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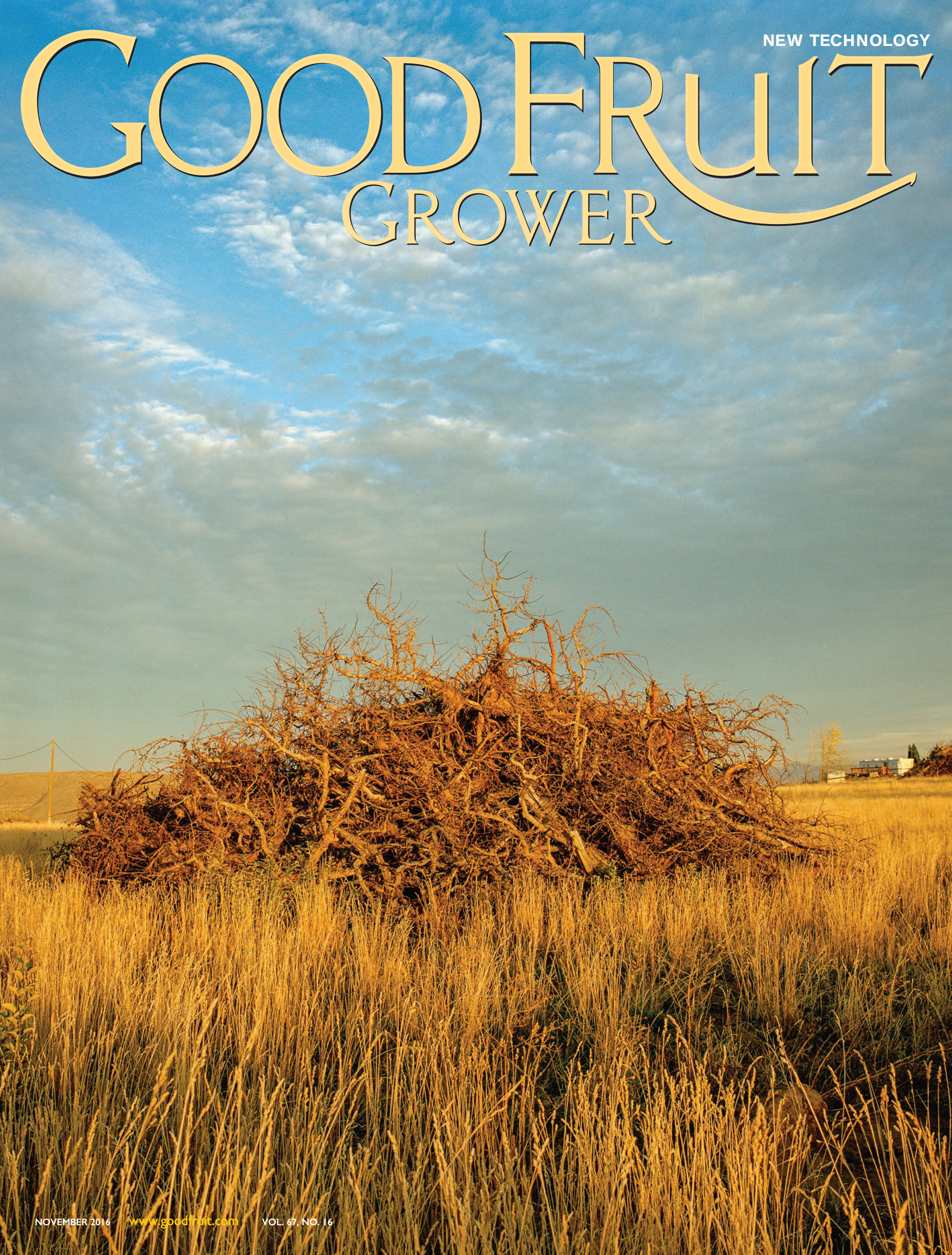

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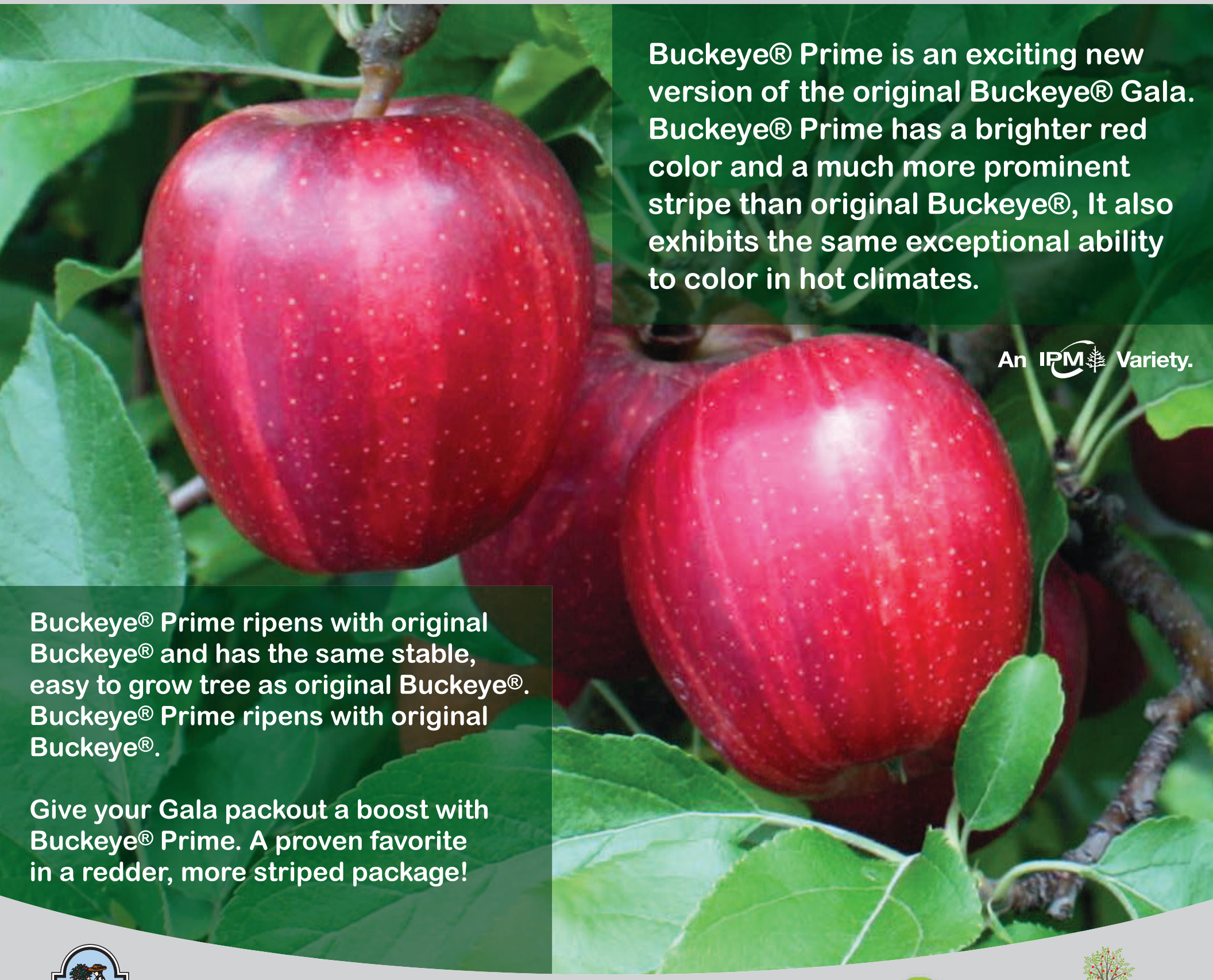

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SHANNON DININNY/GOOD FRUIT GROWER

Workers from Abundant Robotics demonstrated their automated vacuum harvester in an apple block in Vantage, Washington, on Sept. 22. Read more about the harvester beginning on Page 32.

Centerpiece

New Technology

Good Grape Grower

IFTA tour

Last Bite

62 Young grower

Q&A with Pierre Paradis of Silverton, Oregon.

TJ MULLINAX/GOOD FRUIT GROWER

Good Points

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On the cover

"Last Year's Orchard" — apple tree pile in Naches Heights, Washington.

BY JOHN A. KANE, ISSAQUAH & TIETON, WASHINGTON

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Quick Bites

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Canadian bee expert joins OSU

Oregon State University has hired an expert on bee pollinators to fill a new extension position focused on improving the health of honeybees and other pollinating insects.

Andony Melathopoulos comes to OSU from a post-doctoral position in pollination ecology at the University of Calgary in Alberta, Canada. Before earning his doctorate at Dalhousie University in Halifax, Nova Scotia, Melathopoulos spent 13 years in Alberta, working on honeybee pests and diseases for Canada's national honeybee research center. He also studied lesser-known species, including the alfalfa leafcutter bee and wild bees in lowbush blueberry fields in Atlantic Canada and Maine.

COURTESY LYNN KETCHUM/OREGON STATE UNIVERSITY

Andony Melathopoulos, Extension pollinator specialist, watches honeybees at OSU's Oak Creek Center for Urban Horticulture.

Melathopoulos is working with the Oregon Department of Agriculture to roll out a statewide pollinator education and safety plan in the next few months. He is also forging ties with Oregon's commercial beekeepers, farmers, pesticide applicators, urban parks departments and others who play a role in keeping pollinators healthy.

"We want to give people the tools to keep Oregon pollinator-friendly," Melathopoulos said. "If we do our job right, protecting pollinators will merge seamlessly with people's daily life and work."

He joins two other bee health experts recently hired at OSU's College of Agricultural Sciences: Hannah Lucas and Jared Jorgensen. Lucas, who

started her job last November, studies bee parasites and diseases and is assisting with the expansion of OSU Honey Bee Lab's diagnostic services for beekeepers. Jorgensen, who started in March, also helps with bee health diagnostics and conducts field studies in partnership with commercial beekeepers.

The three positions were made possible by a $14 million investment in OSU research and extension by the 2015 Oregon Legislature.

Wine quality research grants available

The Washington State Grape and Wine Research Program is accepting research proposals for competitive grants to improve wine quality.

The grant program is open to principal investigators at all Washington state public institutions with the capabilities to address the research and outreach needs of Washington's viticulture and enology industry. Collaboration with out-of-state researchers is encouraged, but the principal investigator must be located within the state of Washington.

The research program, administered by Washington State University, is funded through a unique public, private and industry partnership. Industry funding comes from the Washington State Wine Commission, which represents all wine grape growers and wineries in the state, and private funding comes from the Auction of Washington Wines. Public funds come from the state liter tax on all wine sold and WSU's Agricultural Research Center.

The research program funded 13 viticulture and enology research programs totaling nearly $870,000 in the last funding cycle.

Research proposals will be accepted through Dec. 12. For more information, visit *cahnrs.wsu.edu*.

USDA OKs Arctic Fuji nonbrowning GMO apple

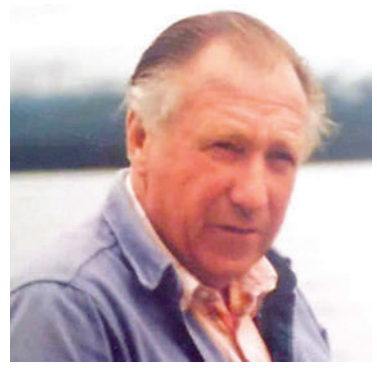
The U.S. Department of Agriculture has approved for public consumption a third genetically modified apple by British Columbia's Okanagan Specialty Fruits: the Arctic Fuji.

