project helped us feel less alone."

Oregon farmer Katie Swanson

One finding was especially surprising: Water tension readings were remarkably low across the board until August, meaning water was readily accessible to crops.

"Farmers realized that early in the season crops don't need as much irrigation as they had assumed," Swanson said. "That's a big takeaway because now they can provide irrigation based on actual water needs, not just based on standard practices or when the soil looks dry."

Water sensors can also provide farmers more peace of mind late in the season when irrigation is limited or completely shut off.

"When you only have so much water, where do you put it?" Swanson asked. "These new tools can help farmers prioritize and make those hard choices."

Swanson held meetings, organized tours, and helped produce a video so farmers could share their findings throughout the region. She also worked closely with several advisors from Oregon State University Extension Service. She's hopeful this new network of small farmers can support each other as well as farmers throughout the West.

"Small vegetable farmers east of the Cascades are not often heard from at large statewide gatherings," she said. "Farmers in our region have accumulated important adaptive strategies in our extreme climate that can be useful to others as we face continually more extreme weather. Together, we can become more resilient."

Project number: FW22-405

Solarization Helps Grower with Weed Control

La Buena Tierra farmer Maria de los Angeles Carrillo is positively beaming that her interest in solarization – a non-chemical pest management practice – reduced weeds on her farm by 80 percent.

Angeles produces vegetables using as few chemical inputs as possible, working closely with natural systems. However, on the land in Salinas, California that she leases from ALBA, she struggled managing weeds and grasses such as purslane, coquille (nutgrass), pigweed, lamb's quarters and others.

While taking classes she learned about solarization, which uses plastic sheeting to capture radiant energy from the sun to heat soil and kill weeds and soilborne diseases. She first worked on an internship to learn more about solarization, which is a popular practice by organic farmers in Spain, then approached Aysha Peterson, Ag Technical Specialist at the Resource Conservation District in Monterey, about conducting further research on her own farm.

Angeles successfully applied for a Western SARE Farmer/Rancher grant to lead an on-farm trial to determine the feasibility of using solarization for small-scale organic farmers in California's Central Coast. The focus of the research looked at the financial difference between plots managed with and without solarization.

"For this project, I prepared the soil, bedded it up and sent soil samples to a lab. I found plastic that lets light through and doesn't let air and humidity out," said Angeles. "The soil temperature never went below 79 degrees, and I also measured the humidity of the soil. I even checked the temperature at night."

In the third week she started checking weed growth and she removed the plastic at seven weeks.

"What I saw was that the weed roots were very weak, and it was easy to pull the purslane," she explained.

Coquillo was the exception and even that stubborn grass has been reduced greatly and grows weaker roots. Lab tests also found reduced levels of the soilborne disease Verticillium wilt in the soil; crucial as Angeles grows lettuce which is very susceptible to the pathogen.

Angeles hosted students in ALBA's PEPA farmer education program to show them the project, and other farmers in the area ask her questions about her plastic.

She's excited by the results and to experiment more with solarization in the future. From this project, she learned that it would be better either not to make beds



Maria de los Angeles Carrillo (left) and Aysha Peterson

in the fields, as more air got in under the plastic, or to find another method to stop oxygen from getting in. She also found that getting the plastic off can be challenging.

Her next idea is to continue with the solarization but incorporate chicken manure into the compost she applies before placing the plastic. She thinks testing this in winter would be helpful as most seeds and diseases are more dormant during that season. She'd like to get the organic material hot in the winter so that it will kill weeds and diseases when they start emerging.

Angeles grew up working her family's farm in Mexico but has only been farming for herself since 2020. Her beginning farm helps her feel connected to her grandparents and her roots while she also develops strong, solid plans for testing new ideas and improving her land and production for the future.

"This isn't a hobby," she said. "I want to increase to five to seven acres and produce food for my local community."

Project number: FW23-435

On Tap:

Developing a Maple Syrup Industry in the Northwest

When you imagine harvesting fresh maple syrup, you picture Vermont or maybe New Hampshire, right?

A growing number of farmers throughout the Pacific Northwest just might change your mind.

Thanks to new research and legislation, farmers are discovering they can harness the sweetness of a fast-growing native tree that is often treated like a troublesome weed.

