JULY 2018

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TASTING ROOM TECHNOLOGY

How to boost sales and manage wine clubs



The 'Underground Economy' of Soil

Lot Traceability and Minimizing Risk

Crocker & Starr Brings Winemaking Home

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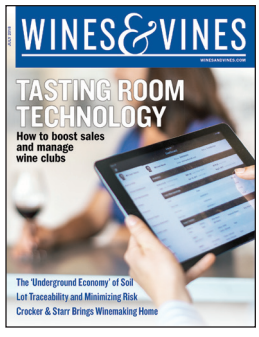
ON THE COVER

A photo by Kim Carrol shows WineDirect's iPad-based POS system. When it comes to DtC sales, tasting room software makes a difference. Tracking customers' visits, purchase history and preferences all affect consumer loyalty and future sales. This month *Wines & Vines* features current softwares wineries are using to boost sales and manage club memberships and looks ahead at the future of tasting room tech.



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QUESTION FOR JULY: How does your current tasting room software boost DtC sales?



Marcia Kunde Mickelson
Chief Operating Officer
Kunde Family Winery
Kenwood, Calif.

We currently are using WineDirect software for our tasting room and wine club sales. Allowing us the capability to use iPads at several outlying tasting areas has been very beneficial to our sales volume, where we can take the order in real time, which minimizes the amount of time to complete the sale. We can also take multiple sales at any time which increases the efficiency of the tasting room. Through this process, we can immediately capture the customer's email address which bolsters our future sales through email and calling campaigns.



Alyssa Ball
Direct Sales Manager
Talley Vineyards
Arroyo Grande, Calif.

With our current tasting room software, we easily collect customer information at the point of sale, allowing us to follow up with new customers via email, phone call, or mail. Establishing a relationship quickly and easily is key to future sales. Furthermore, once a customer is part of our software, we can access their past purchases, email, and website engagement history. This information is crucial in creating a personalized experience for each customer, which results in greater sales.



Charles "AJ" Fairbanks
President
Dierberg Vineyards
Santa Ynez, Calif.

Features of our software (VineSpring 2.0) that boost DtC sales relate to efficiency and streamlined customer service while empowering customers with direct access to their account. The automatic "credit card updater" feature for wine club is the single most significant boost to our DtC sales. The MailChimp software integration allows us to embed "authorization tokens" into emails, allowing each recipient one-click, secure access to their account without typing a password. Connectivity to UPS WorldShip and ShipCompliant generates tracking numbers in real time for customer review.

CONTRIBUTORS

Making his first contribution in his new role as editor at large, **Jim Gordon** profiles the estate winery of Crocker & Starr Wines in St. Helena for this month's Technical Spotlight profile. Gordon edited countless of these types of features during his more than 12 years as the editor of *Wines & Vines* and transitioned into his new role so that he could do more writing and spend more time in vineyards and wineries. In his article on page 28, Gordon describes both the estate vineyard and winery of the vintner and winemaker partners who founded the winery in 1997.

The first part of **Dr. Andrew Reynolds**' examination of the use of unmanned aerial vehicles (UAV) for vineyard mapping appeared in the June edition of *Wines & Vines*. Reynolds, a professor of biological sciences and viticulture at the Cool Climate Oenology and Viticulture Institute of Brock University in Ontario, Canada, reports on a study of UAV mapping of several Ontario vineyards that he reports produced, literally, hundreds of maps in the second part of this feature that begins on page 60.

Andy Starr continues to find ways to help winemakers produce high-quality wines and run well-managed businesses in his "Here's What Works" column that appears this month on page 22. Starr, who has a background in production management, interviewed several experts on how wineries, especially small ones, can and should adopt policies for lot traceability for quality assurance and to reduce risk. Starr was the founder and president of Neocork Technologies and continues to work as a management consultant. Developing a lot traceability program may seem like a daunting task, but as Starr reports not having one could prove far costlier than getting one started.

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Highlighting Technology From the Vineyard to the Tasting Room

THIS MONTH'S EDITION of *Wines & Vines* truly offers insights from the vineyard all the way to the wine glass.

Glasses in particular are well covered with a package of stories on how to ensure your tasting room staff present the best pour possible with crystal-clean glasses. Glasswashers may not seem like a pivotal piece of winery equipment, but a practical piece of commentary on page 36 by John Stallcup makes the case that a glasswasher may in fact be the most important piece of equipment at your winery.

The Product Focus report on page 38 details new glasswashers as well as other equipment for cleaning and buffing glassware. This month's report was by the newest member of *Wines & Vines*' editorial team, Stacy Briscoe, who joined the magazine in April. Briscoe has previously written for several other publications including *The San Francisco Chronicle* and was selected as a fellow for the 2018 Symposium of Professional Wine Writers.

This being our annual technology issue we took a look at what tech helps drive wine sales, and Briscoe wrote this month's cover story about technology in the tasting room. Winery owners have plenty of options for picking a system to handle point-of-sale, wine club management, direct-to-consumer and other sales and marketing operations but they likely will need to do a fair amount of due diligence to find just the right system that fits their business and tasting room.

On the vineyard side, our Practical Winery & Vineyard section features an interesting book excerpt about how heavy-input farming has harmed soils around the world. As scientists have gained a better understanding of soil microbes and the dynamic relationship between plants and the organisms living in the soil, it's become clear that even depleted soils can be brought back to better health.

And speaking of packaging, I'd be remiss if I didn't invite everyone in the industry to join the *Wines & Vines* team for our fifth annual packaging conference on Aug. 9.

For anyone interested in using unmanned aerial vehicles (UAVs) for vineyard monitoring, the second half of Brock University professor Andrew Reynolds's series on UAVs and vineyard mapping on page 60 is a must read. Reynolds focuses on an Ontario study of UAVs used for vineyard mapping that resulted in a wealth of information and maps that growers can leverage for a variety of uses. It actually appears that one challenge could be too much data and maps.

This month's magazine also contains a new feature we're calling Unpacking Packaging on page 56 in which we focus on a new brand, redesign or signature bottling and highlight the packaging suppliers, designers and bottling technology that went into getting the wine ready for market. This feature continues *Wines & Vines* longstanding commitment to covering the packaging segment of the wine industry.

And speaking of packaging, I'd be remiss if I didn't invite everyone in the industry to join the *Wines & Vines* team for our fifth annual packaging conference on Aug. 9 at the Lincoln Theater in Napa Valley. We have another great line up of speakers this year including winemaker Randall Grahm, packaging experts from Nielsen and several other sessions all designed to help you not only make your wine look its best but also sell.