The apple joins the company's Arctic Golden and Arctic Granny varieties.

"The response to Arctic Fuji apples and our overall platform to deliver direct benefits to consumers has been encouraging," said Neal Carter, Okanagan Specialty Fruits' founder and president. "We are confident the positive feedback we have received will translate to the marketplace."

The enzyme polyphenol oxidase, the primary cause of browning in fruit, has been reduced in the apples to prevent browning, which is noticeable when the apple is sliced, bitten or bruised.

Longtime fruit industry leader Brandt dies



COURTESY BRANDT FAMILY

Everette Brandt, 1927-2016

Everette Brandt, a tree fruit industry leader in Washington's Yakima Valley for decades, died Sept. 24 at age 88.

Born in Shelton, Washington, Brandt spent most of his years in the Wapato, Washington, area, where he grew up in a farming family and eventually began growing tree fruit on his own farm. In the 1950s, he became the national sales representative for Carlton Nursery in Forest Grove, Oregon, where he worked for a number of years, introducing many new apple and soft fruit varieties into the region.

Along with his children, Brandt formed E.W. Brandt & Sons in 1979. He was among the first growers in the state to grow apples on dwarfing trees, and in the early 2000s, the company obtained the exclusive rights to bring an Australia variety to the U.S. This variety was ultimately trademarked under the brand Pink Lady.

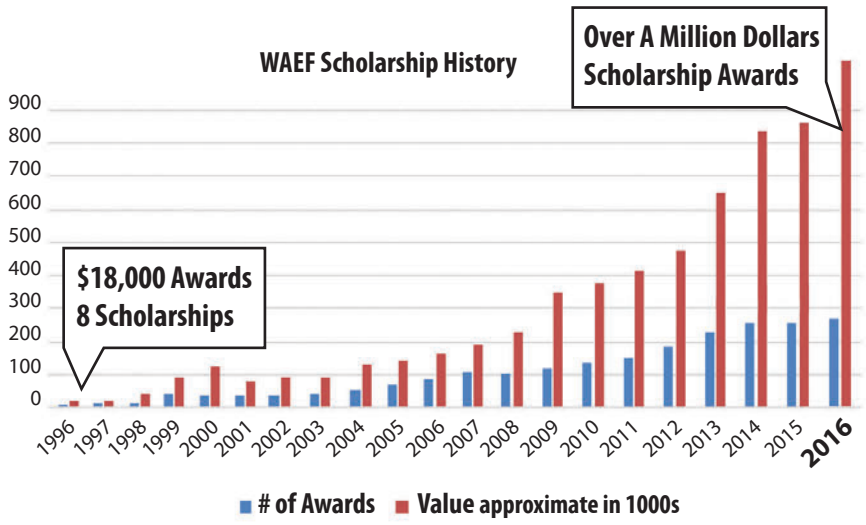
"Dad was always looking for innovation in all that he did. He also instilled a strong work ethic to all of his offspring, " said son Lynnell Brandt, president of Brandt's Fruit Trees, a spinoff of E.W. Brandt & Sons that sells trees and markets new fruit varieties along with a new sister company, Proprietary Variety Management. PVM holds the contract with Washington State University to license to growers, packers and marketers WSU's two new apple varieties, WA 2 and WA 38 (also known as Cosmic Crisp). The first commercial trees of the Cosmic Crisp will be planted by growers in Washington next spring.

Everette Brandt is survived by his wife, Ada, and his four children — sons Lynnell, Allen and Dana and daughter Cynthia Tissell, who now individually own and run E.W. Brandt & Sons, TLC Orchards, Pink Lady America, Proprietary Variety Management (PVM), TKR Orchards and Brandt Fruit Trees — as well as several grandchildren and great-grandchildren, many of whom are also involved with the various businesses.

Growing together

WAEF was founded in 1994 by members of Washington's tree fruit industry to advance the industry's charitable work.

Today, WAEF invests in student achievement, promoting education and support for university, technical and vocational training. WAEF nurtures a network of grass-roots local community services offering ESL programs, citizenship outreach, and Farmworker Family support. WAEF connects the values of tree fruit industry members with good works in the community.



This is a milestone year for the tree fruit industry: over One Million Dollars in scholarship awards. More than 200 young men and women shared in the $1,060,000 awarded in WAEF scholarships.

In 2016 WAEF expanded efforts to identify and assist students pursuing a technical/vocational education aligned with work in the tree fruit industry.

Volunteering is up in 2016: industry member support increased for WAEF student programs and industry charities through committee work, board service and hours spent mentoring and encouraging students.

with your support

Please join Rears and our family of dealers in supporting the Washington Apple Education Foundation. Drop by the WAEF booth at the Washington Horticultural Show, December 5,6 & 7; purchase a raffle ticket to win this year's prize centerpiece: a 2017 400 gallon TTN Powerblast sprayer.

Rears has also donated a 750 series 6' OMF orchard flail for silent auction; all proceeds to benefit WAEF.

For details contact the WAEF: their offices are listed below or visit their booth during the show.

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REARS

Cold, hard efficiency

Matson Fruit leads industry in automated cold storage technology.

by Ross Courtney

photos by TJ Mullinax

Pallets stand five racks high, cramped, dark and sci-fi eerie. Robotic cranes, guided by lasers and bar codes, retrieve the pallets while automatic dollies on a looped track wheel them to and from a web of scaffolding.

No need for people in the catacombs of Matson Fruit's cold storage warehouse in Selah, Washington, where electronics move inventory in tight quarters, staggering heights and near freezing environments with an efficiency way beyond that of a human.

"People aren't so good at it; computers are awesome at it," said Jordan Matson, who oversees packing and shipping for the company.

Matson Fruit is in its third year with a state-of-the-art cold storage facility that uses a mixture of robotic cranes, computerized inventory and automatic dollies to pack pallets of apples and pears higher and denser, with fewer people and less energy than a conventional cold storage unit that relies on people driving forklifts.

Matson, a member of the fifth-generation of owners in the company, declined to share numbers but estimated his family company spent 20 to 30 percent more on the automated warehouse than it would have on a conventional warehouse with the same capacity.

"You have to be pretty tech-savvy, innovative and a little bit insane probably to do this," Matson said. But it's working, he said, and other fruit packing companies in the Northwest are considering similar developments.

Jordan Matson, who oversees packing and shipping for Matson Fruit, stands on a crane at the company's automated cold storage facility in Selah, Washington. Pallets of fruit are automatically stored and retrieved with robotic dollies and cranes instead of forklifts.

Trends and perspectives

The industry calls facilities like Matson's automated storage and retrieval systems, or ASRS.

Matson's cost disparity is on par in the worldwide cold storage industry, said Corey Rosenbusch, president and CEO of the Global Cold Chain Alliance, which is based in Alexandria, Virginia, and represents cold storage companies across the globe. "The technology is not cheap," he said.

But the cost difference between conventional and ASRS facilities is getting narrower in the new age of automation, he said. New construction of cold storage runs anywhere from $115 to $170 per square foot. Conventionally built systems fall on the lower end of the spectrum, with ASRS on the higher end.

The benefits include lower energy costs, cheaper fire suppression, a safer work environment and more efficient use of labor. A 2013 report by a consortium of cold storage industry organizations estimated an annual labor cost savings of $2.7 million per year for a facility with an 18-worker shift and each employee costing roughly

$50,000 in wages, benefits and training expenses. Also, ASRS facilities make more efficient use of space, allowing for three times the storage density of a conventional facility, the report said.

So far, the technology is more common in Europe, where premiums for land and labor are even higher than in the United States, and in the frozen foods industry than among fresh produce packers.

Rosenbusch foresees an increase in the United States and in Washington. For example, German company New Cold has an agreement for a massive ASRS warehouse with a seafood supplier in Seattle, he said, while New Jersey-based Preferred Refrigeration Services built two new facilities last year in Washington and announced an agreement for a third.

However, the rush for this technology may take longer to reach fresh produce. Fresh fruits and vegetables have faster turnaround and producers are less willing to risk damaging delicate products, he said.

Benefits to Matson

Increased storage density is one of Matson's favorite aspects.

For one thing, his company can stack pallets higher and closer together because forklifts struggle to reach high items and need more room to turn around. Meanwhile, people driving forklifts only make use of 70 percent or so of the pallet space due to the imperfections inherent in driving, sorting and moving things around.

"You're always burying something, and — oh, by Murphy's Law — I always need the stuff in the back," Matson said.

The exterior of the Matson Fruit cold storage warehouse in Selah, Washington. The right side of the warehouse, with steel siding and insulation, was built to allow higher stacking of pallets using robotic cranes. The left side of the warehouse, with concrete siding, is similar in size to a standard cold storage facility.

On the other hand, a computer-driven automated storage system makes use of 98 percent of the pallet space. Matson's new facility has five cranes reaching two directions from the aisles. Each crane needs only one empty pallet space to maneuver pallets to reach those in the back.

The robots also allow his crews to more quickly assemble custom orders, cutting down on loading dock space. The fruit industry is in an era of custom packing for buyers who order pallets with say, seven boxes of one variety and two boxes of another, putting pressure on warehouses to quickly retrieve and replace pallets for each order, Matson said.

The company operates the warehouse with 10 to 15 employees per shift, about half the workforce it would take with a conventional facility. All the workers — quality control inspectors and forklift drivers — spend their time outside the storage area in the loading bay. All the retrieving and replacing of pallets happens with the automated dollies and computer driven cranes, all tracked by computer.

"One of the true benefits of this system is pure inventory tracking and keeping control of everything," said Lucas Hanson, Matson's IT director. "Knowing where everything's at. Every single one of these pallet positions, the system tracks."

Added shipping manager Rumsey Abdulla: "And it stays in the cold."

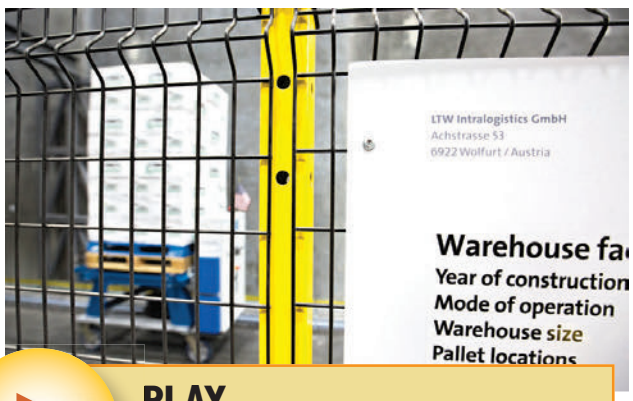
The 66,000-square-foot facility has 4,060 pallet spaces and stands 70 feet tall. Building that much capacity conventionally would have required 150,000 square feet or more. The building also has two empty crane aisles that would hold an additional 1,600 pallet positions for potential expansion in the future.

The company's previous warehouse was built in 1982 when the facility packed 10,000 bins per year. In 2010, facing 150,000 to 170,000 bins a year, the Matsons began leasing storage space from another packing firm but knew they eventually would have to move.

Jordan Matson had heard of the ASRS technology and in 2010 visited a facility in Chicago. It was a tough decision, one made together by Matson, his brother Jason, his

LTW Intralogistics robotic dollies move within a gated section at Matson Fruit's automated cold storage facility. The dollies store and retrieve pallets for arriving or departing shipments.

The No. 4 crane operates in rows about 6 feet wide and can lift pallets five racks high.