"It's called the bigleaf maple, and there's an abundance of them in this region," said Eric Jones, forest ecology instructor and researcher with Oregon State University. "Commercial logging companies often pay to have them poisoned because they grow so quickly and can block out Douglas fir trees, which take longer to mature and are generally more lucrative."

Jones is using a \$100,000 SARE grant to expand research and training so extension agents will be better able to help farmers capitalize on the hardy, sustainable bigleaf maple trees on their land..

"There's an incredible amount of interest," Jones said. "In our area alone, we have 22 commercial producers and hundreds and hundreds of hobby tappers. There are so many questions to explore – everything from basic site assessment to proper tools to heat stress and how best to manage sugaring operations alongside elk herds."

The Pacific Northwest hasn't traditionally produced much maple syrup, in part because sap from bigleaf maples is quite watery, making syrup production expensive.

But scientists and industry recently developed better reverse-osmosis pumps (the kind used to take salt out of seawater) that reduce

the cost of taking water out of sap.

Also, Oregon lawmakers recently agreed to let small-scale producers make syrup in their own kitchens through the Oregon Farm Direct Program, which substantially eased start-up costs.

"That solved the entry-level problem for many growers," Jones said.

As tree-tapping happens during winter when many other crops are off-season, more farmers are finding economic incentive to care for the trees that grow naturally in their landscapes. Capitalizing on this opportunity requires new technologies.

Growers used to have to tap one tree at a time, but now they can tap hundreds of trees at once using long, food-grade tubes and a vacuum pump. It can be tricky to set up and maintain those systems, but with farmers' help, Jones and his team are testing best practices, and also examining a host of crop-management issues such as sap flow, soil health and more.

More of a drizzle than a pour

At this point, syrup from the Pacific Northwest is still an artisan endeavor and can cost more than twice the Northeast variety. Consequently, food lovers use it more as a drizzle over salmon and steak than something to pour over pancakes.

"I'm hoping that changes over time as we start to see more production," Jones said.

So, what does syrup from Oregon and Washington taste like? Jones says it's dark, rich and robust. "As I tell my friends from the Northeast, it tastes just a little bit better than the maple syrup you find in Vermont."

Project number: WPDP24-007

Using Cardboard to Keep Bindweed at Bay

Bindweed can be the bane of farmers' existence. The climbing vine spreads easily by seed and a rigorous root system, choking off crops and other plants along the way.

"Even when we till in the spring, we spend a huge amount of time hand weeding throughout the season to manage bindweed," explained Jonah Sloven of Sweet Hollow Farm in Idaho.

Annual tilling is not ideal for soil health, and the labor cost of hand weeding is high. What if farmers could find a low-cost, sustainable way to control bindweed by harnessing something as basic as cardboard?

Maybe they can. Sloven is encouraged by results of burying cardboard beneath deep layers of compost to keep bindweed at bay. Sloven and his colleagues used a \$25,000 grant from Western SARE to explore whether cardboard layers can suppress weeds, improve soil health and increase profits.

Cardboard is especially good at suppressing grassy weeds, like crabgrass, by blocking seed banks from the sun. But researchers have suspected that bindweed, with its aggressive, horizontal root system, could make its way through or around a blanket of cardboard.

Sloven and others at Sweet Hollow Farm decided to test the theory. They cleared out the weeds in a high tunnel, laid down two layers of cardboard, covered it with a thick layer of compost, and then planted tomatoes.

"The tomatoes really took off, and so did all the crops we've planted since then," Sloven said. "Moving to a no-till system allows a much quicker crop turnover and interplanting opportunities, as well. We've had twice the crop production on the same footprint, which is huge for both profit and land-use efficiency."

The cardboard biodegraded and the soil beneath it is rich with worm activity, aggregate formation and moisture retention – all signs of soil health. Bindweed is not a problem inside the tunnel.

"It's very sparse and weak in the beds," Sloven said. "There's a little more bindweed around the perimeter, but it is so much more manageable than in the field."

Sloven expanded the experiment by creating two 20-by-100-foot outdoor plots. One plot was managed with tilling and hand-weeding. The second plot was carpeted with cardboard and a deep layer of compost.