The conference has proved to be one of the highlights of our year, and I sincerely hope you'll join us for an opportunity to network with your peers and raise a glass to the coming harvest. We'll make sure it's a clean one!

—Andrew Adams



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Crimson Wine Group
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Jordan Kivelstadt, Free Flow Wines/Kivelstadt Cellars
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Jessica Gaedeke
Nielsen Innovation Practice
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Brad Mayer
Precept Wine
Packaging that Sells



Featuring Leslie Sbrocco, host of "Check Please! Bay Area," as emcee

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Key Indicators

Complete data is available at **winesandvines.com/metrics.**

U.S. Wine Sales

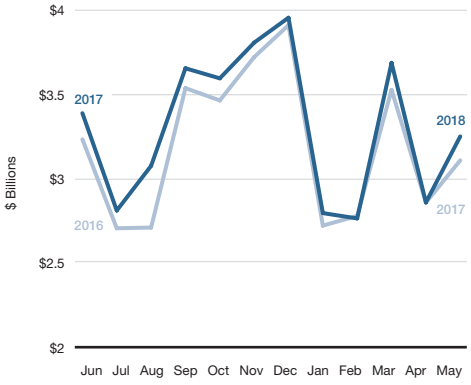
MONTH

May 2018	$3,247M	2% ↑
May 2017	$3,193M	

12 MONTHS

May 2018	$41,497M	<1%
May 2017	$41,311M	

MONTHLY SALES



Source: bw166.com, Wines Vines Analytics. Domestic table and sparkling wine sales on-premise and off-premise.

Off-Premise Sales IRI Channels

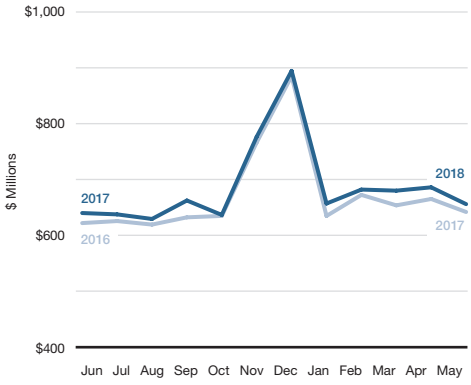
MONTH

May 2018	$656M	2% ↑
May 2017	$645M	

12 MONTHS

May 2018	$8,931M	2% ↑
May 2017	$8,713M	

MONTHLY SALES



Source: IRi, Wines Vines Analytics. Domestic table and sparkling wine sales in multiple-outlet and convenience stores, four weeks ended May 20, 2018.

Direct-to-Consumer Shipments

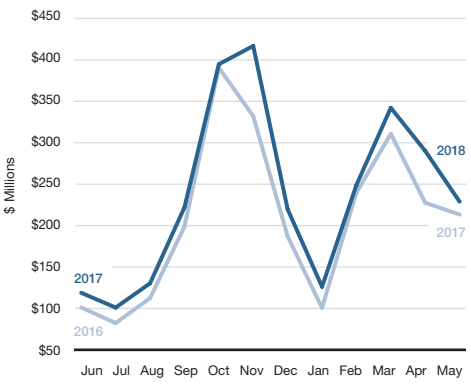
MONTH

May 2018	$229M	7% ↑
May 2017	$213M	

12 MONTHS

May 2018	$2,836M	14% ↑
May 2017	$2,492M	

MONTHLY SHIPMENTS



Source: Wines Vines Analytics/ShipCompliant by Sovos.

Winery Job Index

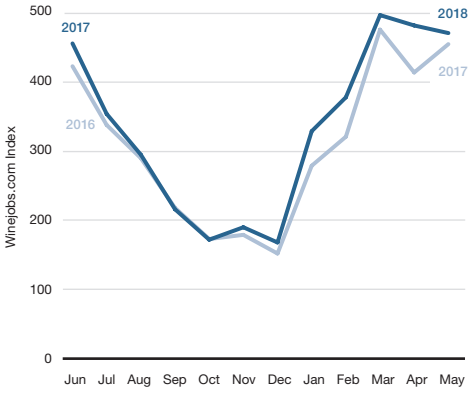
MONTH

May 2018	471	4% ↑
May 2017	455	

12 MONTHS

May 2018	334	8% ↑
May 2017	310	

MONTHLY INDEX



Source: winejobs.com

U.S. Wine Sales

U.S. Wine Sales Rise 2% in May

U.S. wine sales totaled $3.2 billion in May, market research firm bw166 reported, up 2% from a year ago. Domestic table wine sales increased 2% versus a year earlier, accounting for the majority of the gain, but sparkling wine and bulk imports showed healthy growth of 3% and 13%, respectively.

The latest 12 months saw U.S. domestic wine sales unchanged from a year ago at $41 billion. Growth of sparkling wine and bulk imports in the period totaled $512 million, offsetting a $326 million decline in table wine sales.

Packaged imports remained the fastest-growing category, with sales rising 8% to nearly $22 billion in the past 12 months. Jon Moramarco, managing partner of bw166, noted that consumers continue to gravitate to French table wines, primarily rosé, as well as sparkling wines from France and Italy. The result was an additional $1.7 billion in sales for packaged imports, making the category the single-biggest contributor to the $1.9 billion increase in sales of domestic and imported wines in the U.S. in the past 12 months. The sum of all wine sales for the period was $63 billion, up 3% from a year ago.

—Peter Mitham

TOTAL WINE SALES

	$ Millions			
	2017	2018	Change	% Change
Domestic Table, Sparkling & Imported Bulk	$41,311	$41,497	$186	<1%
Packaged Imports & All Other Wines	$20,169	$21,848	$1,680	8%
Total Wines	$61,480	$63,345	$1,866	3%

Source: bw166.com, Wines Vines Analytics. Consumer expenditures for all wines on-premise and off-premise, 12 months through May 2018. Excludes cider.

Off Premise

Off-Premise Sales Increase 2%; Sauvignon Blanc Rises 7%

Off-premise sales through multiple-outlet and convenience stores in the four weeks ended May 20 totaled $656 million, market research firm IRI reported. This was up 2% versus a year earlier, but the lowest monthly tally since last October. Case volumes were flat at 8.3 million. Nevertheless, purchases kept 52-week sales 2% above a year earlier at $8.9 billion.

