OREGON STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

OREGON'S AGRICULTURAL PROGRESS

The next big thing:
Seaweed supper
Student entrepreneurs
Workforce development
Emerging new businesses

Oregon State UNIVERSITY

OREGON'S AGRICULTURAL PROGRESS

Summer 2015, Vol. 61, No. 2 Oregon State University

Front cover photo:
Dulse, a flame-colored seaweed, is set to make a splash in the culinary world. Photo by Stephen Ward

Contents photo:
Indigo tomatoes developed by Oregon State University are a favorite among chefs and gardeners. Photo by Stephen Ward

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Editor's Note

Oregon produces some of the finest ingredients in the world (think: wheat, potatoes, hazelnuts, berries). Producing something new from those ingredients can add substantially to their value in the marketplace. For example, a good Oregon Pinot noir can increase the value of wine grapes eight-fold; artisan cheese can increase the value of milk ten-fold; and a craft microbrew can increase the value of hops and barley 30-fold.

Research adds market value to fine ingredients by improving crop varieties, extending freshness, and experimenting with stuff we might not think of as ingredients at all. One of those new ingredients is the beautiful seaweed pictured on our cover.

In this issue of *Oregon's Agricultural Progress*, we explore how agricultural research is helping build new businesses and support economic development. With research capacity that spans the entire food system, and active programs to strengthen the workforce, the Agricultural Experiment Station is a key partner in building Oregon business.

Peg Herring

Additional features online:
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- Sea vegetables are the Next Big Thing
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- Research supports Oregon breweries
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- Safer oysters through science

OAP

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THINGS ARE MOOOO-VING AT THE OSU DAIRY

By Gail Wells | Photos by Stephen Ward

Strolling the slanted concrete floors of the Oregon State University dairy barn, a visitor gets a feeling of being watched. And it's true: 30 pairs of soft brown eyes follow your steps, and 30 velvety faces gaze at you with an expectancy that says, "Of course, you came to see us."

These 30 registered Jersey cows seem to know they're the stars of this show. And why not? When they arrived in 2013—a gift from a generous OSU dairy alumnus—they helped jump-start the OSU dairy operation after a year-long closure and the sale of most of the previous 180-head milking herd.

The revamped dairy is now in its second year and seems to be off to a good start. "We had record high milk prices the first year," says Troy Downing, "so we started on a high note. We made a lot of investments," including pasture fencing and irrigation, and a new manure tank.

Downing is an OSU animal science professor and the Extension dairy specialist in Tillamook County. He says the university's dairy is aiming at that sweet spot where it can both earn its keep and support OSU's animal-science teaching and research—studies of animal health, nutrition, reproduction, and behavior, as well as herd management and crop and grass production.

The university's dairy is aiming at that sweet spot where it can both earn its keep and support OSU's animal-science teaching and research.

Animal science students come here to get hands-on experience in all aspects of dairy operations and management. Youngsters from public schools and clubs come for various learning experiences—including getting up close and personal with the doe-eyed Jerseys.

Andrea Smaciarz, a double major in ag business management and animal science, attaches the milking machine to one of the OSU Dairy's Jerseys. The dairy is keeping fewer cows these days and feeding them more on home-grown grass and silage.

The 2012 shutdown occurred mostly because of the high cost of feed, Downing says. "The cost of running a dairy is generally 50 or 60 percent feed. With the old herd, we were growing about 20 percent of the diet and buying 80 percent from elsewhere—alfalfa hay from eastern Oregon and grain from the Midwest."

Then feed prices got high and milk prices got low, and budget troubles forced a rethinking of the high-input, high-productivity management regime. Now the dairy is keeping fewer cows and feeding them less grain and more homegrown grass. Between 60 and 70 percent of the cows' diet comes from the 180 acres of OSU pasturelands surrounding the dairy. The cows graze the pasture's grasses in summer and eat silage in the winter, reducing costs for imported grain and alfalfa.

The leaner diet results in a somewhat lowered volume of milk. For Seth Spencer, who manages the dairy and all of OSU's animal facilities, this lowered volume is not a problem: "Our cows are healthy and happy," he says. Spencer sees it as a good sign that researchers who want to study common cow diseases can't find enough pathology at the dairy to study. "We had somebody who wanted to do a project on mastitis," he says, referring to a common udder infection, "but our cows don't get much mastitis. And somebody else wanted to do research on retained placenta [from a just-delivered cow], and we haven't had a single incident of that in the last 9 months." | **OAP**

Growing an educated

Behind Luisa Santamaria, rows of colorful pansies and geraniums complement the purple ink she uses to write instructions on a flip chart. As rain pings on the plastic roof, a collection of workers step closer to hear her speak.

Santamaria moves hands to hips to emphasize her point. She explains, in Spanish, that pathogens cause disease. The damage that fungi, bacteria, and viruses can cause to nursery crops can create economic headaches for an industry that contributes $745 million annually to Oregon's economy.

Viliulfa Gallegos, Damaso Ruiz, Nora Gonzalez, and Javier Magdiel Fajardo take notes as Luisa Santamaria, a plant pathologist with Oregon State University North Willamette Research and Extension Center, discusses in Spanish strategies for sanitation at Tanasacres Nursery. Her program aims to educate nursery workers about the pathogens that cause plant diseases and how to prevent them.

workforce

By Kym Pokorny

Ross Hamilton photo

On this day, Santamaria, a plant pathologist with Oregon State University North Willamette Research and Extension Center, is working with employees at Tanasacres Nursery in Hillsboro. These workers are the first line of defense against the spread of plant disease. Weeding or moving plants can spread deadly pathogens through swaths of potted perennials and shrubs.

Since 2011, Santamaria has reached about 500 Spanish-speaking workers from 25 nurseries with her message of "action before reaction" when dealing with plant disease. She works with many of the largest plant nurseries in the business, like Tanasacres, J. Frank Schmidt & Son, Hines, Iwasaki, and Oregon Pride.


Lynn Ketchum photo

At Gold Hill Nursery, in Hillsboro, Santamaria stands next to a projected illustration of the life cycle of boxwood blight. The audience, including president Matt Gold, his nursery workers, and his production manager, presses in to see details of this fungal disease that has decimated crops in Europe, established a foothold in the eastern U.S., and begun to show up in Oregon. With 25 percent of its crop in boxwood, Gold Hill is eager to take preventive measures.

"We want everyone who works for us to have knowledge of boxwood blight," says Gold. "If not, we could lose our entire crop of boxwood. That would be a huge problem." Santamaria works in Spanish and English to help everyone identify the pathogen and take steps to avoid its spread. "When our employees get the knowledge," Gold says, "rather than just nodding their heads, they say, 'Yeah, we can do that.'"

Santamaria's work focuses on the most serious plant diseases. That includes *Phytophthora*, a fungus-like organism that causes root rot in 150 species of Oregon's most iconic nursery plants, including rhododendron, azalea, pieris, and viburnum. This pathogen travels through water and can be controlled by limiting irrigation and leaving space between plants for air circulation.