"We looked at whether there is a quantifiable difference in bindweed presence between the two plots," he said.

There was. Side-by-side comparisons of onions showed it took less than half the time to weed the test plot than the control (55 minutes vs. two hours), and the cardboard-mulched plot produced 778 additional pounds of onions, or \$2,334 in revenue at \$3 a pound.

He's been sharing his results and techniques widely throughout the region.

"This system could be significant for small-scale producers," Sloven said. "Reducing weed pressure lessens labor hours, lowers costs and improves the quality of life for farmers."

Project number: FW22-393



Outdoor plots where cardboard mulch is being tested for weed control

Boosting Mango Production in Hawaii

Hawaii farmer Umi Martin wants to see tropical fruit production on the islands grow significantly and is working to make that happen.

He and other growers are experimenting with ultra-high-density orchards and other advanced orchard-management systems, and believe they can boost fruit production by 30 percent, or more.

“With a conventional mango orchard, a realistic expectation of production is two to five tons per acre,” Martin explained. “Ultra-high density plantation techniques and the open tatura trellis system have been producing eight to 20 tons an acre. Utilizing these high-density systems have the potential to double Hawaii’s mango production with just 20 acres.”

Martin has received two Western SARE Farmer/Rancher grants for what he calls his “Mango Loa Project.” And while the production increases results are encouraging, an equally important finding was that the new planting densities resulted in a reduction in labor. Martin found that using the high-density plantation technique, one person could manage 10 acres by themselves.

“In Hawaii we will always have a labor shortage, so introducing a technique that was going to reduce the demand of labor and increase the ease of harvest was what I was looking for,” he said.

With his first grant, Martin was able to determine, and share, the best practices for irrigation, fertigation, training and pruning. In the second project, the research demonstrated the benefits of the new orchard-management systems: good yields, quicker production time, higher fruit quality, and easier harvest and post-harvest management.

As Martin experimented with the systems, local farmers showed great interest. Martin developed videos posted on YouTube, conducted seven online trainings, and conducted 24 on-farm demonstrations, field days or workshops. He also created a Facebook group.

“I got the impression that there was real interest in high-density orchard techniques both for farming and backyard growing,” he said. “I believe through the series of videos we produced, we managed to thoroughly cover the subject of high-density orchard management systems for mango production, and contacts through social media also allowed me to interact with people that were interested in installing high density orchards on their farms.”

Watch the videos at:
youtube.com/watch?v=Hq71gcd00AI

Project number: FW21-375



A mango orchard using the open tatura trellis system

Growers Testing Dry-Farm Corn Varieties

As farmers and agricultural researchers work to keep farming profitable throughout the West, some are looking to future innovations, some are exploring past agricultural practices, and some are doing both.

In Western Oregon, a collaborative effort between farmers and researchers to establish and expand dry farming – growing crops without irrigation – is decidedly in the “doing both” camp.

“There is enough winter rain in Western Oregon to dry farm summer crops like corn, tomatoes and melons,” explained Lucas Nebert, a research associate in the Department of Horticulture at Oregon State University. “The problem is that many commercial varieties of seeds for these crops haven’t been dry-farm adapted.”

So, with a Western SARE Professional + Producer grant, and 11 collaborating farmers, Nebert started a corn breeding project to improve the ability of open-pollinated corn varieties to grow successfully during drought and in dry-farmed conditions. In the arid West, where summer rains are scarce, the vast majority of corn acreage is irrigated.

“Plants all around us survive the summer without irrigation, so why can’t we have certain crops do the same?” he said. “What we’re doing with the corn breeding project is nudging the varieties so they’ll perform better in dry-farmed conditions.”

A group of 11 mostly organic growers in the Willamette Valley planted the different corn varieties at multiple sites. Some had dry farmed before while others were trying it for the first time. Some tilled their fields while others used no-till practices. Their results:

First, soil composition is critical for successful dry farming, Nebert said. Sandy soils don’t hold as much water, so are less suitable for dry farming.

The second most important factor in the trials was the variety of corn planted, with the more drought-tolerant varieties out-performing standard varieties.