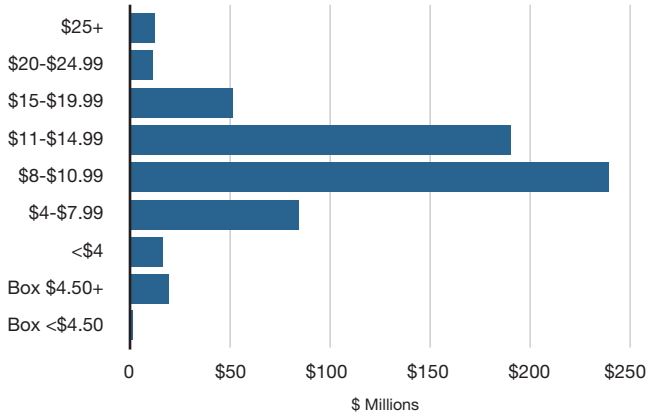
Domestic sparkling wine sales posted the strongest growth, rising 2% in the month and 3% in the year. Domestic table wine sales, a much larger segment, rose 2% in both the month and the year, consistent with overall sales.

With the arrival of warmer weather, upper-end Sauvignon Blanc brands are showing promise. Consumers seeking the varietal stepped up the price scale in the latest 52 weeks, resulting in 16% growth for Sauvignon Blanc at $25-plus a bottle and 15% growth in the $20-$24.99 segment. Indeed, all price segments from $8 up saw greater sales. The trend was seen most dramatically in sales of boxed Sauvignon Blanc, which saw 41% growth among wines selling for $4.50-plus per 750 ml., which represent a total of $19 million, and a 29% drop decline in sales of cheaper boxed brands (a mere drop in the barrel with sales of just $317,166 in the latest 12 months).

Sauvignon Blanc sales rose 7% by value in the period to $623 million. The majority of sales, 69%, occur between $8 and $14.99 a bottle.

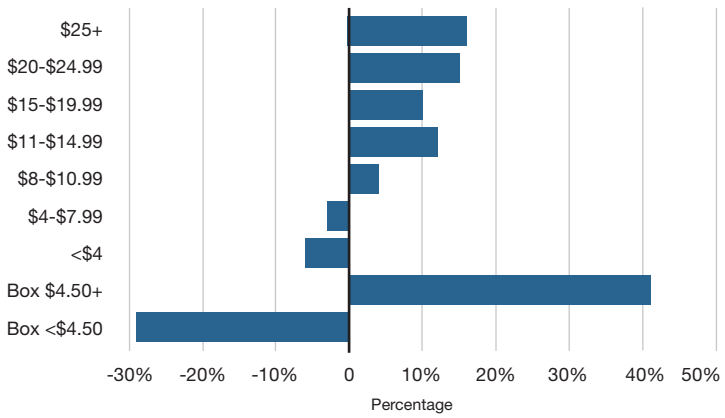
—Peter Mitham

OFF-PREMISE SAUVIGNON BLANC SALES



Source: IRI, Wines Vines Analytics. Domestic table wine sales in multiple-outlet and convenience stores; 52 weeks ended May 20, 2018.

OFF-PREMISE SAUVIGNON BLANC GROWTH (VALUE)



Source: IRI, Wines Vines Analytics. Domestic table wine sales in multiple-outlet and convenience stores; 52 weeks ended May 20, 2018.

Direct to Consumer

DtC Rises 7% in May as Napa Broadens Reach

Direct-to-consumer (DtC) shipments rose 7% in May versus a year earlier to $229 million, Wines Vines Analytics/ShipCompliant by Sovos reported. Case volumes increased 9% to 544,724. The slower growth relative to previous months reflected a seasonal shift as summer arrived with its warmer temperatures. The price of the average bottle shipped in May fell 2% versus a year earlier to $34.96.

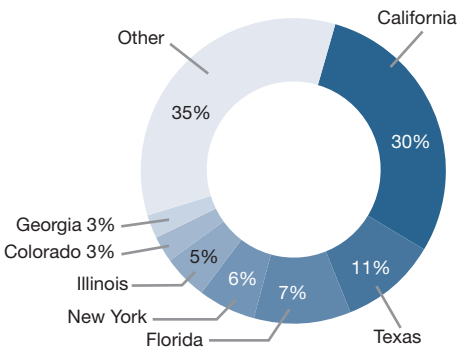
Napa County wineries were the single biggest source of DtC wine shipments in the 12 months through May, with a value of $1.3 billion. This represented nearly 47% of the channel, which overall saw shipments worth $2.8 billion. Shipments from Napa account for 56% of California wines shipped DtC. The primary destination for Napa's wines is California itself, at 30%, down two percentage points from last year as deliveries to other states increased.

Outside of California, Texas, Florida and New York were the top three destinations for DtC shipments from Napa in the past 12 months. This was unchanged from last year, with shipments increasing in step with overall growth of DtC activity. Consumers in these three states also spent the most per bottle, with prices averaging more than $70. Napa wines shipped DtC averaged $63.71 a bottle overall, up 3% from last year, but shipments to Florida exceeded the national average by more than $10 at $74.94 a bottle. New York was second, at $70.75 a bottle, a slight decrease from last year.

Texas, the biggest destination for Napa wines after California, received $143 million worth of shipments in the latest 12 months. These wines averaged $70.18 a bottle, up 7% from last year. The fact reflects strong demand and confidence from consumers in an established market for Napa vintners, well known for that most-popular of DtC varietals, Cabernet Sauvignon.

—Peter Mitham

DTC SHIPMENTS FROM NAPA WINERIES BY DESTINATION STATE—VALUE SHARE



Source: Wines Vines Analytics/ShipCompliant by Sovos. 12 months through May 2018.

Top Stories

The month in perspective

B.C. Resolute in Trade Dispute

As trade relations between the United States and Canada seemed poised to further deteriorate after belligerent rhetoric about America's northern neighbor by President Trump following the G7 conference held June 8-9 in Quebec, Canada, a simmering dispute over wine between the two nations heated up when the United States formally requested the World Trade Organization intervene in a dispute over wine sales in British Columba. Provincial authorities in British Columbia have allowed the sale of B.C. wines in some grocery stores while refusing to allow imported wine space on the same shelves. *See page 14.*

TTB clarifies tax issue

Wineries appeared to be poised to benefit when the federal tax law was signed into law in December 2017, but an announcement by the Alcohol and Tobacco Tax and Trade Bureau in March raised concerns industry-wide that potential tax credits would turn into tax increases. Following an outcry lead by the lobbying group WineAmerica, the TTB clarified itself in May and the tax cuts will remain cuts. WineAmerica, however, is now working to ensure the tax reductions that will end in 2019 remain on the books as a permanent update. *See page 58.*



Samantha Rudd (left)

Auction Napa Valley tops $13 million

The 38th annual Auction Napa Valley raised more than $13.6 million on June 2 at the Meadowood Napa Valley resort. The auction total included a $1 million contribution by Samantha Rudd in memoriam of her late father Leslie Rudd. The top lot, which featured four 6-liter Imperials of Opus One wine and the opportunity for two couples to attend a masked ball at Versailles palace, was doubled and sold for $1.4 million. Hosted by the Napa Valley Vintners, the auction raises money for a host of community service groups focused on child services and health care throughout Napa Valley. The event's barrel auction also saw an all-time record with a lot by VGS Chateau Potelle Winery in St. Helena selling for $114,300.