PLAY

Ride along with a pallet of fruit as it's moved into storage using Matson's robotic system at goodfruit.com/media

father Rod and uncle Daryl, who has since died. Abdulla and Hanson also participated.

Jordan Matson favored the ASRS, but "I tried to keep my personal opinion masked until the very end," he said.

One of the biggest points of reluctance was not the cost, it was the question, "What happens if it breaks?" Jordan Matson said. They have the capacity to get technicians on a video feed, have trained several in-house mechanics and keep a healthy supply of spare parts available. The company performs 99 percent of the maintenance in-house.

Matson Fruit decided to take the risk and started construction in December 2013, finishing in September the next year in time for the 2014 crop. Austrian company LTW Intralogistics built the crane and robotics system.

Matson and his supervisors admit they have experienced troubles. They struggled to integrate software. Training was difficult at first but is getting better. And the dollies' loop system — a novel approach even for LTW — develops points of instability and wear.

But they would do it over again.

"Automation is the future as it saves on physical space, energy and labor," Matson said. ●

Gentle touch

Dan Harburg

Pneumatic air-controlled gripper may lend itself to robotic fruit harvest.

by Ross Courtney

One of the sticking points in the quest for automated fruit harvesters is how to handle fruit without damaging it. So far, nothing the robotic world has invented can compare to the finesse of the human hand.

The engineers at Soft Robotics, a Cambridge, Massachusetts, automation company, believe they are close, though. They make robotic grippers with fingers actuated by compressed air to gently curl around fruit and produce. They planned to test how it works picking apples from a tree this fall during a trial at the Washington State University's Irrigated Agriculture Research and Extension Center in Prosser.

"We're confident that with the gripper that we've got the right tool for the job," said Dan Harburg, director of business development for Soft Robotics.

For more than three years, Washington State University researchers have been working to develop a robotic hand that could harvest apples. Manoj Karkee, associate professor of the university's Center for Precision and Automated Agricultural Systems, said he and his colleagues have developed a three-fingered mechanical prototype that works, but probably not as fast as Soft Robotics' air-powered version.

"They have the advantage of speed," Karkee said, but he said he is eager for more studies to see how fast the Soft Robotics version moves in the orchards.

The university's robotic hand, mounted to a Gator, harvests about 85 percent of the apples at a rate between 5 and 6 seconds per apple. Karkee's goal is 2 to 3 seconds per apple, he said.

Later this season, Soft Robotics planned to visit Karkee for trials of the rubber gripper in Washington orchards to see

Soft Robotics demonstrates its air-actuated gripper in the robotics company's Cambridge, Massachusetts, laboratory. The company planned a trial with Washington State University on ripe fruit in the orchards this fall.

COURTESY OF SOFT ROBOTICS

how fast their tool can go and exchange any other details about their respective robotic hands.

Robots can't do everything

With either version, robotics are still a ways from putting pickers out of work, Harburg cautioned.

Robots don't do everything pop culture makes them appear to do, at least not yet. They work best in controlled environments in which the produce is brought to them on a conveyor belt, not when they must move around throughout an unstructured and varied environment, such as an orchard. They don't do two-handed tasks. They don't collaborate with humans at speed. And for all their sophistication, they still are limited in selecting and inspecting a good piece of fruit in the orchard, passing over a less savory one, the way an optical sorter can do inside the packing shed.

"That kind of complex product sorting … is challenging," Harburg said.

The Soft Robotics hand is being used commercially in bakery warehouses and plastics plants and to handle consumer packaged goods. They are still in trials at food packing facilities for mushrooms, tomatoes and strawberries. "We are just at the beginning of evaluating the Soft Robotics gripper," Richard Harnden, director of research for Berry Gardens, one of the United Kingdom's largest berry and stone fruit production and marketing companies, said in an email. "Regrettably, it's far too soon to make any informed comment."

"We're going to see an explosion in what robotics can bring."
— Dan Harburg

The mobility and vision for orchards and fields will come next for the robotics industry. In fact, the company has tested its hand on apples, Harburg said, placing them on a sample tray at the November 2015 Pack Expo in Las Vegas.

"I think all this stuff is coming quickly," Harburg said.

Harburg showed the gripper at the Precision Farming Expo in January in Kennewick, Washington, sharing pictures and video of the rubbery digits deftly lifting and moving ripe tomatoes, mushrooms and cupcake papers. Others picked up sticks of celery and carrots in different orientations, arranging them in a uniform formation.

The challenge is more than just delicate surfaces, Harburg said. Robots can be made gentle and precise. The automotive industry uses them for tasks both heavy and light. Even in the food industry, robots frequently stack boxes or shrink wrap products. But all those tasks involve repetitive motions with objects of similar dimensions. Food in the fields — cherries, apples, eggs — are unique.

That's one area the "octopus inspired" gripper could fit, adapting to a variety of shapes and sizes, he said. With rising costs of labor and increased food safety scrutiny, more robots may be on the way for farming.

"We're going to see an explosion in what robotics can bring," Harburg said. ●

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Up in the air

Gary Licquia launches a SenseFly eBee unmanned aerial vehicle, or drone, equipped with a multispectral agricultural sensor during the Ag Drone Rodeo in August in Pendleton, Oregon. Licquia Integrated Controls, one of several groups demonstrating drones for agricultural use in a field adjoining Linn Airfield.

Even with recent advancements, drones are not quite ready for optimal use in the tree fruit industry.

by Ross Courtney

Listening to drone manufacturers, researchers and enthusiasts, you would think they are revolutionizing agriculture tomorrow.

"This is like Kittyhawk," Jeff Lorton of Oregon UAS Future Farm announced to a giddy crowd watching demonstrations of unmanned aircraft at a recent conference he staged.

Sort of.

Listen closely. Those insiders still use phrases like "what if" or "envision" or "potential." In spite of rapid advancements, drones still aren't quite there for widespread use in tree fruit and wine grapes. They have shown promise with drying cherries and chasing away birds, for example. And in theory, researchers can now from the air detect the difference between healthy and not-so-healthy trees using drone imagery.

But sensors still have yet to accurately and consistently measure tree health over wide areas, anticipate yields or identify pest pressure, and they can't make any diagnoses from above. Even ardent supporters admit they still have work to do when it comes to helping tree fruit.

"Apples are tricky — really, really tricky," said John Sulik, applications specialist with MicaSense, a Seattle company that makes drone sensors and software for agricultural purposes.

An August event in Pendleton, Oregon, called the Ag Drone Rodeo, attracted 250 people to watch vendors demonstrate the flying of unmanned aerial vehicles, often called UAVs or drones. The first day, at a test strip near the airport, focused on the flying, while the second day centered on how to make use of the flight data generated by a drone. It was organized by Lorton, project manager for the Oregon UAS Future Farm, a real-world test range for drone and sensor manufacturers.

PLAY
Watch different drones demonstrated at the Ag Drone Rodeo at *goodfruit.com/media*

Most sensors attached to drones rely on light reflection — both visible and invisible, including near-infrared wavelengths — to create a map of a field or orchard. Tree canopies with varying heights and shadows throw off those sensors. Also, Federal Aviation Administration regulations require a line of sight between drone and operator. To comply, orchardists often need to stand on a lift, ladder or nearby hill. Then, for drones to be cost effective, growers would have to use them over a wide area.

"The problem we're having: The battery life on those is so short we're not able to make it through even a couple of vineyards," said Jenn Smithyman, precision agriculture specialist for Ste. Michelle Wine Estates near Prosser, Washington. The company, the third largest premium wine company in the U.S., uses a variety of imagery from manned flights over 8,000 acres every year.

She suspects smaller boutique growers may be using the drones, "mixing their recreational activities with their farming jobs," she said. But she and others in the industry like the direction drone technology is headed.

"We're still a few years out, but we're almost there," said Alex Ott,

TJ MULLINAX/GOOD FRUIT GROWER

works as a mapping product manager for RDO

executive director of the California Apple Commission. The Fresno-based group has sponsored several pending research projects into the use of drones in apples and blueberries, also represented by the commission. Among them: studies into mapping, detecting pest pressure and targeted spraying.

The current state of drones

Some growers use UAVs commercially now, though not extensively. Washington growers have deployed drones to chase away birds, California wine grape growers have begun spraying with unmanned flights, and an Oregon viticulturist has used a drone to map future plantings and measure elevation for an irrigation project *(see "Test Flights" on Page 24)*.

Earlier this summer, Yamaha Corp. agricultural vendors sprayed fungicide on wine grapes in California's Sonoma and Napa counties with the RMax, an unmanned helicopter with a 10-foot

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One of three 3DR Solo drones lands in front of spectators. The 3DR drones, equipped with GoPro cameras, were flown together to show how multiple drones could be used together to quickly collect agricultural data from the air.

rotor span, marking the first time a drone has been used for commercial spraying in the United States. The work stemmed from three years of trials with the University of California-Davis.

The results were encouraging, Brad Anderson, manager for Yamaha's U.S. unmanned systems division, said in a phone interview. The company plans to expand next year after setting its price schedule. However, the unmanned flights can't cover anywhere near the same amount of ground as a conventional crop duster. "We are a much better platform for smaller fields, tight spacing, hillsides, things of that nature," Anderson said.

The company has been using the unmanned helicopters to spray crops in Japan for 20 years and currently operates about 2,400 unmanned helicopters in that country. In the U.S., it has six.

Most other drone work is still in the research arena. In July, Washington State University researchers from the Center for Precision and Automated Agricultural Systems used an octocopter — an unmanned helicopter with eight rotors — to collect overhead images of a test block during an apple fire blight resistance trial at the Columbia View Orchard in Wenatchee. Researchers are still analyzing data from those trials.

Last year, the Yamaha RMax group worked with researchers at WSU's center to dry cherries grown on modern architecture at Washington State University's Irrigated Agriculture Research and Extension Center in Prosser. It worked. The unmanned helicopter removed water from cherry trees at a rate of 5.4 to 11 acres per hour depending on flying speed, more than the 3.7 acres per hour a grower would do with a tractor-pulled airblast sprayer, but much less than the 18.5 acres possible with a manned helicopter.

Drone up

Interested in using a drone in your orchard now? The Federal Aviation Administration recently made the permission process easier.

In late August, the FAA opened up applications for a Part 107 waiver, which allows a broad range of commercial activity for operators of unmanned aerial vehicles under 55 pounds.

In the past, the FAA required anyone who wanted to use a drone commercially to apply for an exemption for a narrowly defined specific purpose and place — the "Section 333 Exemption," in regulation parlance. That exemption is still required for aircraft above 55 pounds, which includes the Yamaha RMax, the only drone so far big enough to carry pesticides or dry off cherries with its downwash.

To find out more about Parts 107 and 333, visit this comparison sheet on the FAA website: *www.faa.gov/news/updates/?newsid=86285.*

—R. Courtney

TJ MULLINAX/GOOD FRUIT GROWER

Jeff Lorton, the coordinator of the Ag Drone Rodeo, welcomes attendees to the event.

The experiment, published in April this year in the journal *Computers and Electronics in Agriculture*, used cherry trees after harvest and wetness sensors that mimicked leaves, an indirect indicator of the water that would be on cherries. The group has applied for U.S. Department of Agriculture funding to repeat the test using a sensor that would measure cherry wetness in the stem bowl and tip more directly, said Lav Khot, an assistant professor for the center.

He also has used the drone to help collect data regarding vineyard canopy health and temperature for a subsurface irrigation trial in the fields near the Prosser facility. "For me, a drone is just a tractor," he said.