Ross Hamilton photo

Educating the workforce about managing plant health not only helps to increase profits, it also helps unlock staff reticence about reporting potentially serious disease- and pest-related problems.

Damaso Ruiz, an irrigation supervisor at Tanasacres Nursery, has participated in three of Santamaria's trainings and has changed the way he works. He points to a neatly wound hose and nods approval. No longer, he says, are hoses dropped to the ground where they can splash *Phytophthora* spores or pick up pathogens and transfer them to plants.

"Luisa's class is good for me and important for the company," Ruiz said. "I prevent the disease, rather than having to do something after the plant is sick. I know about plants when they're sick; when they need to be sprayed and when they have to be dumped. Now I learn more about how to stop the disease."

"Bilingual training is very important to us since our workforce is 100 percent Spanish speaking," says Frank P. Kilders, production manager at Tanasacres Nursery. "Workers are not simply being told to do something, now they understand the 'why' behind what they're doing."

Far left: Preventing the spread of plant diseases in nursery production is essential for the industry that contributes more than $745 million a year to the Oregon economy.
Left: A fluorescent gel simulates unseen pathogens that can evade casual handwashing. Thoroughly washed hands reveal no remaining gel on workers' hands.
Right: OSU plant pathologist Luisa Santamaria has provided bilingual education for about 500 Spanish-speaking workers, giving them the skills to identify plant diseases and to adopt practices to protect Oregon's nursery industry.

Santamaria demonstrates why hand washing is crucial. She smears workers' hands with a flourescent gel to simulate unseen bacteria, then instructs them to wash it off. White splotches of leftover gel are visible in the ultraviolet light, showing how easy it is for bacteria to evade clean-up. The workers point and elbow each other good naturedly. To reinforce the lesson, she has them swab seemingly clean pots and clippers and put the swabs in a test tube over night. The next day, the employees see the telltale results.

Since training began at Tanasacres Nursery, Kilders has implemented hygienic watering strategies. Workers wear gloves and use alcohol to disinfect their hands as they plant, stake, and load hundreds of plants a day. They've learned that every time they touch a pot it's an opportunity for a pathogen to jump from one to another, infecting plants along the way. "They're responsible for putting practices


Stephen Ward photo

into play," he says. "They're integrated into the process."

Educated nursery workers have become critical to business success. "At first, they might not know what pathogens are," Santamaria says. "But once they understand, their lives change. They are participants." If they recognize a diseased plant or notice practices that could lead to disease, they're more likely to approach crew leaders to prompt intervention that saves money on labor, materials, and lost inventory.

"Having bilingual Extension programs helps with the overall needs of the nursery industry and challenges of the labor force," says Jeff Stone, executive director of the Oregon Association of Nurseries. "We face labor shortages and it's not getting better. Finding ways to train and educate our workforce is more important now because we have to be more efficient than 25 years ago."

Although most of the workers haven't completed high school, "they're experienced, active in the workforce, they do a good job, and they want to work," says Santamaria. To help nursery workers extend their knowledge, she is developing a certification program in collaboration with OSU's Professional and Continuing Education, with a grant awarded by the U.S. Department of Agriculture and National Institute of Food and Agriculture.

As Santamaria puts down the purple marker and ends her Tanasacres lesson, the students head to lunch. Instead of the usual mealtime gossip, the conversation turns to black lights and bacteria, lifecycles and fungi.

"Education is the key," Santamaria says. "If we prepare them to recognize the problem, they will help find the solution." | **OAP**

ENSURING SAFETY *in a* FAST-PACED FISHERY

By Gail Wells

When albacore tuna are schooling in the blue waters off the Oregon coast, fishermen don't get much rest. A dozen trolling lines unspool off the stern of a boat and trail their bright-orange lures. A crewman leans over and hauls in a line, hand over hand. In a sudden eruption of spray, a silvery torpedo-shaped fish bursts through the waves, its slender pectoral fins rising like wings. The crewman unhooks the fish and flings it into the bleeding trough, then reaches for another line and begins to pull again.

A second crewman seizes the fish from the trough and makes a firm, swift cut under the chin. Blood drains from the wound and puddles down the trough. Albacore require bleeding and chilling as soon as they are landed. The crewman buries the bled fish in ice or in the freezer and hustles back as another fish plops into the trough.

"There's not a lot of time to catch your breath," says Nancy Fitzpatrick, whose husband Mike fishes for albacore and salmon on the F/V Sea Rose out of Newport, Oregon.

Sea Rose is one of a fleet of more than 400 mostly family-owned boats that operate out of Oregon ports from Astoria to Brookings, catching the 12- to 20-pound fish one at a time with trolling gear or single-line poles. These fishing methods, along with international cooperation to regulate catches worldwide, make Pacific Northwest albacore a sustainable seafood choice.

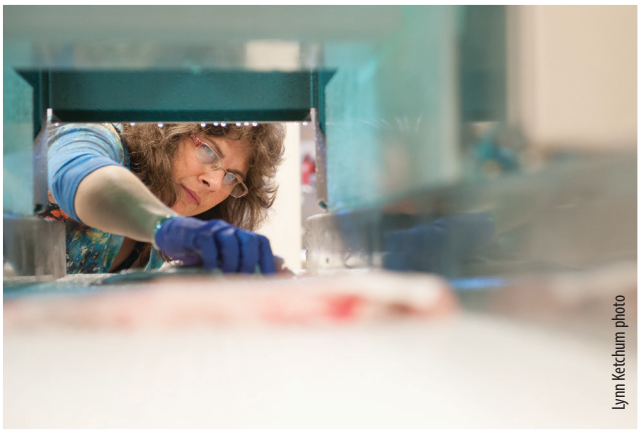
Albacore is also a safe choice, and OSU's Seafood Laboratory is helping to keep it that way. "With seafood, safety is always a challenge," says Christina DeWitt, director of the Seafood Lab,

Left: Troll-caught albacore make up Oregon's third most valuable fishery. And they're rich in omega-3 fatty acids, too.

part of OSU's Coastal Oregon Marine Experiment Station. "And safety is tied to the quality of processing and handling."

More than most seafood, albacore needs special handling. It's imperative to chill the flesh quickly—otherwise it develops a toxin that can cause a severe histamine reaction. This toxin has not been a problem in Oregon-caught albacore,

iStock photo



Lynn Ketchum photo

Seafood safety begins at the moment that fish are caught. Christina DeWitt (above, right) , director of the OSU Seafood Lab, works with the fishing industry to assure the highest quality and safety of Oregon seafood.

DeWitt says. "Our fish are younger, smaller, and come from colder waters" than other tuna species. And, she adds, Northwest albacore fishermen are well aware of the danger and are diligent about icing or freezing their catch immediately.