Sonoma State opens new wine center

The new Wine Spectator Learning Center, which will serve as the headquarters of the Wine Business Institute of the School of Business and Economics at Sonoma State University in Rohnert Park, Calif., officially opened on May 29. The 15,000-square-foot center was a near-complete rebuild of the university's former University Commons building into what the school describes as a modern center featuring three "advanced-technology" classrooms, student commons area, café and garden. The center drew a total of $11 million in donations that included $3 million gift from the Wine Spectator Scholarship Foundation.



Wine Spectator Learning Center

"By bringing together business and community stakeholders from around the world, we expect this new facility will enable even more innovation, more advanced public policies, and better-trained leaders for a changing industry," Ray Johnson, executive director of the institute, said in a press release.

Terlato names new chief operating officer

Terlato Wine Group, which is based in Lake Bluff, Ill., and owns Chimney Rock, Rutherford Hill and other wine companies, announced Sandra LeDrew has been promoted to the new role of chief operating officer. LeDrew will continue to manage winery operations and take on the added responsibility of Terlato Wines International. LeDrew will report directly to president and CEO, Bill Terlato.

Grand jury urges look at farmworker housing

A Napa County Grand Jury recommended a current assessment of the need for farmworker housing in the county and that the county board of supervisors adopt a farmworker housing plan based on new data. In a report released June 5, the jury noted the county last published an assessment on needed housing in 2013 and that was based on 2012 data. While interviews with members of the industry led it to conclude that approximately 25% of the county's wine grape crop is now harvested by machine, some vintners insist on hand harvesting and harvesters can't be used on many hillside vineyards. The jury found it is also unclear how many agricultural workers live outside of the county and existing estimates of the number of farmworker jobs in the county range from 6,000 to 9,000. Because of an increased demand for workers, the jury found many workers want to reside in Napa County and more than 30% of the vineyard workforce are women. The jury also recommended modifying the county code to allow farmworker housing centers to remain open all year.

BV allowed to expand tasting room

Beaulieu Vineyard in Napa Valley earned approval from the county planning commission to host 100 more visitors to its tasting room per day for a total of up to 550 people per day, seven days a week. The winery, which is one of Napa's oldest operating wineries, was also granted permission to host events for up to 250 people. The winery had requested its daily visitor limit be increased as it is planning to move its hospitality center to a stone building dating back to the late 1800s. The winery also plans to seismically retrofit the building.

A to Z wins B Corporation honor

A to Z Wineworks in Dundee, Ore., announced it had won — for the fourth year in a row — "Best for the World" honors from the nonprofit B Corporation. The winery scored in the top 10% in three of six categories related to B Corporation certification standards for social and environmental performance, accountability and transparency. A to Z is now producing around 400,000 cases per year.

Union wine expanding on success of cans

Tualtin, Ore.-based Union Wine Co. has nearly doubled its production of wine from more than 200,000 cases to nearly 450,000 largely on the strength of its Underwood canned wine. The company, founded by Ryan Harms in 2005 now sells wine in 49 states and 12 international markets. The company also announced it hired Adam Coremin as vice president of sales. Prior to joining Union, Coremin was a senior vice president at Precept Wine Brands in Seattle, Wash., and also previously managed brand building and marketing for Michael David Winery in Lodi, Calif. Union also hired 16-year sales veteran Shannon McGill as its Northeast regional sales manager and Brian Altomari as Midwest regional manager. Altomari has more than a decade of sales experience in the Midwest working for J. Lohr Vineyards & Wines and Treasury Wine Estates. The new hires bring Union's sales team to six people who will be supported by a new 43,000-square-foot packaging facility in Oregon.

LATEST NEWS

More detail on the news at winesandvines.com.

AUCTION NAPA VALLEY — ALEXANDER RUBIN

TOP STORY

Napa Votes 'No' on Controversial Measure C

Measure C, the Watershed and Oak Woodland Protection Initiative that some believed would have impeded future development of vineyards and wineries in Napa County, appears to have failed based election results.

Placed on the June 5 primary ballot, it took until the fourth round of results were released on June 13 for any clear indication on which way Napa County residents voted on hotly debated measure. With 97% of ballots counted, "no" votes came to 17,472 (50.92%) and "yes" votes totaled 16,839 (49.08%).

Napa County Registrar of Voters John Tuteur, who ran unopposed and won in the election, told *Wines & Vines* in an interview that, due to "voter-involved damage" to mail-in ballots, the county's election division had between 750 and 1,000 ballots that needed further review or duplication.

Furthermore, California law requires that 1% of county precincts' votes be counted by hand; with 167 precincts inside Napa County, the election division will be conducting a manual tally of all races on approximately 1,200 ballots from two randomly selected precincts, according to Tuteur. "Close elections always put a lot of focus on the registrar, but remember my job is to count every vote accurately not quickly," Tuteur said. "Final results will be published with the certified statement of vote during the week of June 25, 2018."

Measure C would have limited the removal of trees from land zoned as "agricultural watershed" to 795 acres. After that limit was reached, the removal of any additional trees would have required a permit and every tree cut down would need to be replaced by three more trees, according to the measure.

Those in favor argued that protecting these zones would improve Napa's water quality and, thus, its agriculture — namely its vineyards. Mike Hackett, co-author of the measure, said preserving oak trees means promoting water conservation. He estimated that about 70% of the valley floor, where most of Napa's agriculture lay, benefits from the flow of the agricultural watershed. "Trees capture rain, feed it into the permeable layer — the macro pores — entering the aquafers that go directly into the valley floor," he said. "If we take great care of our hillsides, our tree-d hillsides, we will continue to have a sustainable water supply for our agriculture and our community."

But those opposed to the measure argued that limiting potential vineyard acreage could pose a threat to both the environment and the wine industry. Stu Smith, general partner and enologist at Smith-Madrone Winery in Napa, Calif., spoke to *Wines & Vines* about the potential for increased fire hazards and the limiting opportunities for smaller or up-and-coming grape growers and wineries.