TJ MULLINAX/GOOD FRUIT GROWER

A spectator records the takeoff of Aerial Technology International's AgBot during a presentation. The quadcopter demonstration highlighted ATI's AgPlanner software to help growers plan consistent flight patterns for data recording over time.

The future

To overcome shadows in tree canopies, Khot's colleagues are toying with the idea of flying drones low, between rows, scanning horizontally to estimate yields or pre-identify fruit for an automated harvester. Manoj Karkee, another researcher at the center, has filed an invention disclosure with the university's commercialization office, a precursor to pursuing a patent.

"There is so much possible with UAVs," Karkee said.

What about those pesky birds? He envisions tying remote sensors to a computer program that would detect birds and automatically deploy the drones to shoo them away. Same goes for elk and deer.

Meanwhile, better sensors are on the horizon, according to Young Kim, CEO of Digital Harvest, a Virginia precision agriculture company. At the Drone Rodeo, he compared the gap between current and future sensors to the difference

TJ MULLINAX/GOOD FRUIT GROWER

A Yamaha RMax UAV flies a prearranged flight path to spray from two tanks filled with water over a field. The capacity of each tank is about 2 gallons.

between X-rays and MRIs.

"We're sort of at the X-ray stage today," he told the crowd.

So far, the multispectral sensors used on drones can detect light reflection, but nothing that can be tied to a certain problem or disease. A commonly used tool is the Normalized Difference Vegetation Index, which combines visible and near-infrared light readings to detect relative amounts of healthy vegetation. Shadows, reflective ground cover, sunburn protectants, cover crops and even moisture on the leaves can throw off those measurements.

Kim envisions a possible switch from multispectral imaging to hyperspectral imaging, an ultra-high resolution technology that can identify unique electromagnetic "fingerprints" of different diseases or pests. Oil companies use hyperspectral sensors to help spot underground reserves. However, hyperspectral imaging requires an enormous amount of processing capacity, which in turn would require upgrades in bandwidth and connectivity for drones and operating computers to handle.

For now, Kim and Digital Harvest have a partnership with Yamaha that allows them to operate in Washington and Oregon and eventually offer aerial monitoring and spraying services. The company is pursuing permits from the FAA and pesticide applicators licenses from both states to make that a reality. However, even if they had that paperwork in order today, "I wouldn't go to the tree fruit industry right now," he said in a follow-up interview with *Good Fruit Grower*.

Instead, he said he would stick with potatoes or another crop that would benefit from spot spraying. "As much as people are anxious to want something now," the technology just isn't quite there yet, he said. "We got a lot of learning to do." ●

Test fligh

Oregon viticulturist tests, uses drone technology.

by Ross Courtney

photos by TJ Mullinax

Chad Vargas bought a drone just as an experiment, but he's using it for all sorts of chores on his Newberg, Oregon, vineyard.

He uses the DJI Phantom 4 quadcopter to measure slopes, scare off birds, monitor bin logistics and string marking ribbon across rows, saving himself the hike.

"I carry it in the truck all the time," said the viticulturist and vineyard manager for Adelsheim Vineyard.

As for making spray, irrigation and harvest decisions based on aerial imagery — the reason he obtained the unmanned aerial vehicle and a Sequoia multispectral camera in the first place — he's not so sure.

"I'm skeptical of that myself," said Vargas, who manages Adelsheim's 230 acres of estate vineyards in northwest Oregon's Willamette Valley. The company is best known for Pinot Noir, Chardonnay and Pinot Gris, but also grows Auxerrois, Pinot Blanc, Arneis and Syrah on a vertical shoot positioning system trellis with 5-foot spacing and 7 feet between rows.

Most of the estate is laid out in small vineyards of about 20 acres each, lending themselves to experimentation with small drones.

PLAY
Learn more about how Chad Vargas uses the DJI and MicaSense sensors at *goodfruit.com/media*

Chad Vargas holds his DJI Phantom 4 drone above a color and light registration book to help calibrate the multispectral camera before flying and recording images of Pinot Noir grapes in Newberg, Oregon. Vargas says the multispectral images captured by drones help him spot potential troubles, such as in the row shown below, which is overstressed. He also says drones not only help troubleshoot current problems, they also gather data that can be compared over multiple years.

Chad Vargas demonstrates his modified DJI Phantom 4 drone from the back of his truck.

The winery bottles 40,000 cases of wine each year, purchasing grapes from off-site. However, Vargas manages only the Adelsheim acreage.

Vargas is known in Oregon for testing and tinkering with new technology. He was one of the first in the area to experiment with thermal, or hot air, treatments on grapes. He grew up on an Environmental Protection Agency research farm where his father worked and first studied civil engineering before returning to agriculture.

He purchased the drone for himself, but Seattle sensor and analytics company MicaSense issued him the camera to test whether he could use it to guide his decisions about where to pick and when, as well as troubleshoot problems related to fertilizers, irrigation and pests. His ultimate goal is to use the images taken from the air to measure chlorophyll development, note when it begins to drop off, connect that to a corresponding slowdown in sugar development, determine if his fruit is mature and send pickers out to harvest in specific spots.

Connecting all those dots is a big question mark, he said. "Whether we can get it so good that winemakers will trust this."

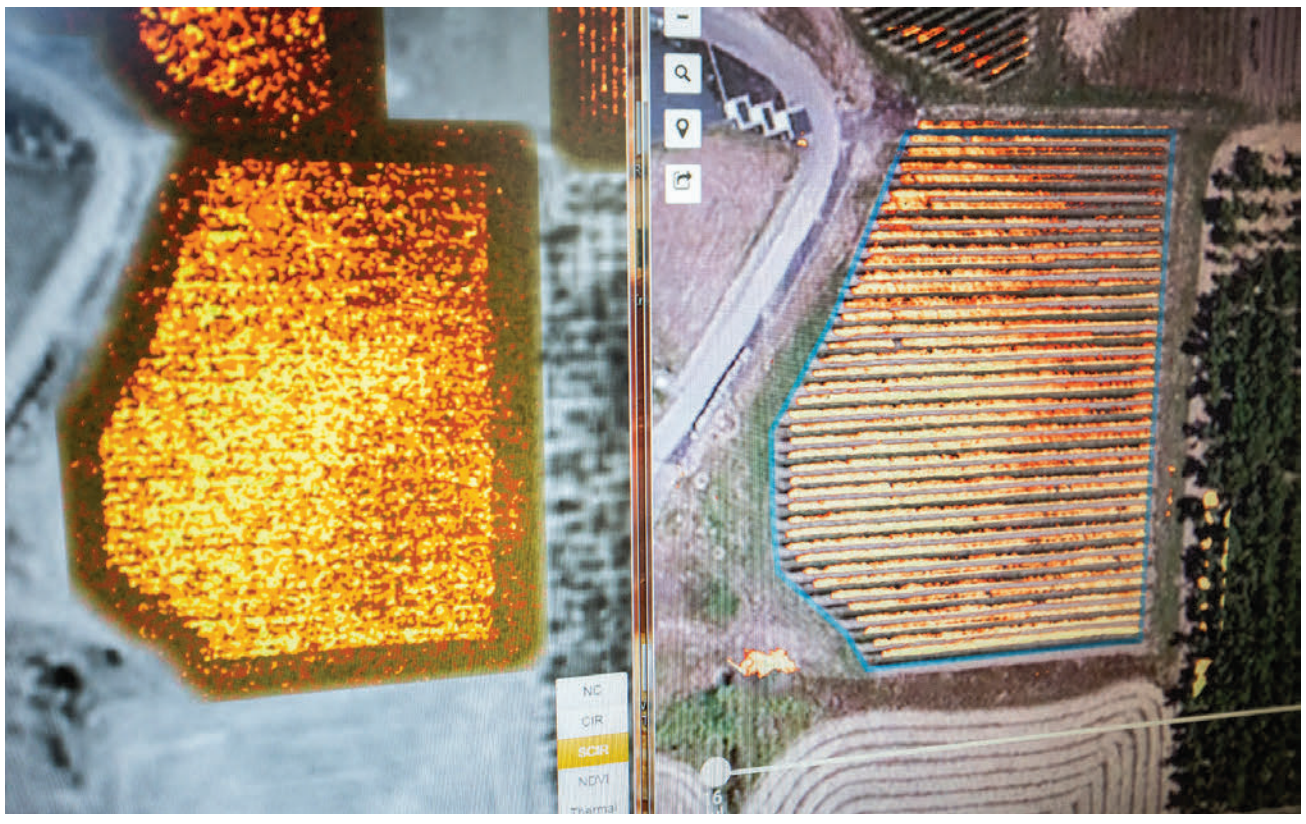
Even large growers have reservations.

"I think that the technology just isn't there yet," said Jenn Smithyman, precision agriculture specialist for Ste. Michelle Wine Estates in Prosser, Washington.

So much of drone technology, though exciting and developing rapidly, still is yet to come for tree fruit and wine grapes due to limitations of imagery indexed from multispectral cameras, such as the Sequoia camera and most others currently mounted on drones. Vargas views his drone work as paving the way for that future.

"What I feel like I'm doing is prepping for the next generation of sensors," he said.

Some in the drone imagery field suggested mixing drone imagery with ground-based methods, such as mounting a camera to a Gator and taking pictures as it drives down the rows. Others suspect more advanced hyperspectral sensors will provide the next step to make drones more useful.



At left, images captured from a fixed-wing aircraft (far left) and from a DJI Phantom drone using the MicaSense camera. These images were captured at the same location in the same time period, showing foliage density in the vineyard. Because the drone image data is much higher resolution than the data from a fixed-wing aircraft, Vargas says it helps him better manage his vineyards. At right, Vargas mounts a multispectral camera by MicaSense to a DJI Phantom 4 drone before flying, as seen above.

"We need a different sensor," said Young Kim, CEO of Digital Harvest, a Virginia precision agriculture company, at an August conference in Pendleton, Oregon. "The multispectrum sensor is just too crude."

Vargas also is testing out the drone to delineate the price points of wine by vine vigor from the air, something he does from fixed-wing aircraft now. Lower vigor vines tend to produce better fruit, so he uses the aerial imagery from manned planes to find those areas and tell his pickers where to prioritize.

However, the resolution is low. Drone imagery resolution, on the other hand, might allow more specific instructions.

The Phantom runs about $1,500, and the camera about $3,500, he said.

"It pays for itself very quickly when you can go from a $30 bottle to a $65 bottle," he said. ●

Good Point

Vicky Scharlau, **Washington Association of Wine Grape Growers**

Advocacy: Slow, incremental, and over time

It seems we are the victims of our own inaction. This month we will vote for America's next president and yet, at this writing, neither candidate has shown more than a slight nod to the industry that feeds the world, reliably and safely.

The same lack of understanding can be seen at the state level. In September, one editorial noted that when California Gov. Jerry Brown signed a law making farmworkers eligible for overtime pay after an 8-hour day or 40-hour week, it was scorned by grower groups who pointed out that the decision wasn't rooted in the real, seasonal world of agriculture. The editorial pointed out that, sadly, to compete, growers would need to cut jobs to keep prices down.

But even worse, the grower groups mentioned were expecting to meet with the governor before he took action, and even the California Department of Food and Agriculture said the decision was outside its jurisdiction.

How did agriculture and its issues become so insignificant? Are decisions being made for agriculture because we're not at the table?

Likely, yes. Farming is an all-in proposition. It is 24-7 and 365 days a year. Who has time to take several days in a row to drive to the state capital, or worse, fly to Washington, D.C., to advocate for your industry, for your livelihood? Aren't there other groups that do that?