“In parts of the country, markets for dry farmed produce already exist,” he said. “In Coastal California, dry-farmed tomatoes and dry-farmed melon are sought-out, valued commodities. In the Willamette Valley, there is more drought stress so those same varieties don’t do as well here. We have to develop varieties that can be dependable and successful in our conditions.”

Other early lessons from the corn trials: no-till and shallow tillage were also more successful than deep tilling, because tillage allows moisture to escape the soil.

Dry farmed yields weren’t as high as fields that were irrigated, but as Nebert explained, “dry farming isn’t a yield-maximizing strategy.” Instead, it’s an options-maximizing strategy for a grower who doesn’t have an allotment of irrigation water one season or has their allotment cut during drought conditions.

“Also, there are a lot of costs associated with irrigating,” Nebert said. “Equipment, moving pipes, weeding. We found that it took half the time to weed dry-farmed fields and that’s significant because organic farming has weed problems. With lower weed pressure, dry farming doesn’t require as much labor.”

Beyond developing dry-farm-adapted seeds, Nebert and others involved with the Oregon State University Dry Farming Project are mapping the state of Oregon to find areas where dry farming can work. Based on soil and precipitation maps, a dry farming overlay will show where producers could turn to this cropping system.

Project number: OW21-366



Can Less Fertilizer Create Higher Sugar Yields? Testing a Win-Win Hypothesis

For a sugarbeet grower, when someone tells you that you can reduce your nitrogen fertilizer inputs and costs by 20 percent and increase your crop quality and sugar yield, there's only one logical response.

Prove it.

That's just what the Western Sugar Cooperative set out to do with a Western SARE Professional + Producer grant after changes to the sugarbeet production practices raised the question of how much added nitrogen the crop really needs.

"Nitrogen is a pretty expensive input and has a pretty significant environmental impact because it's very carbon-intensive to produce and it has pretty big carbon impacts following application," explained Rebecca Larson, the chief scientist and vice president of government affairs for the cooperative. "But it's also a critical component of crop production. If you don't put enough nitrogen down, you can't maximize your land-use efficiency, which also has negative environmental impacts."

And sugarbeet growers have another added challenge: too much applied nitrogen actually reduces the sugar content in the beet and increases impurities, making sugar extraction harder still. Both reduce sugar yield and growers' potential income.

What raised the issue of how much nitrogen to apply was the development and widespread adoption of glyphosate-resistant sugar beets around 2009.

"Our growers fundamentally changed their production practices with the adoption of glyphosate-resistant sugarbeets," Larson said. "It was the first time sugarbeet farmers were ever able to really control the weeds in their field. Suddenly, they had fewer weeds competing for water and nutrients."

But did that lack of competition mean growers were now putting down too much fertilizer?

To answer the question, the cooperative hired a scientist at the University of Nebraska, Dr. Bijesh Maharjan, to look at the ideal nitrogen application rate. He determined growers could support 35 percent higher yields with 20 percent less nitrogen.

"It was really cool to see in a 110-square-foot experimental plot," Larson said. "But if you're a farmer managing 110 acres, it's a big risk to cut your nitrogen that much."

But the Western SARE funding took the risk out of the experiment. The cooperative used the \$75,000 grant to incentivize growers in each of the cooperative's four states – Colorado, Nebraska, Wyoming and Montana – to split a field in half and manage one half using their current nitrogen regime and the other half at the 20 percent reduced rate.

It worked, generally.

"What we learned is that it's not quite as simple as 'one size fits all,'" Larson said. "But by doing this initial test, we could see it works more often than not. Mother nature is sometimes not kind and there were lots of confounding variables that impacted the results."

Understandably, growers weren't about to bet the farm and change practices after just one year of results.

"Yeah, they'll say, 'Okay, you got it to work that year, but maybe we were just lucky,'" she said.

The results were encouraging enough for the cooperative to get two additional grants, a Conservation Innovation Grant and a subaward from Edge Dairy Cooperative's Partnerships for Climate Smart Commodities grant to replicate and expand the initial split-field experiment.

"With these two grants, we're now testing the reduced rate on over 100 farms over four years to see if we get this consistently to work over a large geography under various environmental conditions," Larson said. "If the answer is yes, I think we'll see all that skepticism cast aside and the growers will move forward with this. Because not only are they saving money on fertilizer, but we're also showing that they're able to grow a better crop."