A couple of years ago, DeWitt found herself in the middle of a dispute between fishermen and federal regulators over a new interpretation of a seafood-processing rule. Regulators were calling for detailed onboard recordkeeping of catch times and fish and water temperatures. They wanted documentation that the catch had been handled safely.

Such a system is appropriate for trawlers, seiners, and large processing ships that process fish in bulk quantities, says DeWitt. "But our albacore fleet catches fish by hook and line, one at a time," and the fish are typically iced or frozen within minutes.

The new rule called for a separate record for every single fish. DeWitt met with the fishermen and listened to their concerns. Then she traveled to Washington, D.C. and spoke to regulators at the FDA's Office of Seafood Safety. "I told them how fish are caught here, and we discussed how we could design a record-keeping system that would not be over-laborious to the fishermen."

Listening to both regulators and fishermen, DeWitt drafted a set of handling guidelines that fulfilled the intent of the new rule. She devised a simple log sheet for noting catch periods, type and effectiveness of chilling, and other pertinent records.

"We demystified the record-keeping so that we could get buy-in from the fishermen," says DeWitt.

The economic payoff of effective regulations may be hard to quantify, says DeWitt, but it's real. Without the simpler system, "each vessel might have needed an additional crew member to handle the monitoring and record-keeping," she says. "That would clearly have been a financial burden."

The system hasn't been formally blessed by regulators, but they're happy with the process used to develop it, DeWitt says. And the processors and restaurants that buy the fish—and that are ultimately answerable for its safety—are happy with the added accountability. | **OAP**

NOAA photo by Helena Aryafar

THE NEXT BIG THING:

SEA VEGETABLES

by Peg Herring | photos by Stephen Ward

The Fancy Food Show in San Francisco is the West Coast's largest food and beverage trade show. This is where the next big thing shows up first. In recent years, it was kale, kombucha, and almost anything that tastes like bacon. This year, it's seaweed.

The trade show excitement didn't surprise the folks at Oregon State University's Food Innovation Center, where they've been cooking up their own food innovations with seaweed. They're using a succulent red alga called dulse that grows wild on wave-swept shores of the north Atlantic and Pacific coasts. As a sea "vegetable," dulse has been used for centuries in the local foods of Ireland, Iceland, and Scandinavia. It's nutritious, fast growing, and, when it's fried, they say it tastes like bacon.

Chris Langdon, an aquaculture researcher at OSU's Hatfield Marine Science Center in Newport, began growing dulse in the lab to feed abalone as part of his shellfish polyculture research. Over the past 15 years, Langdon has developed a patented strain of dulse (*Palmaria mollis*) that he grows in bubbling vats of cold seawater just outside his office. Looking like a translucent red lettuce, Langdon's cultured dulse grows faster than wild dulse. The abalone love it. But more to the point, so does Chuck Toombs.

As food for people, dulse is an excellent source of minerals, vitamins, and antioxidants, and it contains up to 16 percent protein by dry weight. That inspired Toombs, a professor in OSU's College of Business, who came to Langdon looking for a project for his marketing students. "Dulse is a super food, with twice the nutritional value of kale," Toombs said with bright-eyed excitement. "And OSU has developed a variety that can be farmed, with the potential for a new industry on the Oregon coast."

Toombs took his enthusiasm to OSU's Food Innovation Center in downtown Portland. There, the product development team began to cook up a vision for dulse as a primary ingredient for a slew of new foods. Langdon delivered a cooler full of fresh dulse, and food scientists Qingyue Ling and Sarah Masoni got busy, directing the creative energy of two Saturday Academy students, Isaac Morrise and Emily Highkin, to see what could be created from Langdon's seaweed.

If you think seaweed is only used in sushi, think again. Food manufacturers use processed seaweeds as ingredients in many foods, from ice cream to salad dressing. At the Fancy Food Show, seaweeds were prominently featured in chips, crackers, and salads. Masoni and Ling saw the potential. So did their colleagues at the Oregon Department of Agriculture, who helped get Langdon's farmed dulse recognized as a specialty crop by the U.S. Department of Agriculture.

"This is a huge step forward," said Michael Morrissey, the OSU director of the Food Innovation Center. "Until now,

Previous page: This fresh salad, with raw dulse and a ginger-dulse vinaigrette dressing, is the product of two research centers: the Food Innovation Center and the Coastal Oregon Marine Experiment Station.
Left: Chris Langdon, who leads research in shellfish aquaculture at Oregon State University, has been breeding new varieties of dulse at Hatfield Marine Science Center for several years.

As food for people, dulse is an excellent source of minerals, vitamins, and antioxidants, and it contains up to 16 percent protein by dry weight.

Above: Jason Ball, a research chef at the Food Innovation Center in Portland, prepares dishes made with dulse to be taste-tested by the general public.
Right: Crispy dulse rice crackers are one of several concoctions the Food Innovation Center is testing with consumers.

there had never been a seafood included on the specialty crop list." This meant that the Food Innovation team could apply for a specialty crop grant.

The grant funds helped bring Jason Ball onto the project. A research chef and self-described culinologist, Ball had been working at the University of Copenhagen's Nordic Food Lab, where he was helping to reinvent Nordic cuisine focused on local ingredients. Now at the Food Innovation Center, Ball has a similar challenge: to help expand Pacific Northwest cuisine. His first assignment is dulse.

At the Nordic Food Lab, dulse is foraged from the wild. At OSU, because Langdon's strain of dulse is cultured in tanks of seawater, it's consistent in quality, available year round, and harvested without impact on fragile intertidal habitats. Aquaculture also makes it possible for Langdon to develop new varieties for new culinary uses.

Ball is pushing the envelope, testing dulse veggie burgers, trail mix, and even dulse beer. Working directly with Langdon, Ball can experiment with different strains that have different flavors and attributes. With fresh dulse, he's looking for a tender chewiness and slightly salty finish. "Pan-fried," he says, "dulse can be light and crispy with a savory saltiness, like bacon."

Anxious to see this savory crispiness make it to the marketplace, Toombs helps deliver fresh dulse from Langdon's Newport lab to Ball's Portland kitchen each week. Ball created 14 prototype dulse products, tested them with consumers, and narrowed the field to the top five for further testing—trail mix, rice crackers, salad dressing, sesame seed chips, and smoked dulse popcorn peanut brittle.

Meanwhile, Toombs's graduate students are preparing a marketing plan for this hot new line of specialty foods. Among the many things they'll consider is how to scale production from a few tanks at Langdon's lab to a potential new aquaculture industry for coastal communities. With a plant breeder, a production facility, a research chef, a product development team, a consumer sensory lab, and a classroom full of MBA students, OSU has the entire supply chain to take dulse from production to plate within a year.

"There are few places in the world with this much collaborative talent from start to finish," Toombs said.