Prior to the election, he described the debate over Measure C as a "breakdown of morality," in which some growers are benefiting while others lose. "They (the supporting vintners) are taking land rights for their benefits," Smith said. "They don't own any oak woodlands, they give up nothing, but they are taking from the oak woodlands the water they want from the oak woodlands."

—Stacy Briscoe

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B.C. Resolute in U.S. Wine Trade Spat

The threat of World Trade Organization (WTO) intervention shows that three years of criticism and even a change in government has failed to dampen British Columbia's resolve in allowing only its own wine to be sold in grocery stores. U.S. Trade Representative Robert Lighthizer made good on those threats May 25 with a formal request to the WTO for a dispute settlement panel after formal complaints and consultations with Canada last year failed to resolve the issue. Argentina, Chile, Australia and Europe support the U.S. challenge, meaning the B.C. industry faces a world of opposition.

The plans, first announced in December 2014, called for allowing only wines made entirely from B.C. grapes and bearing the BC Vintners Quality Alliance (BC VQA) designation to be sold in the province's food outlets. Other wines would be sold via a store-in-store model requiring a separate check-out. This drew sharp criticism from California's Wine Institute.

Tom LaFaille, then vice-president and international trade counsel with the Wine Institute, took issue with the provisions in a letter to the province's premier of the day, Premier Christy Clark, asking "the initiative be withdrawn or modified to allow for equal access of all wines at B.C. grocery stores." David Eby, who oversaw liquor policy for the party and now serves as the province's attorney general, initiated a review of provincial liquor laws in late 2017. Results of the review have not been made public.



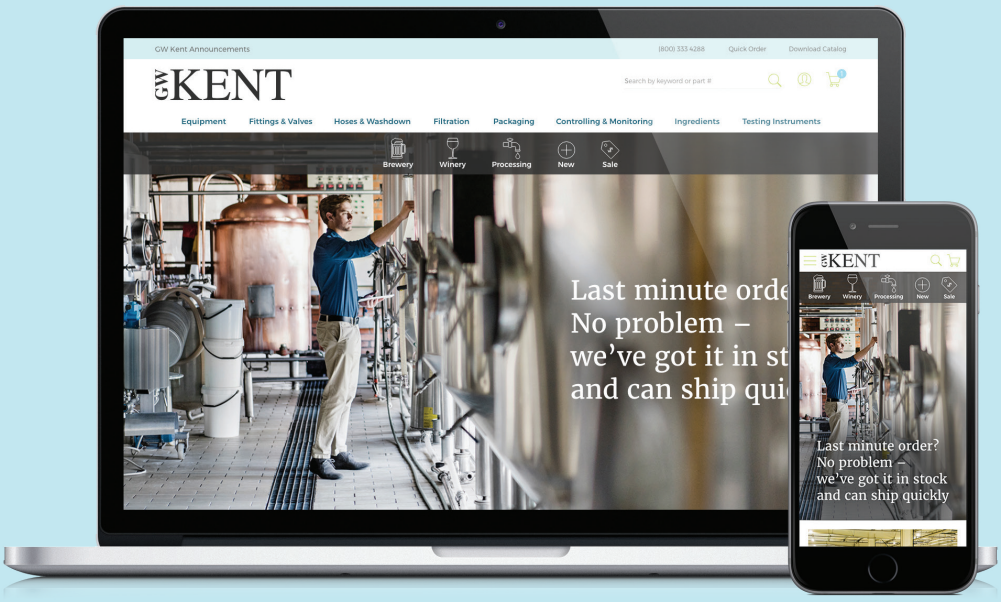
Unlike this New Brunswick supermarket, most British Columbia grocers can't sell foreign wines alongside domestic product.

Provincial trade minister Bruce Ralston doubled down on supporting wine sales in grocery stores, upholding the previous government's line that the North American Free Trade Agreement allows some private wine outlets to sell only B.C. wine. Miles Prodan, president and CEO of the B.C. Wine Institute, expressed confusion over the ongoing U.S. concerns, but said he plans to be proactive in working with all levels of government and addressing concerns across all trade issues.

Prodan and others, including Bert Hick, principal of liquor license consultancy Rising Tide Consultants Ltd. in Vancouver, say allowing grocery store sales to sell whatever wines they want would damage the B.C. industry because listings would tend to be from high-volume wineries selling more affordable bottles. "If the decision is, as a result of this, that imported products have to be there as well, it's very difficult for the B.C. wine industry to compete with the likes of Gallo," Hick said.

Hick doesn't feel the previous government's approach to creating space for wine in supermarkets was the right one, but it's tough for government to backtrack now given the number of licenses it has issued and the millions of dollars retailers have spent to establish the channel. The result could be a dramatic reshaping of wine retailing in B.C., which currently occurs through government stores, private liquor stores, private wine stores, stores licensed to sell BC VQA wines, winery stores as well as the wineries themselves, and now grocery stores.

—Peter Mitham



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Paso Robles' Next Wine Wave



RENDERING BY PROJECT M+

Architectural rendering of proposed Paso Market Walk in downtown Paso Robles, Calif.

Earlier this year, the city council in Paso Robles, Calif., unanimously approved a rezoning plan to a section of blocks on the northeast side of the city's central park, allowing small-scale production, including boutique winemaking.

Christopher Taranto, communications director for the Paso Robles Wine Country Alliance said the wine industry development will help the city achieve its goal of revitalizing some downtown neighborhoods. By rezoning a section of blocks between 13th and 15th Streets, and Spring Street and the Union Pacific Railroad, the city has made wine, spirits and beer production permissible for a significant portion of the downtown district — a first for Paso Robles.

As for policing the volume of wine manufactured downtown, associate city planner Darren Nash said the existing layout serves as a primary limiting factor, as the use of existing buildings, not empty lots, make up the majority of vacant space available. Nash said those looking to make wine at large volume, will need to go outside downtown or even outside the county. City staff have recommended any company wanting to set up a production facility downtown to secure a conditional use permit beforehand.

Deborah Longo of Montecito Choice LLC said she was hoping to break ground at the end of June on the new Paso Market Walk, a public market she describes as akin to Oxbow Public Market in Napa, Calif. While Longo has no specific plans to offer the space to winery tenants, she expects that nearly all retailers and restaurants within the market will sell local wine.