Well yes, there are. And most of them are advocating against your position. Without your voice, your advocacy, only one side of an issue is heard.

Advocacy. Government affairs. Though government affairs might conjure up even greater muddiness, it is perhaps a more descriptive term for taking industrywide challenges to the Legislature, Congress, state or federal agency. Whether advocacy or government affairs, the goal is to promote an environment beneficial to a crop or an entire industry. The Washington Association of Wine Grape Growers (WAWGG) was formed in the early 1980s, and shortly thereafter board minutes included discussion and action on topics ranging from labor, trade and excise taxes to pesticide use, research funding and exports.

Over the years, and as the industry has grown in size and significance, WAWGG has worked on a more deliberate process to engage and influence decision makers, stakeholders, and other relevant audiences to support or implement actions that contribute to the well-being of the Washington grape and wine industry. The change could be governance, regulatory (some form of institutional function), practice, attitude, behavior or power. However, change or action is often slow, incremental and over time.

Over the years, and as the industry has grown in size and significance, WAWGG has worked on a more deliberate process to engage and influence decision makers, stakeholders, and other relevant audiences to support or implement actions that contribute to the well-being of the Washington grape and wine industry.

In the past half-decade, WAWGG has become yet more intentional about government affairs, starting with the hiring of a well-known and respected lobbyist based in Olympia, Washington, and then by creating a formal partnership with another wine grape association for a more unified voice at the national level.

Advocacy and issue work is challenging and frustrating as it includes a great deal of "process" work. A group has to agree on much before getting into the "fun" of politics. While it may seem intuitive to begin with the issues, the first step is agreeing on definitions and then creating a standardized process to allow consistent and systematic engagement for industry members. Once a process is established, the steps to identify and prioritize issues are next. Even at this point the work is just beginning. The board must identify the role to take on a given issue and determine resources to support the role. Do we own or drive the issue? Are we trying to influence the issue? Are we just participating in the process with many other groups or merely disseminating information out to the industry so they are aware? And, of course, one option is just to remain neutral and have no opinion.

TJ MULLINAX/GOOD FRUIT GROWER

The Washington Association of Wine Grape Growers (WAWGG) and the Washington Wine Institute are presenting an "Issues Caucus" on Nov. 9.

Recently, the WAWGG board had a robust discussion about several issues facing the industry. Often the decision about an issue is intuitive, but with complex issues that affect a vineyard differently than a winery, the process requires deliberate and intentional thought and analysis. Consequently, since then, we have established a checklist to determine when we weigh in on an issue:

—Does it have a financial impact on or to grape/wine industry business?

—Is it an impediment to grape/wine industry business?

—Does it impact the grape/wine industry reputation?

—Does it solely impact the grape/wine industry? (If not us, who?)

—Will the voice of the grape/wine industry on the issue make a difference?

—Does the issue hurt or build grape/wine industry credibility?

On Wednesday, Nov. 9, not so coincidentally just after the election, WAWGG and the Washington Wine Institute are teaming up to present an "Issues Caucus" for the Washington grape and wine industry. To be held in Yakima, Washington, to allow easier access from both sides of the mountains, the daylong workshop will cover issues facing the Washington grape and wine industry at the state and national level and feature not only our own lobbyists in Olympia but also Michael Kaiser, director of public affairs with WineAmerica, and Joe Bischoff, a Ph.D. with Cornerstone Government Affairs representing the Winegrape Growers of America, both based in Washington, D.C. The day also has two keynote presentations: One on water availability for vineyard expansion and the other on Washington's winery wastewater general permit.

Please make your voice heard and weigh in on the issues most important to your industry.

Vicky Scharlau is executive director of the Washington Association of Wine Grape Growers.

The long and tricky p to automated

Vacuum picker under development brings the apple industry closer than ever to automating harvest.

by Shannon Dininny / photos by TJ Mullinax

It's no secret that hired labor is the most significant variable cost in apple production, representing as much as half a grower's total production costs, and many labor-intensive tasks are time sensitive.

None more so than harvest. Decades ago, as Washington growers faced a shortage of workers, the industry identified harvest automation — development of a machine that could pick the fruit as quickly as people could without damaging trees or bruising fruit — as a research focus. Yet today, even though some growers have deployed modern mechanical platforms to speed workers and reduce the risk of falls from ladders, thousands of people are still needed to manually pluck apples from trees each season.

So, when might automation of apple harvest become a reality? Perhaps sooner than you think. A vacuum harvester under development by Abundant Robotics of Menlo Park, California, has the apple industry closer than it's ever been to fully automating harvest — a potential game changer for growers and the industry at large.

Abundant CEO Dan Steere is careful about making any pronouncements that could sound like promises to the industry. Though the company is moving into a commercialization phase with its technology, it still has work ahead to perfect the machine. But the goal is to have the first such harvester working commercially in orchards in 2018.

A long process

Evolving technologies have been gradually changing the way the apple industry does business for years. Advancements in optical scanning and robotic systems are elevating packing houses to new levels of efficiency and production. In the orchard, growers are employing temperature and moisture sensors, GPS technology and aerial imaging to better manage orchards and quickly recognize problems.

Picking fruit is another story. An orchard is not a standardized work environment, and any number of variables, including ground slope, trellis type and angle, pruning style and even weather, complicate mechanization efforts. In addition, the human mind makes hundreds of minor decisions in the orchard each day, something a robotic harvester must be able to do as well.

"We're asking a lot when it comes to something as complex as an automated harvester," said Jim McFerson, director of Washington State University's Tree Fruit Research and Extension Center and former manager of the Washington Tree Fruit Research Commission. "But when you really examine any major technological innovation — I suspect it's true in areas of agriculture and many other areas — it doesn't seem to come quickly or smoothly or ever ahead of schedule."

The Research Commission, which identified an automated harvester as a research focus as early as 1969, has helped to fund several research projects toward that goal over the years, but there have been challenges:

Development of an automated tomato harvester in the 1960s raised concerns about the societal impacts of mechanizing horticulture and displacing thousands of workers. Enthusiasm — and in some cases funding — waned for automation research, creating a gap in graduate students, scientists and engineers to help develop automation technologies for agriculture. "We haven't really caught up," McFerson said.

A gulf between research and application creates a high hurdle for anyone looking to bring a product to market. "It's so difficult to get through this no-man's land, and there's extra effort you have to go through to close this gulf," said

A Fuji apple is sucked from a tree by an automated vacuum harvester built by Abu

path picking

"We're asking a lot when it comes to something as complex as an automated harvester. But when you really examine any major technological innovation, it doesn't seem to come quickly or smoothly or ever ahead of schedule."

—Jim McFerson

ndant Robotics. Read more about how the harvester works beginning on Page 36.

"If the old system is working reasonably well, the new system that is going to replace it is going to have to work significantly better. You don't change to get the same effect. You will make the incremental change if you can do it faster, better, cheaper."

—Jim Doornink

Jim Doornink, a longtime grower in Washington's Yakima Valley and board member of the Washington Tree Fruit Research Commission. Often, technologies developed for other industries with greater likelihood for widespread adoption are refined for agriculture, he said, such as the sensor technologies and electronics that were adapted for packing lines. "Then, somewhere in there you have to convince the vendor, who is oftentimes in opposition to the idea, that there's a million units that can be sold, enough that they should make the product," he said.

It's also taken years for the technology — the cameras, sensors and engineering — to catch up with the idea of an automated apple harvester.

Pursuing the goal

Three years ago, a researcher for SRI International, an independent, nonprofit research and development organization with headquarters in California's Silicon Valley, began a research project to develop a robotic apple harvester. That researcher, Curt Salisbury, grew up on the edge of southeast Washington's apple country and saw the potential.

A consultant to SRI's ventures group, Steere joined the team in spring 2015 and, after about six months together, he and Salisbury spun off a new company with a goal of commercializing the still-under-wraps technology. They launched Abundant Robotics five months ago with investment capital largely from investors in Silicon Valley.

Steere noted the U.S. tree fruit industry is extremely sophisticated in multiple ways: horticulturally, operationally and in the types of available data that are typical of well-managed orchards. "The better those management practices are, the better equipped people are to both make decisions about what automation can help with and to implement them," he said.

Abundant Robotics has worked closely with a cross section of the apple industry, both in the U.S. and abroad, to understand the needs and learn how to best apply the technology to meet multiple demands. The engineering requires a design that's reliable, hits a certain cost and performance targets, and that single piece of engineering must integrate and function alongside a lot of other systems. "We've spent a lot of time in the last couple of years just trying to learn about different orchard systems and then trying to understand what systems work best," Steere said.

In other agricultural systems, if an automated harvester gets to the point where damage to the plant or the produce is minimal, then automation has happened. "But for all the sectors where the produce can't withstand that kind of rough treatment, there's been very little automation," he said. "There's this perception that ag is slower to adopt new technologies, but I don't see that."

Therein lies another challenge. Abundant Robotics isn't ready to offer any specific recommendations yet to growers to prepare their orchards for automation *(see "Pushing their pluck" on page 36)*, and despite the potential benefits, many people are wary of change.

"If the old system is working reasonably well, the new system that is going to replace it is going to have to work significantly better," Doornink said. "You don't change to get the same effect. You will make the incremental change if you can do it faster, better, cheaper."

Growers may be forced to adapt to the changes around them though, he said. As demographics shift around the world, the labor pool U.S. growers have tapped for the last 50 years is changing. It seems natural to bring in some automation.

"This project is critically timed. I don't think in the history of tree fruit, I don't think there's another time this could have been accomplished," Doornink said. "Everything is just right — the need is here, computers have developed sufficiently, and the industry is prosperous and can make a change like this.

"It's a great time for this to happen," he said. "Now we just have to wait and see." ●

TJ MULLINAX/GOOD FRUIT GROWER

Operators of an Abundant Robotics automated vacuum harvester monitor the test vehicle working a Fuji apple block during the 2016 Washington apple harvest.

PLAY
See the Abundant Robotics automatics harvester in action at goodfruit.com/media

Dan Steere, left, and Curt Salisbury, co-founders of Abundant Robotics Inc.

Pushing their pl

Creators of vacuum harvester aim to have machines ready for growers in 2018

by Shannon Dininny

photos by TJ Mullinax

A vacuum apple harvester under development by a California company has shown it can see the apples, pick them from the tree and do so without causing significant damage to either at a picking rate of faster than one apple per second.

Now that researchers have proven the technology works, their focus is to engineer a machine that will operate effectively in today's orchards and can be easily integrated with other orchard systems. Their goal: have the first machines available for commercial use in 2018.

"There's a lot of work to be done to build the product, but there comes a time in research and development where you switch from technology research to good producing engineering, and we've reached that point," Abundant Robotics CEO Dan Steere told *Good Fruit Grower*. "We recognize it needs to lower the cost per pick, and we expect this will do so substantially."

Researchers at Abundant Robotics, a spinoff of SRI International, began work to develop an automated harvester three years ago, with trips to orchards in Washington state and the Southern Hemisphere to test their prototypes during harvest.

In trials last year, they found that the vision system and vacuum picker were capable of recognizing, localizing and picking apples without bruising them, at a picking rate of faster than one apple per second. However, the machine remained parked, picking in place, the optical sensor showed room for improvement, and the machine's workspace needed to be expanded to reach more of the canopy.

Multiple changes to hardware and software in the ensuing months resulted

uck

in additional advances in orchard trials this year, both in Australia and Washington.