And did I mention that it tastes like bacon? | **OAP**

Lynn Ketchum photo

GETTING TO THE MEA

OSU's Lauren Gwin is on a mission to put more locally raised and butchered meat on the table

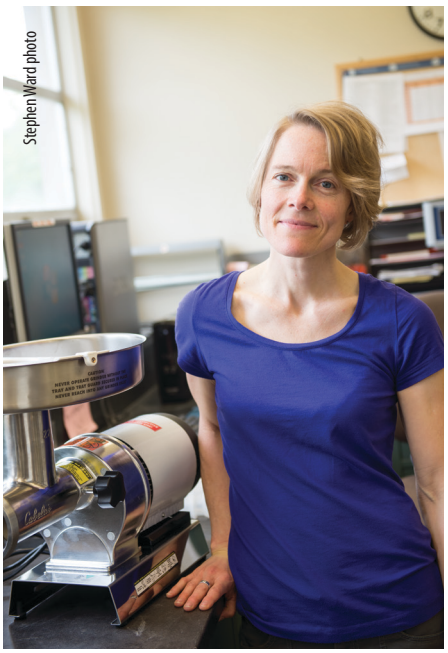
Long before the days of fast-food chains and big-box supermarkets, many people raised their own meat or purchased it from a local farmer. They stocked their freezers with packages wrapped in white butcher paper. The meat was often free of hormones and antibiotics; the cows grazed on grassy pastures; the pigs rooted in roomy pens; and the chickens chased insects in the backyard. The animals had names.

Those days aren't necessarily gone. Relatives of Colin—the hazelnut-fed, free-range chicken from TV's "Portlandia"—can be found at restaurants and markets that offer local meat that wasn't cut, ground, or packaged by large, out-of-state commercial operations. But locally raised and processed meat is still far from being commonplace.

Oregon is home to two dozen slaughterhouses, 59 slaughter trucks, and 87 custom meat processors, according to the Oregon Department of Agriculture's database of licensed businesses. They are part of a closely regulated industry with policies to assure, among other things, food safety. To help ranchers and processors understand policies that affect them, Lauren Gwin and her colleagues with the Oregon State University small farms program offer workshops and one-on-one consultations for people interested in starting or expanding their business. Gwin, a food systems specialist with OSU Extension, is the expert to whom the U.S. Department of Agriculture refers meat processors in Oregon when they have questions about safe production practices.

"My OSU colleagues and I provide the industry with technical assistance and applied research that helps them make decisions about their business," Gwin says. "When they have an idea, they invite me in and I help them think it through. I ask questions and provide information that will turn their big ideas into something that will work. If they say, 'Could we do this with the regulations?' I say, 'Let's look.' We give them the

By Tiffany Woods



Stephen Ward photo

Lynn Ketchum photo

Above: Lauren Gwin, a food systems specialist at Oregon State University, offers support and information to small-scale meat producers through the Niche Meat Processor Assistance Network.

rules of the road, translate them, and let them test out their idea on us."

Lately she has been helping farmers and processors decide what's appropriate for the supply chain. "People often choose an approach that doesn't fit the scale of their operation," she says. "They'll say, 'I want to start a dry-cured salami business and I have six pigs.' But that isn't enough volume to do dry-curing profitably."

When Bob and Lori Mehan, the owners of Cinder Butte Meat Co. in Redmond, wanted their business to become a USDA-inspected butcher shop, Gwin put them in contact with others who had gone that route so they could learn from their experience. And Gwin connected the couple with a computer systems consultant to update their pen-and-paper record-keeping system. "She's a wealth of knowledge and contacts. And she's always asking, 'What can I do to help you?'" Bob says.

To engage more of the community, Gwin co-founded the Niche Meat Processor Assistance Network, which now connects more than 1,000 members. She introduced the network to Cory Carman, who sells about 400 grass-fed cows a year on her century-old ranch in northeastern Oregon. Carman posted a question about beef patty production on the network's listserv. "I got some great responses from people who had similar situations," she says. When Carman wanted to become a wholesale distributor, Gwin wrote a feasibility study that Carman later used to obtain a $200,000 USDA grant to develop marketing materials to expand her customer base.

"She has gone through so many of the ups and downs and provided technical perspective or big-picture brainstorming," Carman says; and adds, "Everywhere you go in the specialty meat world, people are familiar with her work."

In Oregon, the Department of Agriculture knows Gwin's work. She attended hearings and provided technical expertise to lawmakers and the agency when the Legislature considered a bill to exempt people from ODA license requirements who raise and butcher no more than 1,000 birds a year that are sold to consumers at the farm. Once it became law, she wrote a guide on best practices for open-air poultry slaughtering and conducted workshops on the topic. She also helped the ODA's food safety division adopt federal regulations that make it easier for small-scale farmers to process poultry in licensed facilities.

Through her work with consumers and producers, Gwin senses that interest in locally grown and processed meat is increasing. "The question we all ask," she says, "is how do we get this meat into the mainstream and get the right price points?" And that is exactly what Gwin is trying to do—one butcher-paper package at a time. | **OAP**

The seed-to-supper ec

Indigo tomatoes show off the purple anthocyanins they have inherited from their wild tomato relatives, evidence of their high antioxidant potential. This line of purple tomatoes, developed by OSU vegetable breeder Jim Myers, continues to expand as chefs identify distinctive culinary value.

Shawn Linehan photo

onomy

By Peg Herring

Contrary to urban legends, most Oregonians know where their food comes from. Markets and menus advertise the names of farms and fishermen who provide the essential ingredients for our renowned Northwest cuisine.

Food is the handshake between urban and rural communities, the thing most closely shared by all Oregonians. In the business world, this handshake connects the rural economy of farm production with the urban economy of food preparation in an industry worth $21 billion annually in the Pacific Northwest. Innovation in the food industry can begin, quite literally, with the seed of a new idea, the seed of a new vegetable.

Breeding vegetable seed has traditionally focused on developing crops that are high in yield, resistant to disease, and profitable to grow. Profitability of a vegetable has a lot to do with flavor, of course, despite the ubiquity of flavorless supermarket tomatoes. But here in Oregon, flavor counts.

When breeders and growers get together to evaluate new varieties, they evaluate flavor in the most obvious, direct ways: by tasting the vegetables, right there in the field. Where were the cooks who care about blended flavors and eye-popping presentation? And where are the consumers who eat for nutrition as much as for pleasure? The food chain needed extending.

"We needed to get beyond our field tests of 'bite it and rate it,'" said Lane Selman, who organizes vegetable variety trials as a research assistant at Oregon State University. She created the Culinary Breeding Network to complete that food chain, to connect seed growers with chefs and diners. She began the idea in 2010, when she set out to evaluate several varieties of sweet peppers. Selman took the test beyond the field, preparing each variety for tasting—raw, sautéed, and roasted—and invited Portland area chefs and farmers to evaluate the results in the field and in the kitchen.

"The results led to new varieties that provided something for everyone," Selman said. "Chefs got more flavorful peppers, farmers got more vigorous plants, and the seed breeder got increased sales. It became clear how important it is to involve consumers in the plant breeding process."