In southeast Paso Robles, a cluster of wineries has moved into an industrial zone in the 3300 block of Ramada Drive. Like the nearby Tin City complex, the zone is slated to offer a walkable area for visitors while combining production and tasting rooms for wine, beer, spirits and cider producers. Cordant and Nelle wineries were the first wine-producing tenants to constitute the Ramada block properties about one year ago, followed by Seven Oxen, Anglim Winery, and Anarchy Wine Co. The block will also include a new brewery and distillery.

—Jamie Lewis



Latest Research on Wine Smoke Taint

The Innovation + Quality (IQ) conference held May 23 and 24 at the Silverado Resort and Spa in Napa, Calif., hosted a panel of experts discussing questions surrounding smoke taint in relation to their recent research.

Dr. Kerry Wilkinson, associate professor in oenology at the University of Adelaide in Australia, relayed her research regarding the difference in smoke taint effects across grape varieties. Wilkinson exposed seven different varieties to smoke at seven days post-veraison, when the berries are most susceptible to the permeation of the volatile phenols produced by smoke. Wilkinson's team harvested each row of vines at maturity, immediately looked at the fruits' composition and observed a big difference between the smoke tainted grapes verses the grapes from protected control groups: glycoside compounds (responsible for volatile phenols) were much more prevalent in the grapes exposed to smoke than those that were not. When they produced wine with the grapes, Wilkinson noticed the same pattern, but noted the levels of glycoside compounds in the grapes don't necessarily predict the levels in the resulting wines.



Smoke from a 2017 wildfire in Sonoma County.

Red varieties had much higher instances of volatile phenols than whites. "But then… it looks like some varieties are more susceptible than others," Wilkinson said. Of the whites, Pinot Gris had much higher levels of taint; Cabernet was the most tainted of the reds. According to Wilkinson, the reasoning behind this is inconclusive, and she's currently looking for another project to study this in detail.

Dr. Tom Collins, assistant professor of grape and wine chemistry at Washington State University in Pullman, Wash., presented his research on how the source of smoke influences the smoke taint composition in wine grapes by measuring the chemical composition of smoke from 15 different rangeland plant varieties known to grow along Washington vineyard sites and comparing that to smoke composition of common tree mulch from Washington forests. Chemical compositions varied across the burnt plant life, but it was the rangeland plants that provided the highest amount and most variety of volatile phenols.

To conduct the smoke taint trial, Collins used Merlot and Cabernet grapevines just past veraison, treating the Merlot with rangeland smoke and the Cabernet to forest mulch smoke. He presented both his Merlot and Cabernet for comparison. While both samples presented obvious smoke taint, it was the Merlot that emitted the most sensory phenolic affects.

During the technical tasting, winemakers presented trials on minimizing smoke taint sensory perception in wines. These included decreased fermentation temperatures and oak regimen (conducted at the University of California, Davis, research and teaching Winery), flash détente (conducted by the Carneros Vintners) and varied maceration time (conducted by A to Z Wineworks). While all trials displayed minimizing effects, experts across the board agreed that none of them are a cure for the latent phenolic compounds residing inside smoke tainted wine.

—Stacy Briscoe

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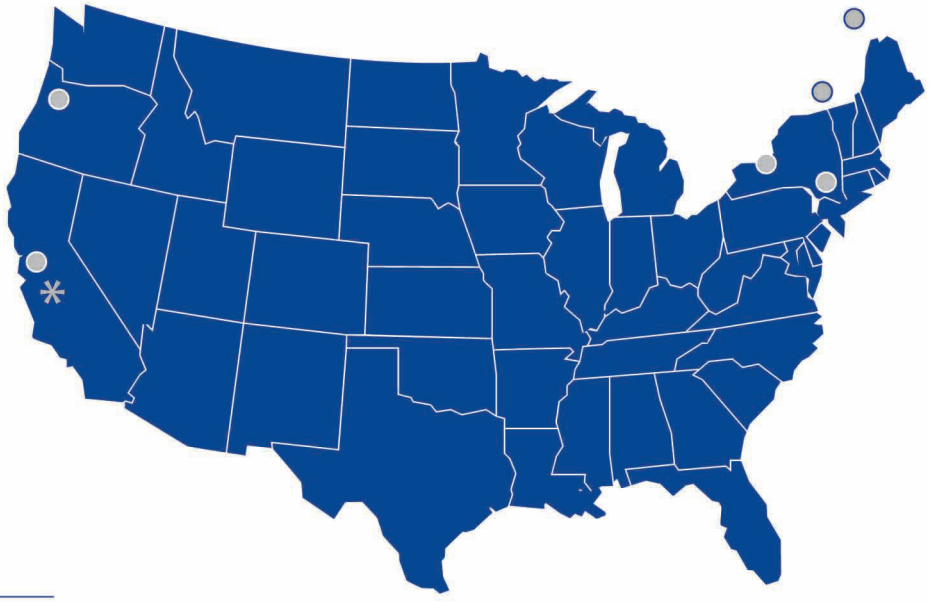

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Regional News

CALIFORNIA

Silicon Valley Wine Auction tops $1 million

The fourth annual Silicon Valley Wine Auction, hosted by Santa Cruz Mountains Winegrowers Education Foundation (SCMWEF) on



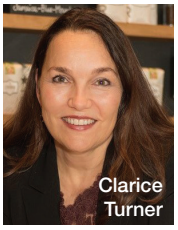
May 19 and 20, raised more than $1 million for education programs that serve local communities. The two-day event attracted more than 1,000 guests to Eden Estates and Montalvo Arts Center in Saratoga. The weekend-long event featured 50 local vintners from the Santa Cruz Mountains Winegrowers Association pouring more than 150 wines.

Melka joins Westwood

Winemaker Philippe Melka will oversee winemaking at Westwood Estate Winery in what will be the French winemaker's first project in Sonoma Valley, according to a statement by the winery. Melka will be working with Pinot Noir and Rhône variety grapes form the Sonoma Valley winery's Annadel Gap Vineyard that is certified organic through Stellar Certification and Demeter Association biodynamic certified. Melka will finish the 2017 vintage wines and will oversee the 2018 vintage with Silverado Farming Company.

Phelps hires new president

Joseph Phelps Vineyards appointed Clarice Turner as its new president. Prior to joining Phelps, Turner founded and was CEO of Carneros Associates, a strategic advisory firm guiding vision, strategy and culture for businesses in transition.