And the economic potential is substantial.

"If we can get just a one percent higher sugar yield by improving nutrient stewardship, that's worth \$20 million to our cooperative," Larson explained. "It's money on the front end saved and money on the back end earned – which every grower in this current market environment needs."

Project number: OW21-368

Reducing Predation in Multi-Species Grazing

New Mexico rancher Sydney Franz tested two approaches to kidding goats for economics and safety and found a clear winner.



When Sydney Franz moved her goat ranch from Central Texas to Mora County, New Mexico, predation was a problem.

She'd moved her operation, K&C Boer Goats, to join with Turner Ranches and form a cattle-goat multi-species grazing program for better pasture management and increased income. But losing animals to predators like mountain lions and coyotes was a problem that had to be solved.

Her first attempt was using an intensive kidding program. In intensive kidding, does are contained in corrals for up to three months to give birth and raise their kids. All feed and water has to be provided, resulting in high feed cost, intensive labor and increased exposure to illness. It also resulted in a lack of bonding between does and their offspring.

For Sydney, this lack of bonding resulted in abandoned kids, and kids who would not follow their mothers and the herd. This caused a higher kid loss from predators as kids were left behind the herd.

Another approach is extensive kidding is a pasture-based program with the goats' diet derived primarily from grazing, and with birthing happening on pasture with little or no human assistance. The animals are protected by high wire fence, but in large pastures or "traps" that are gated so animals can be moved between them.

Curious if extensive kidding would increase the num-

ber of live kids raised from birth to sale, as well as reducing labor and production costs, Sydney applied for a Farmer/Rancher grant to compare the two systems.

Over three years, Sydney found that an extensive program, with does contained in two connected traps, reduced the cost of feed and labor. She also found those kids are able to follow their mothers earlier, resulting in a higher percentage of live kids surviving until market.

"Our project conclusively shows that having the most kids to market for the lowest expense is obtained through the extensive kidding pasture use," she said.

Sydney did find one downside in extensive kidding – the lack of shelter during uncertain weather. She believes this can be addressed through the construction of portable A-frame shelters.

Through the project's outreach, which includes [videos](#), other ranchers are looking into making changes. According to Sydney, one local ranch has adopted the extensive kidding program in their operation.

"Our dream is to re-introduce small ruminants (mainly goats) onto large ranches in multi-species grazing programs," she explained. "Prior to receiving funding to determine a better kidding program, we were losing too many goats. The number of losses we were experiencing was unsustainable."

Project number: FW22-403

Creating a Functional Forest on a Hawaiian Farm

In Hawaii, pono matters. Pono is the concept of balance and righteousness – of doing right in the world.

Pono ACRES – a demonstration functional forest on Wailea Spring Farms north of Hilo on Hawaii’s big island – is planting the ethos of pono deep in the Hawaiian soil. It’s doing right in the world – and by the Earth – by:

- Clearing out invasive trees, weeds and vines that have overgrown land that was part of a former sugarcane plantation
- Planting 50 native ohia trees and over 100 other native trees and shrubs
- Incorporating non-native (but non-invasive) species to support the native trees
- Including agricultural species like avocado, ulu, macadamia, mango, banana, coconut, noni and others to create farm income and additional species diversity

“Forest ecologists here came up with the idea of a functional forest for the Pacific Islands,” explained Shari Tresky, who owns Wailea Spring Farms. “The idea was you mix native and non-native but non-invasive trees and plants because it can create a more balanced ecosystem. There were working on it from an environmental perspective, but when I was reading about it, I had the idea that it could be integrated with farming and agroforestry and that would encourage a lot more people to do this.”

Tresky ran her idea by the researchers who developed the functional forest model, Dr. Rebecca Ostertag, a forest ecologist at the University of Hawaii and Dr. Susan Cordell, the director of the Institute of Pacific Islands Forestry.

“They loved the idea,” she said. “That’s how Pono ACRES was born.” (ACRES is an acronym for Agroforestry Conservation Reserves for Eco-Economic Sustainability.)