Selman continued to grow the Culinary Breeding Network, which now connects collaborators from across the country. Last year, she organized an invitational Variety Showcase that brought together the talent and innovation of this new community, as she paired top seed

Innovation in the food industry can begin, quite literally, with the seed of a new idea, the seed of a new vegetable.

Shawn Linehan photo

Above: Mild habañero peppers are one of the newest vegetables to debut from OSU's vegetable breeding program. Breeder Jim Myers has emphasized high fragrance, low pungency, and early ripening to meet the needs of chefs, diners, and growers.
Below: The Variety Showcase encourages experimentation and innovation, as chefs create dishes using the newest works-in-progress of vegetable breeders. Here, chef Earl Ninson, owner of the Portland restaurant Lang Baan, creates a dish with Thai lemon basil developed by Adaptive Seeds of Sweet Home, Oregon.

Stephen Ward photo

Above: Rainbow-colored vegetables adorned the 2014 Variety Showcase, including these beets developed by the University of Wisconsin.
Above left: The test of the seed is in the taste of the fruit. Plant breeders are listening to chefs and diners to develop vegetables full of flavor and culinary possibilities.
Left: Winter squash is a vegetable with enormous variety and nutritional value that OSU vegetable specialist Alex Stone is beginning to explore, in collaboration with cooks and consumers.

breeders with top chefs, as one might pair fine food and wine. Selman asked each chef to develop a dish that explores particular characteristics of a particular vegetable variety; then she invited breeders, growers, retailers, and food writers to taste the next big thing in vegetables.

The conversations around the room went beyond sampling existing vegetables to focusing on desirable traits for future vegetables—color, flavor, nutrition, appearance—that will guide the development of new varieties. These are not rediscovered heirloom vegetables; they are new varieties that are being traditionally bred to meet the demands of growers, chefs, and diners in a world of changing tastes and growing challenges.

Jim Myers, who heads the vegetable breeding program at Oregon State University, was at the showcase with several new types of 'Indigo' tomatoes, the sprightly flavored, nutritionally enhanced purple tomato that he developed at OSU. Chef Timothy Wastell used Jim's tomatoes to create a rich Bloody Mary, sipped through the hollow stem of a new celery variety.

Myers also showcased a new, milder type of fiery habañero pepper. His new peppers have a sweet-tasting heat without the lip-scorching fire. Working with chefs has helped Myers hit the right notes for developing a flavorful new ingredient for Northwest cuisine.

Myers, Selman, and others are extending the idea of farm to table, by connecting two ends of the food supply chain: seeds and diners. By bringing plant diversity into the food conversation, innovative chefs and vegetable breeders are using all their senses, Selman says, including what they hear from consumers. | **OAP**

Karl Maasdam photo

STUDENT ENTREPRENEURS CREATE ARTISAN FOODS AND GAIN JOB SKILLS

By Gail Wells

OSU's food science students are an economic force unto themselves. Student entrepreneurs are designing and crafting artisan-style, commercial-quality meats, cheese, and beer in OSU's labs and serving them up with a heaping helping of enthusiasm. In the process, they're making themselves extremely employable.

Ryan Howe (left) stirs a mash of malted barley in Oregon State University's pilot brewery, while Jason Zeno checks the mash's temperature. Howe and Zeno are students in OSU's fermentation science program.

STUDENT BREWS MAKE WORLD NEWS

Left: Student-brewed beers are winning international recognition.
Above: Compounds in malted barley contribute to beer color, body, flavor, and foam.

Last fall, OSU fermentation professor Tom Shellhammer got a call from Jeff Edgerton, brewmaster at BridgePort Brewing Co. in Portland. Edgerton, an OSU alumnus, was developing a trio of brews to commemorate the company's 30th anniversary. The three-beer project, dubbed Trilogy, was to be a salute to BridgePort's past, present, and future.

Edgerton told Shellhammer that he wanted to inject some youthful energy into the development of the third installment. How about bringing some OSU student brewers on board?

Shellhammer rounded up fermentation science undergraduates Ryan Howe, Robert Proffitt, and Jason Zeno and graduate students Meghan Peltz and Dan Vollmer. They climbed aboard a 12-passenger state van and headed north.

"We've worked with BridgePort before; we've done some of their pilot trials," says Peltz, who's in her second year of a master's program in sensory research of hops and barley. But this, she says, was the first time OSU's fermentation science students had been invited to partner on a commercial product.

OSU's pilot fermentation lab opened in 1996 in response to a need for real-life flavor evaluation of hops. Sensory scientists were trying to identify the best-tasting hops for beer. They soon realized that sniffing the flowers or sipping their nectar "only carried you so far," says pilot lab manager Jeff Clawson. "To find out what these flavors will do in beer, we needed to make beer."

> "I couldn't help but think about how the future of brewing in Oregon, and in the United States, was likely in that room."

On their way to Bridgeport, Clawson and the students threw ideas around. They decided they wanted to shoot for a "sessionable" beer, not too alcoholic, suitable for a lengthy drinking session. They wanted a brown ale with notes of nuts and evergreen. "We wanted it to be like Oregon," says Zeno, who grew up in Pittsburgh. "Earthy, piney, like a hike in the woods."

By the time they sat down with Edgerton, they had a rough recipe in mind. Edgerton liked the way they were thinking and told them to go ahead. "As an Oregon State alum," he says, "I jumped at the opportunity to partner with these students to create Trilogy 3. When we were coming up with ideas for the beer, I couldn't help but think about how the future of brewing in Oregon, and in the United States, was likely in that room."

The students developed the initial recipe and took it through five trials at the OSU pilot brewing lab, making adjustments with each trial. After a bit more tweaking at BridgePort, Trilogy 3 was unveiled: a dry-hopped caramel malt ale, brown in color and rich in flavor, and lighter than the other two Trilogies, coming in at 5 percent alcohol.

In November 2014, Trilogy 3 took a gold medal at the European Beer Star competition in Grafelfing, Germany. "That was a huge deal," says Shellhammer. "We were up against 1,400 entries, and there are very few categories." He believes Trilogy 3 is the start of something big for OSU's fermentation science program. "We weren't just playing," he says. "This wasn't just wishful thinking. There was a spot waiting for this beer to be brewed, and we stepped up and filled it."

Karl Maasdam photo

STUDENTS LEAD THE WHEY

At 5:30 on a Monday morning, Food Science students Eva Kuhn and Nick Hergert wait on the loading dock behind Withycombe Hall on the Oregon State University campus. A small tank truck heaves into view, carrying 244 gallons of creamy raw milk from OSU's dairy center. The students hop down and clamp a sanitary PVC hose onto the tanker's port. They turn on a pump, and in a few minutes milk starts flowing into a steel-jacketed water-bath vat in the Withycombe Hall creamery.