Fine-tuning the equipment

For their trials, the researchers thinned apples to singles, as well as to those they considered physically inaccessible to the robot, such as those immediately behind the trunk. They also pruned the tree to 10 inches beyond the trellis wires to create a fruiting wall.

To allow the machine's vision system to better recognize fruit on the tree, they moved the camera to the end effector, or

"There's a lot of work to be done to build the product, but there comes a time in research and development where you switch from technology research to good producing engineering, and we've reached that point."

—Dan Steere

"hand." In a prepared canopy of Pink Lady apples 10 feet tall with 10 feet between rows, they found the machine recognized 92 percent of apples distributed across three wires at different heights — 30 inches, 46 inches and 62 inches from the ground. Detection rates varied across wires, with 79 percent of apples detected on the lowest wire, followed by 94 percent and 97 percent on the second and third wires.

The poorer sight for the bottom wire was attributed to foliage blocking the picker's vision, which could be corrected by scanning farther below the bottom wire, Curt Salisbury, lead researcher and Abundant's chief technology officer, told members of the Washington Tree Fruit Research Commission at an August meeting.

The robot's blind spots were directly behind the wire and behind the trunk, and it picked 99 percent of the fruit it saw. "If we saw it, we picked it," Salisbury said.

In addition, the researchers expanded the workspace of the robotic arm to 51 inches diagonally and 20 inches deep, which enabled the machine to pick apples between 24 inches and 57 inches above the ground, however Steere commented that a commercial system would have a much larger reach. They also continuously picked while moving down a row using a tractor with a minimum forward speed of .05 mph, or about .8 inches per second, when put in lowest gear and with an engine speed of 1,200 rpm. The speed was varied by the tractor driver based upon the apple load in the canopy to maintain the desired average pick rate of one apple per second, with an average travel rate down the row of between 1 and 6 inches per second.

In fall 2015, a trial picking of 180 Fuji apples had a cull rate of 14 percent, largely due to punctures and cuts on the fruit. In spring 2016, a trial picking of 200 Pink Lady apples resulted in a reduced cull rate of nearly 11 percent, largely due to bruising. Punctures were eliminated by better preparing the canopy, Salisbury said, and some of the bruises, which occurred on a more bruise-prone variety, were caused by changes to the vacuum system that will be corrected in future iterations of the prototype.

There were only a couple of instances where spurs were picked, and the number of stem pulls also was quite a bit smaller and has been found to be variety specific.

Recommendations

Many growers are already asking what they should be doing to prepare for automation. For its part, Abundant Robotics isn't prepared to start offering growers recommendations for orchard specifications just yet — or provide details about how the system might be rolled out commercially or at what cost — but the team has been able to answer a number of questions about use in different orchard systems.

Both of these Fuji apples were picked by the vacuum harvester.

The machine's ability to pick has been the same in both vertical and angled canopies, and trained canopies will have better results with the robotic picker, Salisbury said.

"There are a few benefits that come from that. One is that all of the fruit tends to be close to one another along that plane, so the amount of motion and resulting movement time you have to go through to transition from one set of apples to another tends to be shorter," he said.

Additionally, he said, longer growth tends to obstruct the machine's ability to get into the canopy and increases the propensity for pulling in a branch and bruising or puncturing the fruit.

Steere agreed. "We're very comfortable at this point that tightly trained canopies are going to be necessary for automation," he said. "The specifications for that, we're not ready to put a hard stake in the ground, but a lot of this work is pointing to tightly trained canopies enabling this type of automation."

As they continue work to advance the robotic harvester toward commercialization, the researchers also are working on engineering the prototype to work in conjunction with a conveyance system. ●

A Fuji apple is sucked from a tree during the 2016 Washington apple harvest during a demonstration of an automated vacuum harvester by Abundant Robotics.

Spraying with precision

Cornell researcher offers tips for making your grandfather's sprayer more effective, but says precision sprayers are the future.

by Shannon Dininny

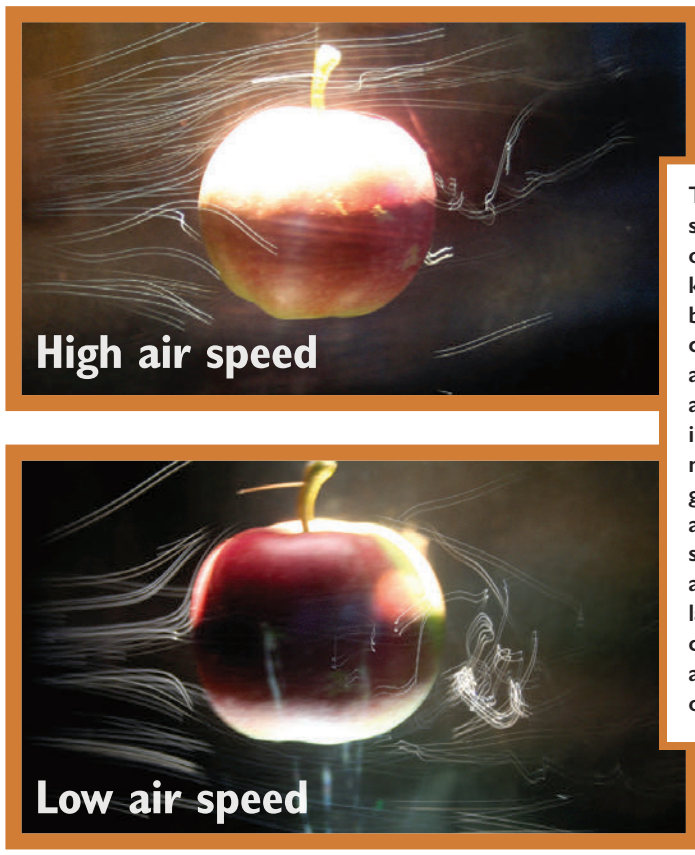
As commercial apple growers plant more profitable high-density orchards, those longstanding traditional orchards, with wide rows of stately trees 20 feet tall, are gradually becoming a thing of the past.

The sprayers growers use to apply chemicals in these newer orchards? Not so much yet. Instead, at the start of each season, many growers roll out the airblast sprayers their grandfathers used, along with the widely held belief, "If it ain't broke, why fix it?"

Those sprayers, designed or built in the 1960s, feature a large axial fan to push a liquid spray of water and chemicals across wide rows and into huge canopies. Growers needed those sprayers in traditional orchards, but today, orchard systems have changed, and in modern orchards they are often spraying at too high a volume, too high a speed and missing their targets.

That's the message of Andrew Landers, a faculty fellow at Cornell University's Atkinson Center for a Sustainable Future and one of the world's leading spray technology researchers. Landers touted the benefits of modern sprayers at the International Fruit Tree Association Study Tour in New York in July, saying growers can more effectively deliver their spray, thereby reducing chemical use,

Slower air speeds when spraying can provide better coverage



These two images show how a property of fluid dynamics, known as the boundary layer effect, can impact spraying an apple. At higher air speeds, as shown in the top photo, most spray droplets go straight past the apple. But lower air speeds, which have a lower boundary layer, allow spray droplets to go around and land on the back of the fruit.

PHOTOS COURTESY ANDREW LANDERS

drift and cost, than they can with those so-called "legacy sprayers."

Of course, Landers also recognized that many growers may not be in a position to buy a machine worth hundreds of thousands of dollars — there's a reason some people still use granddad's sprayer. For those growers, he recommended tips and tools for improving effectiveness.

The dynamics of spray

It's all about matching air speed and volume to the growth stage of a vineyard or orchard canopy. Too little air results in poor penetration, while too much results in spray drift and a failure to adequately deposit the spray where it's needed.

The latter point seems counterintuitive, but in 1904, a little-known German physicist named Ludwig Prandtl revolutionized fluid dynamics with his theory that high air speed applied in a liquid diverges around an object when it reaches it and then converges again behind it. The untouched area on the backside of the object and behind it is referred to as the boundary layer. The greater the air speed and the rounder an object — like, say, an apple — the larger the boundary layer.

In addition, the large canopy of a traditional orchard allows for more turbulence to be created; when the air flow hits the tree, that turbulence in the canopy causes droplets to fall out of the spray cloud and stick to fruit and leaves.

"Now, with these modern trees and narrow, very narrow, very well managed canopies — we have trees that are summer pruned, exposed apples — we no longer have that air turbulence," Landers said. The spray launches onward, rather than stick to the tree. Which means growers need to start thinking differently about how they apply their chemicals, he said, particularly since sprayers only provide between 55 and 65 percent coverage anyway, resulting in "huge wastage."

Understanding canopy density

Landers already has patented a louver technology, a metal panel that can be retrofitted to a traditional airblast sprayer, to adjust air flow. Now he and his postdoctoral researcher, Tomas Palleja, are studying ways to estimate canopy density to reduce air flow where it's not needed.

The density of a fruit wall can vary anywhere from 30 to 75 percent, but too often, growers fail to adjust the air

SHANNON DININNY/GOOD FRUIT GROWER

Cornell researchers show how attaching a series of ultrasound sensors to a sprayer provides information about gaps in the tree canopy and, by controlling the fan, reduces air speed.

flow for the canopy. They also can't see what's making it through to the other side of the canopy.

The researchers attached a series of ultrasound sensors to the sprayer to gather information about the canopy volume and density; a sparse tree requires far less spray. The sensors act as both microphone and receiver, sending a very high frequency sound wave. When the sound hits the leaves, it bounces back to the receiver. If there's a gap in the branches or leaves, it passes through, providing details about the gaps in the canopy.

These sensors also control the speed of the fan. Previous studies with a single-row sprayer have shown adequate coverage when the air leaves the fan at 7 mph, Landers said. Airblast sprayers typically shoot spray at speeds of up to 190 miles per hour.

Overall, adjusting the air flow to keep the spray in the canopy allows for the volume of water to be reduced from 100 gallons to just 65 gallons per acre. "That's quite an

appreciable amount of water," Landers said. "We would still try to maintain the label rate. We're not proponents of skimping on the amount of product, primarily because it's risk and reward — if you take the risk in reducing the amount of product, your reward might be quite low."

Applying the sensors to a single-row sprayer at Lamont Fruit Farm in Albion, New York, enabled the farm to reduce sprays to every other row, requiring 50 percent less fuel, according to co-owner Rod Farrow. "All our fire blight, everything we spray for is every other row. We run at 5 mph and use 50 percent less fuel," he said. "We have to run PTO (power take-off) a little faster, we're down a gear, but we're still close to 5 mph." A two-row sprayer Farrow has on the farm runs at close to 5.3 mph.

The research team also successfully applied the sensors to a traditional airblast sprayer equipped with the louver system.

The researchers have developed an in-canopy flow system still to be commercialized. Called the Electro-leaf, the small, triangular sensor simulates a leaf in the canopy, vibrating when the air flow hits it and sending a signal to adjust fan speed.

To have more flexibility to adjust spray volume, Landers also recommended using nozzles in clusters. Connecting the sprayer to a bank of four color-coded nozzles, each applying spray at a different rate enables a grower to combine the nozzles in different combinations for up to seven different rates. For instance, banks of nozzles can be used when there are variations in canopies, such as small replant trees next to large, mature trees, or where there are blocks of different varieties requiring different application rates.

The nozzles are commonly used on boom sprayers in the Midwest, he said.

Growers need to adjust the tools used today to meet their modern needs, not only to attract workers — "Why disrespect the $10-per-hour worker and give him grandad's sprayer to use?" Landers asked — but also to attract young people to agriculture. Technologies that employ the latest software applications and high-tech features to automate the industry, such as robotic harvesters and precision sprayers, are one way to do so.