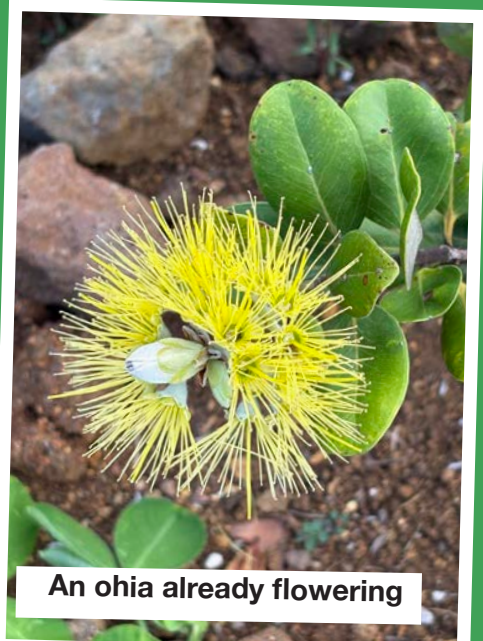
Tresky applied for and received a Western SARE Farmer/Rancher grant and got to work. She and her farm crew rented excavators and cleared out the invasives – African tulip tree that have a toxic nectar that can harm native insects, albezia trees that ignite easily, guinea grass that grows in 8-foot-high clumps that choke out native seedlings and also burns hot and fast, and wide-lia, a climbing, spreading, choking vine.

The danger posed by those invasives – which have spread over thousands of acres of former sugarcane and pineapple plantations on the islands – was brought home by the wildfire on Maui in August 2023 roared through acres of overgrown land and claimed the lives of more than 100 people.

After removing the invasives, Tresky terraced a section of the project site



Planting the functional forest



An ohia already flowering



Shari Tresly, second from left, with the University of Hawaii students who helped plant more than 150 trees and shrubs using a “functional forest” model.

near the spring-fed stream, added mulch and compost to the entire site and started planting – the ohia trees plus 29 other native species, 10 species known as “canoe plants” that were brought to Hawaii by Polynesian voyagers and have been in the ecosystem for centuries, and the agricultural species.

“They’re all integrated but the natives are generally concentrated toward the center near the stream and they’re surrounded and protected by the agricultural stuff where it’s easier to harvest. Part of the idea was also that since the agricultural trees generally grow faster, they can provide shade for some of the natives that grow more slowly.”

It’s working. The ohia and native ho’awa trees – a fruiting species that is the main food source for the nearly extinct native Hawaiian crow – are thriving. The invasives are resprouting in dwindling numbers and weeded out when they do come up. The agricultural trees haven’t all reached full production yet but she’s harvesting some and the trees are generally growing well. And Tresky is propagating the native plants and selling them as nurse stock to further diversify her

income streams.

She’s held four demonstration tours, developed a plant list, published a brochure and maintains a dedicated website about the project at ponoacres.org. The county, which is Hawaii island, offers property tax credits for people incorporating functional forests on their land.

“People are excited and I think there’s a lot of interest in it here,” Tresky said. “My immediate neighbor is very interested, so I’m going to help them continue the project right into their property.”

So Tresky is planning more tours and hopes to keep spreading the benefits of agriculturally focused functional forests – ecosystem restoration, species diversification, fire protection, farm income, habitat and food for native birds and other fauna, property tax credits, and even improved pest management – to farmers around the islands.

And that’s pono indeed.

Project number: FW24-007

Heritage Grains Help Farmers in Drought

Farmers in southern Oregon are struggling under historic drought conditions. Many growers receive little or no irrigation water and are making hard choices to move or go out of business. Results from a recent Western SARE-funded project with heritage grains may offer encouraging news.

“We found that heritage grains adapt well to local farming conditions even during drought,” said Cacia Huff, a commercial seed farmer who led the project. “By adding heritage grains and specialty seed crops to their rotations during times of drought, regional farmers can stay more economical viable and climate resilient.”

Huff grows a wide variety of seeds on Feral Farm, a four-acre organic farm in Applegate Valley in southern Oregon. She and three of other producers both large and small with diverse farming practices cultivated four types of heritage grain: Tibetan Purple Barley, Ukrainian Wheat, Banatka Wheat and Rouge de Bordeaux Wheat.