More students arrive in the predawn light. They don hairnets as they prepare the cheese culture, the rennet, and the pressing hoops, settling in for a 12-hour day of making Beaver Classic cheese.

Kuhn loves food and everything about it—she used to compete in "Iron Chef"-style cooking competitions. She got excited about a dairy career when she took a class from Lisbeth Goddik, professor and Extension specialist in dairy processing in OSU's Food Science and Technology department.

OSU food science students Danton Batty, Julia Cresto, and Kyle Lackey muscle the heavy curds toward one side of the vat to squeeze out the whey. OSU master cheesemaker Robin Frojen (in the blue apron) supervises.

The Danish-born, American-educated Goddik has done extensive research on artisan-style cheesemaking in Europe. Five years ago, with financial help from Oregon's cheese industry, Goddik remodeled space in Withycombe Hall into a creamery. She installed a state-of-the-

art Dutch cheese vat and started teaching her students to make mozzarella, chèvre, Gouda, and Camembert-style cheeses in the artisan way—by hand, in small batches, from local ingredients.

The first Beaver Classic cheese—"The Original"—was launched in 2012. Made and marketed by students, it's advertised as Alpine-style with "a nutty, sweet, and subtle flavor... developed during 9 months aging in our natural cheese cave." (The "cave" is actually a big refrigerator where the cheese ripens at a constant temperature and humidity.)

Since then, the students (now guided by OSU cheese master Robin Frojen) have created three more varieties—The Swiss, The Hop, and The Peak—all of which are available plain or smoked. The students sell half-pound wedges of Beaver Classic at the campus creamery on Fridays and peddle them at football-game tailgate parties. The cheese is also available at Market of Choice, Costco, and some Safeway stores, and from the student-run Beaver Classic website.

"What's nice about cheesemaking is that you get to be a part of the entire process," says student cheesemaker Nick Hergert, a junior who's double-majoring in food science and microbiology. Kuhn agrees. "I just love the hands-on aspect," she says. "We start with the raw material—the milk—and at the end of it we have cheese! And if it's good cheese, then ... wow!"


Karl Maasdam photo

Eva Kuhn stacks ten-pound wheels of freshly made Beaver Classic cheese. The Peak Beaver Classic took first place from the American Cheese Society in the mozzarella-style category.

And it *is* good cheese. At last summer's American Cheese Society competition, The Peak proved worthy of its name, winning first place in the mozzarella-style category and beating out commercial entries from all over the United States.

Like all good entrepreneurs, the students keep an eye out for the next big thing. Perhaps it will be ice cream. There was a time when you could get a scoop in Withycombe Hall, at the counter next to where the theater box office is now.

"I was selling cheese at the creamery one Friday," says Hergert, "and this older couple came in and told me they'd met right here. Over an ice cream cone."

"That's too sweet," says Eva.


Karl Maasdam photo

Ten-pound wheels of smoked Beaver Classic cheese jostle for space in the smoker among award-winning hams, bacons, and sausages made and sold by OSU's meat science students at the Clark Meat Center.

In the meat center's tidy retail store, customers might choose from fresh steaks and chops, cooked and uncooked sausages, smoked ribs and jerky, dry-cured salami and mortadella, and even dog treats made from beef hearts and livers and pork skins.

The retail butcher shop has been a part of the Clark Meat Center ever since it opened in the 1970s, says Nathan Parker, a master's student in animal sciences who supervises student workers at the meat center. It's been student-run since 2011, but the products in the store have always been student-made.

"The Clark Meat Center is where animal science students get hands-on experience and practice with every phase of meat processing," Parker says. The steps include careful handling and slaughter

STUDENTS BRING HOME THE BACON

Lynn Ketchum photo

Students Scott DelCurto (far left) and Matt Cugley prepare a customer order in the Clark Meat Center, where student-made sausage, bacon, and ground beef are sold.

of the live animal, safe handling of the carcass, grading and breaking the carcass down into "primals," "subprimals," and retail cuts, and crafting value-added products like bacon and sausage.

and cattle near Roseburg—Cugley didn't know much about the finished product before he hired on.

"It's really interesting to me, to see the anatomy, to learn and practice how to properly fabricate a carcass," he says. And it's a marketable skill, too: Cugley has already been offered a summer job with a butcher near his home.

> The Clark Meat Center is where animal science students get hands-on experience and practice with every phase of meat processing.

Some of the animals are raised by students in OSU's Steer-a-Year club. Others are purchased or donated from outside ranches. All killing is done humanely, in strict keeping with animal-welfare laws and regulations. "In recent years," Parker says, "everybody has wanted to be educated on the whole process, everything from when the animal comes in until the meat goes out through the retail store."

Store work is a sought-after job, and openings are rare, says Parker. The store's newest employee, Matt Cugley, is a senior double-majoring in animal science and communications. Though he comes from cattle country—his family raises hay

Bacon and sausage are staples in the store. "We specialize in value-added products," says Parker. "And we're always tweaking them, trying to add a little special something." Case in point: a succulent chicken-bacon-ranch sausage created by animal science student Claire Logue won a Reserve Grand Champion award at the Northwest Meat Processors Association convention in Seaside.

Graduates who know how to make good food and good drink can walk into a good job, says Lisbeth Goddik. And students become even more employable when they get entrepreneurial experience, working with their peers to brainstorm, develop, make, and sell a product.

"Our mission is to supply Oregon and the world with good graduates," Goddik says, "and that's what we do. And that ***really*** is economic development." | **OAP**

Pacific oysters, like this one in Netarts Bay, contribute $60 million annually to the economy of the Pacific Northwest.

BUILD A BETTER OYSTER

By Gail Wells

Evan Durland photo

"He was a bold man that first eat an oyster," Jonathan Swift is reputed to have said. Bold, or maybe just hungry. Whichever it was, the reward must have been worth the risk, because humans have been prying open oyster shells and slurping down the salty-sweet meat for thousands of years.

The Pacific Coast's cold ocean waters and extensive intertidal zones make for prime oyster-growing country. Oysters are not only good for you (high in protein, low in fat, and packed with minerals), they're good for the economy. Oysters grown in Oregon, Washington, and Alaska have a dockside value of about $70 million a year.

And oysters are good for the environment, too. They're filter feeders that remove particulate matter out of coastal waters and reduce the size of algal blooms. Oyster reefs create habitat for other bottom-living creatures; they stabilize coastlines and help minimize damage from storm surges.

"Oysters are an aquaculture success story. They're one of our most sustainable fisheries," says Gil Sylvia, director of OSU's Coastal Oregon Marine Experiment Station.

The Northwest oyster industry has been going strong for more than a century. Most farmed oysters are Pacific oysters, imported from Japan in the early 20th century after heavy harvesting nearly wiped out the Northwest's native Olympia oysters. Pacific oysters vary widely in survival, growth, and disease resistance. They also vary in shell size, color, and shape, all of which affect the market price for oysters and the efficiency of harvesting and shucking.