Clarice Turner

Pine Ridge promotes assistant winemaker

Pine Ridge Vineyards promoted Colleen FitzGerald to assistant winemaker for the winery's white blend, Chenin Blanc + Viognier. In her new role, FitzGerald will lead the vineyard and winery operations under the direction of Michael Beaulac, working with growers in the Clarksburg AVA to make decisions about pruning, vine management, and harvest timing; in the cellar, she will see the wine through fermentation and blending. FitzGerald remains the winery's enologist as well.

Sonoma winegrowers hire sustainability expert

Sonoma County Winegrowers hired Dana Cappelloni as its new director of sustainability and grower education as part of its effort to become the nation's first 100% sustainable wine region in 2019. In her role at the winegrowers, Cappelloni will work directly with growers to achieve certification and facilitate continuing education programs on sustainable wine grape growing for the Sonoma County grower community. As of January, the winegrowers reported 72% of the county's total wine grape acreage had been certified and 92% had been assessed.



Dana Cappelloni

New leader for Rhône Rangers

The national Rhône Rangers board of directors appointed Kim Murphy-Rodrigues as its new executive director. Rodrigues' experience includes general management, new business development

The Gourmet Barrel

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and marketing in both the wine and produce industries. She's also been active in the Paso Robles Rhône Rangers chapter for several years, co-chairing and serving on various committees.

Lula's Jeff Hansen dies

Jeff Hansen, the founder of Anderson Valley's Lula Cellars, passed away on June 5 at UCSF Medical Center in San Francisco. He was 66. Hansen's career in wine began in 1987 working in the tasting room of Spring Mountain Vineyard in Napa Valley. Later, while working in sales for Spring Mountain, he discovered the Anderson Valley region in Mendocino County. In 1991, Hansen produced his first wines for Amici Cellars in Calistoga, and continued to make wines for the label for nearly 20 years. In 2009 he sold his interest in Amici, creating the small-batch Anderson Valley winery, Lula Cellars. In 2017, Hansen stepped down as winemaker at Lula Cellars, retaining the title of founder, and serving as winemaker *emeritus*.

NORTHWEST

Wilson Daniels Wholesale acquires Galaxy in Oregon

Wilson Daniels Wholesale announced it is acquiring Portland, Ore.-based Galaxy Wine Company from founders Matt Elsen and Bob Liner. After the deal closes, Galaxy will operate under the wholesale division of importer Wilson Daniels LLC, which is a New York-based subsidiary of Young's Holdings. Elsen and Liner will continue to lead Galaxy's existing staff. Galaxy imports wines from more than 400 producers into Oregon.

Cowhorn tasting room certified

The tasting room at Cowhorn Vineyard & Garden in Jacksonville, Ore., has earned Living Building certification, making it the first commercial building in Oregon and one of the first in the wine industry to earn the green building standard. Green Hammer, a unified design-build firm based in Portland, designed and built the


Cowhorn Vineyard & Garden

2,200-square-foot tasting room, which includes a case storage area. As of May 2018, only 20 buildings worldwide have achieved Living Building certification, according to the International Living Future Institute.

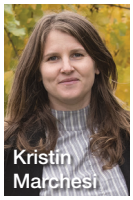
Changes to Black Hills winemaking team

Black Hills Estate in Oliver, B.C., announced that after working at the winery for 10 years, winemaker Graham Pierce is transitioning to a new role as consulting winemaker. In this new part-time position, Pierce will continue to be involved in key strategic decisions and practices in the winery's winemaking program, including grape picking, fermentation, barrel selection, blending and stylistic directions. As consulting winemaker, Pierce will also work closely with Black Hills' future winemaker and the existing winery team to execute the day-to-day operations.

Panther Creek Cellars opens new tasting room

Panther Creek Cellars in Dundee, Ore., opened a new tasting room in Woodinville, Wash. The tasting room integrates reclaimed and local materials with a Pacific Northwest design. "We'll feature horizontal and vertical flights, offering guests the chance to explore one wine over multiple vintages or one vintage across multiple vineyards," said Madelaine Morford, Panther Creek tasting room director and assistant general manager in a statement.

Montinore Estate names new president


Kristin Marchesi

Montinore Estate, in Forest Grove, Ore., announced Kristin Marchesi is the company's new president. Marchesi is taking the reins

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from her father, Rudy Marchesi, who became proprietor of the estate and winery in 2005. In her new role, Marchesi will be responsible for expanding Montinore Estate's presence as a leader in sustainably grown cool-climate varietals.

Archery Summit hires new winemaker

Ian Burch is the new winemaker at Archery Summit winery in the Willamette Valley of Oregon. Burch will direct and oversee all winemaking operations, from vine to bottle. Burch studied wine and viticulture at California Polytechnic State University, San Luis Obispo and has worked harvests in Australia, California, New Zealand, Oregon and France before settling in the Willamette Valley in 2008. Most recently, Burch was winemaker for Scott Paul Wines in Carlton, Ore.

New DtC manager at Youngberg Hill

Youngberg Hill appointed Karyn Howard Smith as the winery's first full-time direct-to-consumer manager. This is a new position for Youngberg Hill, as the winery continues to expand its consumer-based offerings and operations. Smith will play a leading role in the development and execution of all DtC programs. Smith joins the Youngberg Hill team with more than 15 years of experience in the wine industry, and a background in luxury goods.

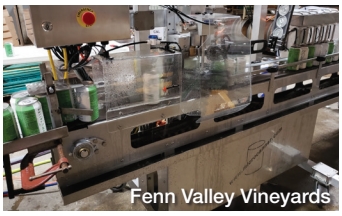
CENTRAL

RNDC names new senior VP for wine

Republic National Distributing Company (RNDC), headquartered in Grand Prairie, Texas, promoted Russell Motz to senior vice president of supplier business development for its wine division. Motz previously held the position of vice president of retail national accounts. In his new role, Motz will have responsibility for leading the RNDC strategy related to supplier business development for wine and work closely with the sales leaders on various business initiatives.

Fenn Valley launches canned wine

Fenn Valley Vineyards in Fennville, Mich., invested in canning equipment and claims to be the first Michigan winery launching a canned wine. The family-owned winery launched Vino Blanco in 375 ml cans and plans to offer canning services to other wineries


Fenn Valley Vineyards

in the state. The new wine brand will initially be distributed to retailers in Michigan and Illinois.

EAST

Southern expands Jackson Family Wines distribution

Southern Glazer's Wine & Spirits, North America's largest wine and spirits distribution company, announced it has expanded its distribution relationship with Jackson Family Wines in Florida. Southern Glazer's will now distribute Jackson Family Wines in 13 U.S. markets, including Arkansas, Alaska, Arizona, Delaware, Hawaii, Iowa, Idaho, New York, Ohio, Oregon, and Washington.