"We want to bring the industry forward, and we want to bring young people into the ag industry," he said. "And I submit to you that legacy sprayers are not the way to do it." ●

SHANNON DININNY/GOOD FRUIT GROWER

A multirow sprayer was on display at the International Fruit Tree Association Study Tour in New York in July.

Guides for growers

Andrew Landers, Ph.D., has released a new book, *"Effective Orchard Spraying: A Practical Guide for Growers,"* that offers tips for sprayers owners and operators to get the best from their machine and spraying operation. In addition, a second edition of his 2010 spray guide for wine and juice grape growers, *"Effective Vineyard Spraying: A Practical Guide for Growers,"* is also available. For more information or to order either book, visit *www.effectivespraying.com.*

PHOTOS BY TJ MULLINAX/GOOD FRUIT GROWER

Entomologist Peter Landolt holds a commercial pheromone attractant for brown marmorated stinkbug that he used along with a common sticky wasp trap.

Using smell to battle stinkbug

Researchers using pheromones to lure stinkbugs find some traps work better than others.

by Michael Bush

Researchers from Washington State University, the Washington State Department of Agriculture and the U.S. Department of Agriculture-Agricultural Research and Extension continue to monitor the expanding distribution of the invasive brown marmorated stinkbug (BMSB).

By the end of 2015, BMSB was found in 16 Washington counties, primarily along the interstate corridors. In early 2016, BMSB was confirmed in another three counties as the range of this stinkbug continues to expand.

There are reports of BMSB causing significant crop damage to tree fruit and vegetable crops in the Atlantic Seaboard states, but no confirmed reports of BMSB damage to crops in Washington. Nevertheless, Northwest researchers (similar efforts are underway in Oregon) are concerned that the abundance of BMSB may continue to build and are hopeful that fruit producers can adopt and implement management strategies before crop damage is confirmed in the region.

There have been a number of research and commercial trap designs that use stinkbug pheromones to lure stinkbugs into the traps. Peter Landolt, Ph.D., (USDA-ARS, Wapato) and WSU collaborators have experimented with numerous combinations of these traps with the goal of finding the best means of monitoring BMSB. In one trial, the Rescue Wasp Trapstick baited with BMSB lures produced by Sterling International captured more BMSB in one trap at one Yakima, Washington, location in 24 hours than all BMSB captured in Yakima County in 2015 and 2016. Over the next month, we will continue to monitor BMSB and confirm the efficacy of this potential new trap design as a monitoring tool.

In 2017, monitoring of BMSB will continue in

This bottle-style trap, above, had caught only one stinkbug while a sticky wasp trap nearby, shown at right, captured far more BMSB using the same pheromone.

Washington and Oregon. Any growers with an interest in monitoring BMSB in their regions or to confirm stinkbugs as BMSB are encouraged to contact Michael Bush, WSU Yakima County Extension at 2403 S. 18th St., Suite 100 in Union Gap, Washington, 98903, or their local university extension office.

Michael Bush, Ph.D., is a Washington State University Extension entomologist. Peter Landolt, Ph.D., is a research entomologist with the U.S. Department of Agriculture's Agricultural Research Service in Wapato, Washington.

GOOD POINT

Jon DeVaney, **Washington State Tree Fruit Association**

Continuous improvement

The WSTFA annual meeting will reflect the change in our industry.

The 2016 Washington State Tree Fruit Association Annual Meeting and Hort Expo — the "Hort Show" — is fast approaching. This year's event, the 112th, will take place at the Wenatchee Convention Center from Dec. 5-7.

This theme selected by Sam Godwin, the chairman of this year's meeting, is "The New Normal: Continuous Change." While changes have always been a part of our dynamic and competitive industry, their pace will only accelerate with the substantial investments being made in research and the deployment of these advances. Our goal is to bring the same spirit of continuous improvement to your annual conference and trade show.

One of our challenges is that a substantial portion of our 1,600 meeting attendees arrive at the same time, right before the program begins at 8 a.m. on Monday morning. Even with a very efficient registration and credential pick-up process, if everyone arrives at once lines will form that can cause attendees to miss the beginning of the program. To alleviate these delays, we are offering an opportunity for early registration pick-up sponsored by Northwest Wholesale. This service will be available on Sunday, Dec. 4, from 2-6 p.m. in the Wenatchee Convention Center Lobby. If avoiding a line isn't already enough incentive, those who pick up their packets early on Sunday afternoon will also be entered in a drawing for special prizes.

We also encourage attendees to access Annual Meeting program information and updates via our WSTFA mobile app. Sometimes winter travel can delay a speaker's arrival, causing last-minute changes to the agenda for a session. It can be disappointing to find that a speaker you wanted to hear had been moved up in the program and you already missed their presentation. Our app allows us to send out ongoing schedule updates and notifications so you won't miss key events and speakers. We will also be offering opportunities to provide ongoing feedback on the event and speakers through the app, so that you can share your comments and ideas while they are fresh in your mind. The WSTFA mobile app can be downloaded now at *wstfa.org/mobile*.

It can often be hard to decide which concurrent session to attend when each has interesting speakers and content. In 2015, we transitioned from printed to electronic conference proceedings so that our members could have access to recordings of all the presentations at the Annual Meeting. The electronic proceedings include a recording of the audio of each speaker along with the video of their slide presentations. This is particularly valuable for speakers with significant research data that would otherwise be hard to recall. The proceedings are available on a flash drive for only $25 and can be ordered when you register or after the conference. Recordings of the 2015 conference are still available as well.

WSTFA's goal is to make all of the valuable content presented at the Annual Meeting available to our members. However, in the past it has been a challenge to capture the research results presented in the poster session. This year we are moving to a video poster session, sponsored by Pape Manufacturing. Presenters will provide brief video updates of their research projects, which will be available for viewing throughout the conference. There will also be scheduled question and

ONLINE
To learn more about the WSTFA 112th annual meeting, visit wstfa.org/annual-meeting/

While changes have always been a part of our dynamic and competitive industry, their pace will only accelerate with the substantial investments being made in research and the deployment of these advances.

TJ MULLINAX/GOOD FRUIT GROWER FILE PHOTO

This year's Washington State Tree Fruit Association Annual Meeting and Hort Expo returns to Wenatchee, Washington, where it was last held in 2013.

answer sessions when attendees can interact with the presenters. Unlike past poster presentations that were unavailable following the conference, these videos can be made available for ongoing viewing by our members.

Our industry and its annual conference have changed a great deal over the last 112 years, and will no doubt continue to do so in the future. We are all working hard to ensure that the changes we experience are for the better, and sharing knowledge and experience as an industry is a key means of accomplishing this. We hope that you will take the opportunity to learn from our program speakers and from each other in Wenatchee this year and that you'll share your feedback so that we can continue to improve our industry's most important annual event.

Jon DeVaney is president of the Washington State Tree Fruit Association.

Share your know-how & grow-how

Expert view: Individual growers must take on customer fears about GMOs and chemicals.

by Leslie Mertz

There's a right way and a wrong way to answer consumer questions about genetically modified foods, sprays and other agricultural practices, and growers have been doing it wrong for far too long.

That's the position of Kevin Folta, molecular biologist, professor and chair of the Horticultural Sciences Department at the University of Florida, who will deliver the keynote address at the Great Lakes Fruit, Vegetable, and Farm Market Expo on Dec. 6-8 in Grand Rapids, Michigan.

"Whether we're scientists or farmers, it's very simple in our minds, because we know the products we use are safe and are very comfortable with them. The problem is that when we talk to the public about these things, we can come off as arrogant or defensive," he said. "To a

COURTESY OF UF/IFAS

Growers need to begin engaging with consumers to counter the many online and television sources of misinformation about today's agricultural practices, according to Kevin Folta, professor and chair of the Horticultural Sciences Department at the University of Florida. He will present his tips during a keynote address at the Great Lakes Fruit, Vegetable, and Farm Market Expo on Dec. 6-8 in Grand Rapids, Michigan.

consumer, we can sound like this: '*We* know how to do what we do, and *you* don't. What's wrong with you that you don't get that?' We need to fix that, and it's actually not too hard."

A real food fight

Folta became all too familiar with this gap in communication more than a decade ago when he tried to teach the people in a favorite neighborhood organic grocery store about the benefits of genetically modified crops, or GMOs. "I liked the people there but they had the science all wrong, and I thought this would be a great opportunity for me to share what I knew and help them to understand what's true and what's not," he said. "So I went in and I buried them in data, and it didn't change anybody. Not only that, but I went on screwing it up for 10 more years!"

It was only about four years ago that the light began to dawn, and he figured out how to get the information out there in a way that people who are not scientists or growers can appreciate. "It's not about the data, and it's not about the facts. It's about how people trust and feel about their food, and that's where we can make a difference in how we talk about ag practices," Folta said.

First off, it's important to understand consumers' worries. "Consumers are concerned about all kinds of

things relating to food production, including genetic engineering; the application of herbicides, insecticides, fungicides, hormones, and antibiotics; water use; fertilizer use; land use; labor. And their opinions can be very strong." Regrettably, he said, they are often basing those concerns and opinions on suspect sources.

"The conversation currently is dominated by people like Dr. Oz and TV chefs, rather than by the experts who actually know what they're doing in terms of food production," Folta said. He also pointed to "very deliberate and intentional misinformation put online by people who want to change the way we eat and the way we farm." Some are politically driven, others are anti-corporate, but regardless of their motivation, he said, "these sources can be very compelling to consumers because it's about what they feed their families."

With such an inundation of misinformation, he said, the time has never been better for growers to begin speaking up.

Talking to customers

In speaking with customers, growers should lead with ethics and values, Folta said. "Farmers have to start by talking about what's important to them: their families, their land, the quality of their products, and why they do what they do. If people are interested in where food comes from, tell them. That's how we can change public perceptions."

He gave the example of pesticide usage. "Here, a farmer might say, 'It's most important for me to minimize the amount of chemicals I use, because they're expensive, it costs us money to apply them, plus I want to keep them out of my environment. And I always have to use them very carefully within the limits so I know my fruits or vegetables will be safe to eat,'" Folta said. "That's a perfectly solid case that communicates to a skeptical consumer that the grower is concerned about the environment and consumer safety."

> *"The conversation currently is dominated by people like Dr. Oz and TV chefs, rather than by the experts who actually know what they're doing in terms of food production."*
>
> ***—Kevin Folta***

For older customers who recall some issues with agricultural chemicals from the mid-20th century, he said, growers can explain how the understanding of chemistry and its impacts on the environment have greatly expanded since then, as have the regulations of the approved sprays. "Growers can tell the consumer that today's chemicals are targeted, they're specific, and we know how to use them safely. We are always learning and adjusting, so what we use today is tremendously safe compared to products years ago," Folta said.

From there, he said, the grower may want to address genetically modified foods by describing it as a way to add a trait that isn't present naturally, and by so doing, reduce the need for insecticides to even lower levels. Examples include the addition of a trait to papayas that essentially saved that fruit from devastation due to an aphid-borne virus, or a genetic modification to eggplants that allowed farmers in Bangladesh to vastly reduce pesticide use, realize a profit on the crop and share their seeds. "These are all great success stories of GM technology," he said.

The examples and the wording will vary based on the conversation, but the important thing to remember is to make a connection with the consumer first by leading with ethics and values, and then provide the

RICHARD LEHNERT/GOOD FRUIT GROWER FILE PHOTO

The Great Lakes Fruit, Vegetable and Farm Market Expo will be held at the DeVos Place Convention Center in Grand Rapids, Michigan.