In the mid-1990s, Chris Langdon, a shellfish biologist at OSU's Coastal Oregon Marine Experiment Station, started thinking about building a better oyster. Farmers on land have benefited from selective breeding of wheat, cattle, and hundreds of other crops. Why should oyster farmers be left out?

Langdon started the Molluscan Broodstock Program in 1996, with funds from a special federal appropriation. Today Northwest oyster growers are enjoying increased yields and profits from his improved mollusks. Langdon estimates that OSU's better broodstock has increased commercial yields as much as 35 percent. The improvements have pulled an estimated $4.5 million per year into the Northwest's seafood economy.

Breeding oysters is not quite like breeding chickens, Langdon says. "We can control their early life, but we can't control the influences of the environment in which they mature. They depend on natural food and natural conditions."

Oysters start their lives as fertilized eggs smaller than the tip of a human hair. Within 24 hours the larvae grow a tiny, hinged shell. In 2 or 3 weeks, when they are about the size of a grain of fine sand, they develop an appendage and go looking for something firm to attach to—rocks, concrete, ceramic tile. They prefer to settle on reefs of previous generations of oyster shells deposited in the intertidal zone.

Once attached, the young oysters undergo a metamorphosis, emerging as spat—tiny perfect oysters about as big as the point of a sharp pencil. They mature over 2 or 3 years, filtering nourishment from the tides that wash over them and growing about an inch in length each year.

The heavy influence of the environment on the oyster's life cycle, says Langdon, means genetics plays a relatively lighter role. "Most of the traits we were interested in, such as survival and growth rate, are heritable," he says, "but the heritability is very low. So it took us quite a while to see any improvement."

Langdon started his broodstock improvement by collecting 600 Pacific oysters from different areas along the West Coast. Working at a pilot-scale hatchery at the Hatfield Marine Science Center, he began the long process of selection and crossing to develop pedigreed lines. He reared the offspring in the Hatfield Center's pilot hatchery and then planted them out at study sites all along the Pacific Coast, from California's Tomales Bay to Alaska's Prince William Sound. After the oysters reached spawning age, he identified the ones with the best survival and growth, and crossed and recrossed them systematically until he started to see improvements.

> The commercial-scale oyster pod production developed by Langdon was ready for hand-off to the industry.

To ramp up production to a commercial scale, Langdon crossed the top-performing families to produce genetically distinct "pods" of offspring. The pod-production was now ready for hand-off to the industry. A group of partners from the seafood industry have scaled up pod-production and are helping to fund Langdon's ongoing rearing of larvae and spat. "The farmers now have a collection of pods," says Langdon, "and they work with the hatcheries to cross the pods that will give them the qualities they want."

Lynn Ketchum photo

OSU research has led to oysters that are plumper, tastier, and easier to shuck.

Chris Langdon leads OSU shellfish research at the Coastal Oregon Marine Experiment Station in Newport. Improved oysters are more uniform in size and shape.

The project has paid off in plumper, faster-growing, sweeter-tasting, easier-to-shuck oysters, says Paul Taylor of Taylor Shellfish, the nation's largest producer of farmed shellfish and a long-time partner in the oyster-breeding program. "Initially we were going for growth, and that priority has not gone away," says Taylor, whose family has been farming shellfish for five generations. Broodstock improvement has also achieved more-uniform size and shape, which makes harvesting, sorting, and shucking oysters much easier.

Another improvement was coloration of the shell and meat. Now oyster lovers can choose oysters with black shells, speckled shells and cream-colored shells, with meat the color of cream, the color of spindrift, the color of storm clouds. With their variegated appearance and deep, lustrous, meat-packed cups, these well-bred oysters make a stunning presentation. | **OAP**

Acid assault

OSU research has made oysters better and safer. Now we're helping them resist acid oceans.

Langdon is continuing his research with a new mission: to breed oysters that can withstand an environmental assault from acidifying oceans.

Earth's oceans are becoming more acidic as they absorb greater amounts of carbon dioxide from the atmosphere. In 2006–2008, there was a massive, mysterious die-off of oyster larvae in Pacific Northwest hatcheries. In 2012, scientists linked the crash to strong upwelling of the oceans off the coast, which had brought carbon-rich cold water to the surface.

Shellfish are vulnerable to changes in ocean chemistry because they build their shells with calcium carbonate. Langdon is part of a team led by OSU marine ecologist George Waldbusser that found that acidified ocean waters decrease carbonate saturation. The lower the saturation rate of the seawater, the harder it is for the organisms to gather the calcium carbonate they need for their shells.

Within a few months, oyster seed, called spat, have already formed a hard, calcium-rich shell. The ability to form this protective shell is threatened by increasing ocean acidity.

Oysters are particularly at risk because they must race to build their first shells within 12 hours of fertilization. If the tiny larvae have to work too hard to gather calcium during this critical window, they end up with weak, deformed shells and lowered chances of survival.

Fortunately, most commercial oysters begin their lives in the controlled environment of a hatchery where managers carefully monitor the pH of the seawater in which they raise the larvae.

But recent research by Waldbusser and others suggests that acidifying oceans threaten oysters and other shellfish throughout their lives. With funding from the National Science Foundation and Oregon Sea Grant, Langdon has begun a related study to see how different families of oysters respond to long-term exposure to acidic waters.

INGREDIENTS FOR SUCCESS:

ADDING VALUE TO THE FOOD INDUSTRY

Lynn Ketchum photo

Yanyun Zhao is a master of developing unusual food combinations. Her research explores ways to extend freshness and boost nutrition using the most surprising of ingredients. For example, Zhao, a food scientist at Oregon State University, is turning leftover pulp from crushed wine grapes into a natural food preservative, a nutritional additive, and even biodegradable packaging.

The U.S. wine industry crushes more than four million tons of grapes each year, extracting the juice and creating tons of leftover stems, skins, and seeds. A small amount of this so-called pomace is used in low-value products such as animal feed, but most is hauled away at the wineries' expense. These leftovers are packed with valuable nutrition that was literally being thrown away.

Zhao's team has extracted dietary fiber from grape pomace and turned it into a nutritional powder that can be added to foods. She worked with OSU cereal chemist Andrew Ross to test pomace powder in muffins and breads, where it adds a gluten-free boost of fiber and nutrients. They found that pomace flour can replace as much as 20 percent of regular flour without altering taste or texture.

Because the antioxidants in pomace also control microbial growth, Zhao's team has added the powdery fiber to yogurts and salad dressings to extend shelf life by up to a week. And if that's not enough, she is collaborating with Western Pulp Products in Corvallis to mold pomace into biodegradable containers that will degrade quickly in soil, adding their value to the next round of compost.