The farmers prepared a 25-foot bed for each variety using different methods depending on the farm’s scale, soil type and climate conditions. All the beds were in a field, not high tunnels, and they were all planted in mid-November. None of the varieties received water or fertilizer.

By summer, the grains were thriving.

“All four grains germinated, grew to harvest and produced good yield and ample biomass,” Huff said.



Harvesting heritage grain

One variety in particular, Banatka Wheat, did well under all bed-preparation strategies. Without any inputs and with low or no tillage, the Banatka Wheat plants grew more than five feet tall and produced high yields of grain to sell, seeds to save and biomass to support soil health.

“The results were surprising and even more impactful than we anticipated,” Huff said. “All the farmers who participated in trials now plan to add more heritage grain to their farming operations.”

Heritage grains are older than modern grains, which are bred for traits like high gluten and high yield. Heritage grains are genetically diverse and offer more complex flavor and nutritional benefits. These older varieties are also more drought tolerant and adapt well to low- or no-till agriculture.

“They produce more biomass, which captures carbon and gives more organic matter back to the soil,” Huff explained.

Beyond the environmental benefits, farmers can also reap economic gains from specialty seeds like heritage grains.

“Bakeries are taking more interest in creating products from heritage grains because consumers like the increased flavor and nutrition,” Huff said. “This new market is growing fast and farmers in our region could help meet that demand.”

All the farmers who participated in Huff’s trial have now added heritage seed to their operations. Fry Family Farm, a 50-acre vegetable and fruit farm in Medford, has leased more land just so they can devote 35 acres to heritage seed production. Fry Family Farm also hopes to buy a grain mill to heritage flour.

Huff and her team offered a series of farm tours and workshops to share what they learned with farmers and students throughout southern Oregon.

“We’re seeing several community partnerships and collaborations around heritage grains,” Huff said. “Farmers tell us this trial has given them the confidence, knowledge and understanding to grow heritage grains. Working together, we hope this work can help strengthen viability, economic resilience and climate adaptability for farmers during this difficult time.”

Project number: FW23-412



Farmstay Website Helps Producers Profit

Fifteen years ago, a Western SARE award enabled Oregon farmer Scottie Jones to develop a Northwestern Farmstay USA website. Today, the website highlights 306 farms and ranches across the country and in U.S. protectorates.

A farm stay is overnight lodging on a working farm, connecting urban residents to the land and their food. Back in 2010, it was a new idea for many Americans, but there was growing interest by both travelers and producers seeking to diversify their operations.

The challenge Scottie proposed overcoming was how farmers could market their farm stay while more comfortably selling produce and livestock products. By the end of her project, FarmStay USA launched with 197 operations in Oregon, Washington, Idaho, Montana, and California. Scottie and her team of producers provided education to other farmers and ranchers about farm stays and the website.

Visitors to the website can now conduct a detailed search to find the best farm stay for them. In addition, there is a newsletter, blog, and podcast.

Scottie credits the grant for helping develop a tool allowing her farm and other farms to remain profitable.

“For us, farm stays weren’t just a fun idea – they were a lifeline,” she said. “In my case, the concept quite literally saved our farm. Opening our doors to guests

gave us the financial and emotional support we needed to keep going. And as I looked around the country, I realized we weren’t alone. There were incredible farms and ranches doing the same thing – but scattered, hard to find, and operating without a shared platform.”

As Farmstay enters its 15th year, Scottie is passing the leadership baton to Cathy Barnes. According to Scottie, “she has been working with me for the past year and will be a shining light for new and refreshed ideas to help farmers with their agritourism ventures.”

Looking toward the future, Cathy says, “We’re excited for the next 15 years as we build on a strong foundation and expand to showcase not only lodging, but also authentic experiences and events on working farms across America. We’ve been developing meaningful partnerships and collaborations while revamping our library of resources to equip farms with the tools they need to welcome visitors and to help existing agritourism businesses grow and thrive. The future of farming is rooted in connection, and we are here to help those roots grow deeper and stronger.”

With the growth of FarmStay USA, it’s clear that the movement is here to stay and an important tool in both connecting people with their food source and in maintaining economic viability for producers.

Project number: FW10-029



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