ONLINE
To learn more about the Great Lakes Fruit, Vegetable and Farm Market EXPO, visit www.glexpo.com

evidence to support the agricultural practice, he said. This can happen in face-to-face exchanges or on social media. "The difficult person probably won't be influenced by the farmer, but other passerby readers will," he said. "They will appreciate the grower who is extending compassion and expertise, and that will help them make up their minds."Our individual farmers have the power to fix these misconceptions, and should become comfortable operating as reputable sources, whether that's in person or on social media," he said. "This is how we'll make a difference and take back this conversation." ●

Leslie Mertz, Ph.D., is a freelance writer based in Gaylord, Michigan.

2017 Empire State Producers Expo

The 2017 Empire State Producers Expo will take place on January 17-19 at the OnCenter Convention Center in Syracuse, NY. This annual show combines the major fruit, flower, vegetable, and direct marketing associations of New York State in order to provide a comprehensive trade show and educational conference for New York producers, as well as neighboring states and Eastern Canada. In years past, over 100 presentations were given by Cornell Cooperative Extension personnel and highly regarded speakers from across the country. Panel discussions feature some of the top industry experts and growers in New York. Between educational sessions, attendees can visit the trade show featuring over 150 commercial vendors and non-profit exhibitors.

• 2017 Becker Forum: Good Agricultural Practices (GAPs)/Produce Safety Alliance (PSA) Training. The New York State Vegetable Growers Association in conjunction with the Produce Safety Alliance (a collaboration between Cornell University, FDA and USDA) are pleased to announce that one of the first producer trainings to meet the requirements of Food Safety Modernization Act (FSMA) will be offered during the Becker Forum on January 16, 2017 in Liverpool, NY. This 7-hour training will provide the required training for farms to meet the Produce Safety Rule.

• Berry Grower Protected Culture Workshop on Tuesday, January 17.
• GAPs Day 2 - Writing Your Own Food Safety Plan Workshop on Tuesday, January 17.

Join us for the Expo at the Oncenter in Syracuse, NY and the Becker Forum hosted at the Holiday Inn in Liverpool. Visit our website to register www.nysvga.org and to see the complete program, lodging information, and directions. For more information visit www.nysvga.org or email NYSVegetableGrowers@gmail.com

January 16-19, 2017

Good Stuff

A selection of the latest products and services **for tree fruit and grape growers**

AgroFresh Introduces Novel Sensor Technology

AgroFresh Solutions, Inc. and C2Sense Inc. have developed proprietary sensors to monitor for ethylene and 1-methylcyclopropene (1-MCP), the active ingredient in patented SmartFresh postharvest technology.

The sensors monitor the SmartFresh application and provide insight into storage conditions, delivering real-time information about the condition of fruit in refrigerated and controlled atmosphere storage rooms. Once installed, AgroFresh fruit physiologists will work with customers to monitor the SmartFresh application and storage room conditions to help optimize storage protocols.

SmartFresh is applied after fruit is placed in storage rooms and helps maintain fruit at peak quality. Since each storage room has unique conditions, AgroFresh technical specialists provide customized storage and SmartFresh recommendations.

For more information about fruit quality management, visit *www.AgroFresh.com* or contact your local AgroFresh representative.

Tree Connection welcomes Loren Queen as new rep

Loren Queen

Fruit industry veteran Loren Queen has joined Tree Connection, based in Newberg, Oregon. He will be representing Tree Connection's nursery partners throughout the Northwest from his office in Yakima, Washington.

Queen has most recently worked for Extenday USA and Domex Superfresh Growers and has spent more than 20 years in the produce industry in both sales and marketing. "I look forward to networking with growers and nurseries to deliver solutions that help drive returns to the land," Queen said.

You can contact Queen at (509) 480-2447 or (800) 421-4001 or *loren@treeconnect.com*.

Farm Fuel Inc. offers soil treatments

Pacific Northwest farmers interested in preplant use of Pescadero Gold mustard seed meal can now benefit from Farm Fuel's milling operation in Washington, which will make orders and shipping much more efficient.

Mustard seed meal is an excellent soil amendment after an orchard is pulled out and can be applied in the fall. A 5-1-1 fertilizer, it also is listed for use in organic operations.

In its milled form, it can be easily worked into the tree line with the recommended application rate of 3 tons per acre. It is also currently available in pellet form at Chamberlin Ag Products in Wenatchee, Washington, and Hood River and The Dalles, Oregon.

Farm Fuel also is introducing Pacific Northwest growers to anaerobic soil disinfestation (ASD), a preplant soil treatment that combines a soil amendment with field preparation to effectively eliminate soil-borne pathogens.

Farm Fuel has been implementing ASD commercially in berries for the past six years, and ASD is now being used in orchards and other crops.

For more information, contact Farm Fuel at 831-763-3950. Visit the website at *farmfuelinc.com*.

MACRO PLASTICS

Macro Plastics offers new, lightweight MacroBin

Macro Plastics has developed a new, lightweight bin with "bruise buffer zone" technology that is designed to be both lightweight and strong and durable.

The MacroBin 29 includes an interlocking stacking feature for increased safety and can be constructed highly ventilated to maximize airflow and fruit cooling. At 63 pounds, it is about 30 pounds lighter than comparably sized plastic harvest bins.

The bin, manufacturered in Union Gap, Washington, was designed for Washington apple growers and other food storage companies who were looking for a plastic bin that is cost competitive to a wooden bin.

Based in Northern California, Macro Plastics is one of the world's largest manufacturers of bulk plastic containers.

Its products are sold in seven distinct product lines, including MacroBin, MacroTote, ProBin, ShuttleBin, HybridBin, IsoBin and MacroTrac. All products are reusable and recyclable.

For more information, visit *www.macroplastics.com* or call (800) 845-6555.

Good to Go

For a complete listing of upcoming events, check the Calendar at **www.goodfruit.com**

November

November 7-11: American Society of Farm Managers and Rural Appraisers (ASFMRA) Annual Meeting and Trade Show, "Agronomics — Performance Under Pressure," Indian Wells, California, *asfmra.org*.

November 9: Washington Association of Wine Grape Growers & Washington Wine Institute Grape and Wine Issues Caucus, Yakima, Washington, *wawgg.org*.

November 8-10: The Methyl Bromide Alternatives and Emissions Conference, Orlando, Florida, *www.mbao.org*.

November 9-10: Northwest Cherry Research Review, Wenatchee, Washington, *www.treefruitresearch.com*. For more information, contact Kathy Coffey, (509) 665-8271, ext. 2.

November 10-11: Washington State Grape Society Annual Meeting and Trade Show, Grandview, Washington, *www.grapesociety.org*.

November 11-13: Tilth Annual Conference, Wenatchee, Washington, *seattletilth.org/special_events*.

November 14-15: Sustainable Ag Expo, San Luis Obispo, California, 805-466-2288, *www.sustainableagexpo.org*.

November 15-17: FSMA Preventive Controls Qualified Individual (PCQI) training, Modesto, California, *dfaofca.com*.

November 22: Stone Fruit Research Review, CPAAS, Prosser, Washington, *www.treefruitresearch.com*. For more information, contact Kathy Coffey, (509) 665-8271, ext. 2.

November 28-30: FSMA Preventive Controls Qualified Individual (PCQI) training, Manteca, California, *dfaofca.com*.

December

December 5-7: Washington State Tree Fruit Association 112th Annual Meeting and NW Hort Expo, Wenatchee Convention Center, Wenatchee, Washington, *www.wstfa.org*.

December 5-9: Irrigation Show and Education Conference, Las Vegas, Nevada, *info@irrigationshow.org*; *www.irrigationshow.org*.

December 6-8: Great Lakes Fruit, Vegetable and Farm Market Expo, Grand Rapids, Michigan, *www.glexpo.com*.

January

January 5-6: Yakima Ag Expo, SunDome, Yakima, Washington, *www.yakimaagexpo.com*. For information, contact Laurie Hammermeister, 509-248-2900.

January 9-10: Kentucky Fruit and Vegetable Conference, Lexington, Kentucky, *www.kyhort.org*. For information, contact John Strang, 859-257-5685.

January 9-11: Northwest Food Manufacturing and Packaging Expo, Portland, Oregon, 503-327-2200, *expo@nwfpa.org*, *www.nwfpa.org*.

January 10-12: Indiana Horticultural Congress and Trade Show, Indianapolis, Indiana, *www.inhortcongress.org*.

January 11-13: Illinois Specialty Crops, Agritourism and Organic Conference, Springfield, Illinois, 309-557-2107, *www.specialtygrowers.org*.

January 16-18: Ohio Produce Growers & Marketers Association Congress, Sandusky, Ohio, *www.opgma.org*.

January 17-19: Empire State Producers Expo, Syracuse, New York, *nysvga@twcny.rr.com, www.nysvga.org*.

January 20: Cherry Institute, Yakima Convention Center, Yakima, Washington, 509-453-4837, *www.wastatefruit.com*.

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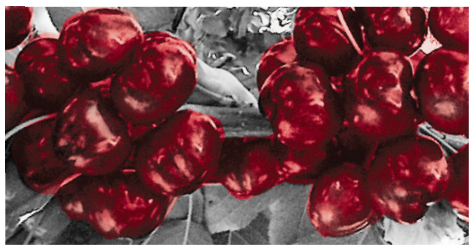

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grower / *Silverton, Oregon*

age / *23*

crops / *Wine grapes*

business / *Manager, Pardis Vineyard and Rainbow Valley Enterprises*

family background / *Pierre is the son of Peter and Donna Paradis, who were among the first wine grape growers in Oregon's Abiqua Valley in the Willamette Valley Appellation.*

How did you get your start?

"I initially got started in the vineyard doing jobs with Dad either out in the shop or in the field. Stuff like taking care of equipment so it would produce the results we wanted — from basic things, how to set a mower, to more complicated things like working with leaf removers and hedgers. These were tools where you have a very narrow window of use, that you really need to know how to use it, quickly and correctly. Some of the leaf removers you only have a few weeks to use them and then your chance is gone. If you have any breakdowns, I learned that you've got to get them running, even if you have to fix it overnight to get it back in the field.

How do you grow your grapes?

"In Oregon, the predominant wine grape is Pinot Noir, usually in small blocks, managing them with a high attention to detail. Really taking care of the vines cluster by cluster. It's pretty intense work out in the vineyard. There's a lot of things that are done by hand, and really only recently are we starting to do things mechanically. With better machines available, we're beginning to introduce them into our programs to reduce costs and labor.

What is the major growing challenge?

"In the Willamette Valley, it rains enough through the summer that a lot of vineyards don't have irrigation. Contrary to other growing regions, where you can use water to help control your vigor, here we don't have a lot of ways to control vigor. You end up having to control it in other ways. Things like hedging. In one year we'll hedge maybe four times, especially in vigorous sites. Other growing regions may not hedge at all because they can just ratchet down the water to the point where your canopy stops growing. Restricting the water to keep the plants going and ripen your fruit but you don't need to hedge.

Why are you a farmer?

"I really enjoy thinking about what problems I have in the field and working to solve them. One of my favorite times is harvesting in the fall. I get a feeling of accomplishment, just being done and seeing the grapes drive off on the truck. I've grown this product — not necessarily created it — but you've helped it along as best as you can.

"I decided to go to college because I knew what we were doing in the vineyard, but I didn't understand why we were doing what we were doing.

by TJ Mullinax

More from this interview and other Young Growers at goodfruit.com/yg.

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