Zhao finds treasure everywhere. She has extracted substances from blueberry leaves to create an edible coating that adds nutrition and shelf life to fresh blueberries themselves. Blueberry leaves, it turns out, contain high levels of antimicrobials that protect against pathogens, such as *E. coli* and *Salmonella*. To create the coatings, Zhao and an international team of scientists mixed these leaf extracts with chitosan, a natural preservative that comes from crustacean shells. Berries dipped in this clear, flavorless, organic coating stay fresh and juicy up to 25 percent longer.

"We continue to find ways to add value," Zhao said. "One industry's trash can become another industry's treasure." | **OAP**

Chez Marie

An Oregon success story

by Peg Herring

Marie Jensen hadn't planned to go into the food business. But Marie had a veggie burger that friends and family raved over, and with their encouragement, she began the journey that eventually landed Chez Marie's veggie burgers on the menu at Burgerville, on the shelves of 100 Fred Meyer stores, and at grocers and restaurants throughout the Pacific Northwest.

Marie's story begins like that of many other successful food entrepreneurs in this wildly food-centric region: "... and then I met with Sarah Masoni." As the product development manager at Oregon State University's Food Innovation Center, Masoni has helped launch hundreds of successful food businesses, guiding entrepreneurs from recipe to market.

"I worked with Sarah for five months in the research kitchen at FIC, refining my recipe, sourcing suppliers, developing the nutritional label," Jensen said. "There was so much to discover that I didn't know." With help from Masoni and her FIC colleagues, Jensen learned it all: she acquired the requisite licenses and insurance, developed packaging, designed a label, and found her first retail markets.

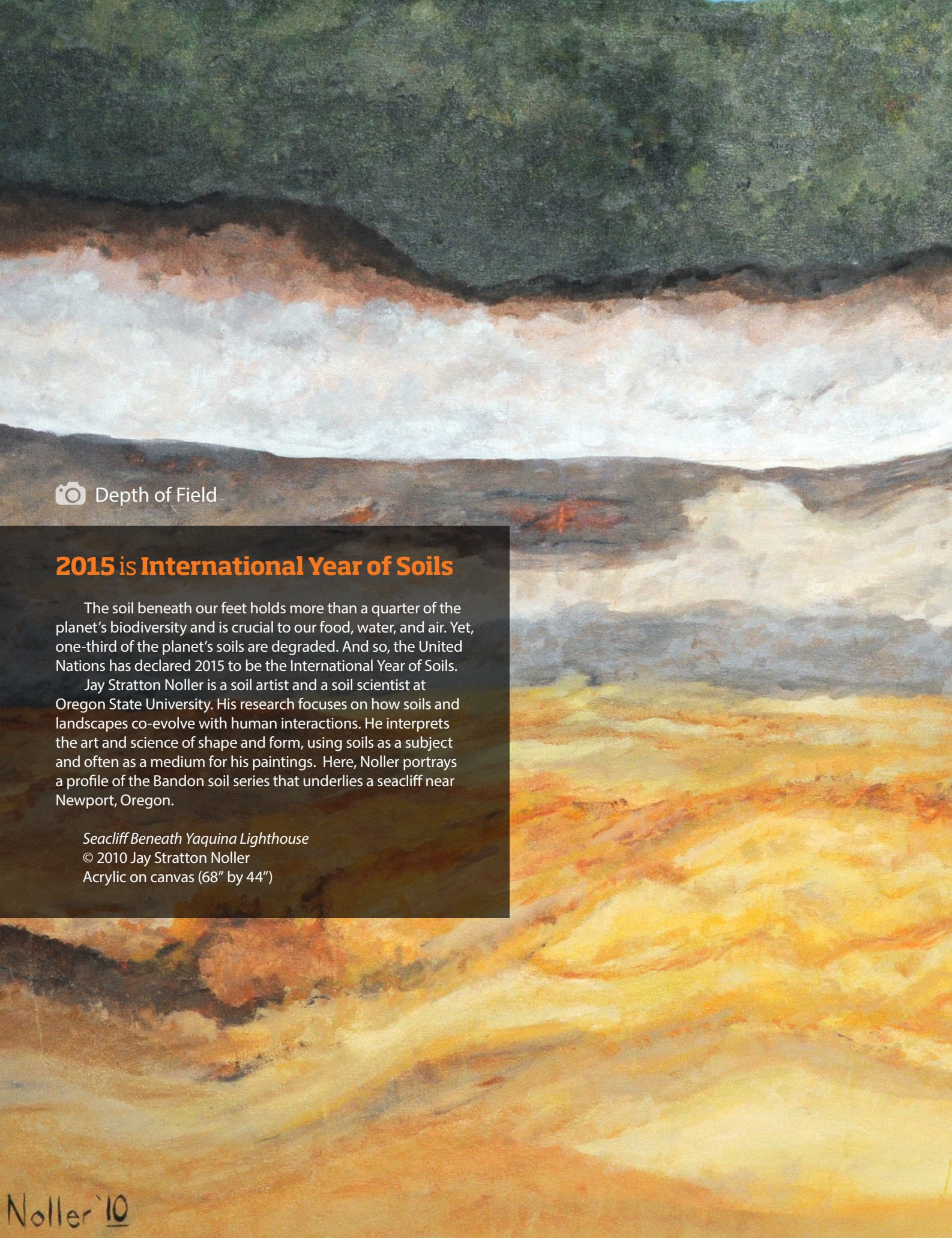
"Eventually I outgrew the research kitchen at FIC, and Sarah helped me set up my own industrial kitchen," Jensen said. Eventually, Chez Marie outgrew that space, too. "Creating delicious recipes with the most nutritious ingredients became my mission and the foundation for everything I wanted to do at Chez Marie," Jensen said.

Jensen and her team at Chez Marie continue to innovate. Her recipes include whole food ingredients and her packaging is fully biodegradable. And she has won awards and expanded her business as far east as Texas.

"I learned an enormous amount at the Food Innovation Center, they were an invaluable key to my success" she said. "They have answers to questions that you don't even think to ask." | **OAP**

Marie Jensen's Chez Marie is a natural food company based in Wilsonville, that specializes in vegetarian, vegan, gluten-free, and GMO-free veggie burgers that even meat eaters love.

Photo contributed by Marie Jensen



Depth of Field

2015 is International Year of Soils

The soil beneath our feet holds more than a quarter of the planet's biodiversity and is crucial to our food, water, and air. Yet, one-third of the planet's soils are degraded. And so, the United Nations has declared 2015 to be the International Year of Soils.

Jay Stratton Noller is a soil artist and a soil scientist at Oregon State University. His research focuses on how soils and landscapes co-evolve with human interactions. He interprets the art and science of shape and form, using soils as a subject and often as a medium for his paintings. Here, Noller portrays a profile of the Bandon soil series that underlies a seacliff near Newport, Oregon.

Seacliff Beneath Yaquina Lighthouse
© 2010 Jay Stratton Noller
Acrylic on canvas (68″ by 44″)

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Stephen Ward photo

Entrepreneurs flock to the Food Innovation Center to develop their ideas and take them successfully to market.
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