Constellation promotes Sabia to chief marketing officer

Constellation Brands, Inc., headquartered in Victor, N.Y., announced it promoted Jim Sabia to the newly created role of executive vice president and chief marketing officer. In this new role, Sabia will serve as the marketing lead for the company's beer, wine and spirits divisions, responsible for all aspects of marketing across Constellation's entire beverage alcohol portfolio. Sabia will serve as a member of the


Jim Sabia

company's executive management committee and report directly to Bill Newlands, president and chief operating officer.

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Hudson Valley group adopts bottle logo

The Hudson Valley Cabernet Franc Coalition (HVCFC) launched a distinctive seal that will mark locally produced bottles meeting HVCFC's standards of high-quality production and authenticity. The seal — which features a soaring hawk — is meant to guarantee that 85% of the grapes used in making the wine are grown in the Hudson Valley and that the wine has been aged for at least 12 months. The hawk icon symbolizes the unified commitment of HVCFC members to grow and produce Cabernet Franc wines that capture the region's *terroir*.



SUPPLIER NEWS

Winebow appoints new leadership

The Winebow Group, headquartered in Glen Allen, Va., announced Dean Ferrell is the company's new president and chief executive officer and Ian Downey was appointed to the newly created position of executive vice president of Winebow Imports. Ferrell, who previously served as executive vice president and chief financial officer of The Winebow Group, succeeds David Townsend, who will remain on the board of directors. Downey, in his new role, will ensure that the import divisions align strategic efforts and streamline activities to benefit suppliers and customers.

Winemaker launches equipment repair service

Winemaker Fintan "Fin" du Fresne launched Winery Mechanical Systems, which he says in the Central Coast's first provider of comprehensive, winery-specific repair and maintenance services. Managing technician Daniel Krichevsky has more than a decade of winemaking and winery facilities maintenance experience on California's Central Coast. Winery Mechanical Systems is also partnering with key winery equipment manufacturers to operate as an authorized service agent, such as Willmes presses and Armbruster grape destemmers, sorters and conveyors.

M.A. Silva USA hires operations director

M. A. Silva USA, a vendor of corks, glass and packaging in Sonoma County, announced the addition of Kevin Hernandez as operations director. In this new position, Hernandez will lead the quality and manufacturing departments with the goal of continuous improvement and production efficiency.

WS Packaging Group names new chief commercial officer

WS Packaging Group in Green Bay, Wisc., announced Mark Roy as its new chief commercial officer. Roy's 25-year career has spanned private equity owned, publicly traded, and privately held companies. In the newly created role of chief commercial officer, Roy will focus on oversight of sales, marketing, account management, customer services, strategy, and business development.

SolarCraft Completes Solar Power System at Comstock Wines

Novato and Sonoma-based SolarCraft recently completed the installation of a 165 kW DC solar system at Comstock Wines in Healdsburg, Calif. The system is designed to produce 205,000 kWh annually and is expected to offset 80% to 90% of the winery's utility bills, helping the winery save thousands every month in electrical costs. The solar photovoltaic system is mounted on south-facing roof of the winery for maximum sun exposure and is touted to eliminate over eight million pounds of carbon dioxide during the life of the system, which is estimated to be more than 30 years.

Correction

Justin Seidenfeld, winemaker at Rodney Strong Wine Estates, was identified incorrectly in a photo on page 51 of the June edition of *Wines & Vines*.



Product News

Latest offerings and announcements

Decorate the top of the can

Ball Corporation is now offering the option of a decorative lid on the top of its aluminum cans. The proprietary "Cameo" end printing



"extends customer branding to the top of the can," and is intended to make canned beverages even more appealing to a customer. The option will be available in early 2019. "For our customers, Cameo extends the can's 360-degree billboard to the top of the package, further increasing brand visibility and offering exciting new possibilities for contests, special promotions and limited release packaging," said Jay Billings, Ball's vice president of commercial beverage packaging in North and Central America. ball.com

Insurance for wine shipments

Roanoke Trade, a subsidiary of Munich Reinsurance Company, is now offering what it calls "quality shortfall coverage" that is based on the technology developed by eProvenance for monitoring wine during transport and storage. According to Roanoke, the new quality shortfall coverage will insure wine shipments against reduction in value during transit or storage incidental to transit. When proper conditions are not maintained, and wine quality has been compromised, the insured can opt to have the shipment destroyed and reimbursed as per the terms of the coverage. roanoketrade.com



Must mover

P&L Specialties new Must Vessel is designed to provide a simple way to move sorted and destemmed berries from the processing line to the fermentation tank. The stainless steel bin features 8-inch wheels with locking brakes and fork lift channels so it can be lifted above tanks. Once in position above a tank, an operator opens a knife gate valve at the bottom of the vessel and the must flows into the tank. An optional motorized drive enables the valve to be operated by remote from the forklift. pnlspecialties.com

Destemmer for fragile varieties

Bucher Vaslin introduced the Delta Evolution 2 destemmer to provide what it describes as "superior protection of the most fragile grape varieties" when paired with the company's Delta Trio XS sorter. The destemmer is equipped with a cylindrical cage that turns in the same direction as the destemming shaft to prevent any shear on the grapes. Rounded edges on the inner and outer perforations of the cage further reduce the risk of berry damage and destemming is conducted by adjustable fingers and rubber tips. The rotation of the cage and shaft can be adjusted with two variable frequency drives through one interface and the speed ratio between cage and shaft can be changed with an internal switch. bvnorthamerica.com

Tank cleaning nozzle

Bex introduced the TWK Nozzle Series for cleaning and rinsing applications. The nozzles feature a self-rotating head to provide 360-degree spray coverage in a compact assembly. The nozzles can be installed in any orientation, operate up to 100 psi and 180°F and are ideal for vessels up to 10 feet in diameter. Bex reports the nozzles provide a concentrated, higher impact spray, and large droplets from a two-slot design fly further "delivering maximum impact on the target." bex.com



Canning services

AWDirect, which provides wine and grape sourcing, brand development and sales support, is now offering wine canning services by The Can Van. Santa Rosa, Calif.-based AWDirect and The Can Van can provide 187ml, 250ml and 375ml cans in 24-can cases for domestic or international varietal and blended wines. The 250ml cans are packed in custom-printed four-pack, paperboard cartons or 4-plastic snap top carriers. awdirectusa.com

Enhanced compliance reporting

Process2Wine announced an enhanced compliance reporting function to help vineyard managers by generating monthly pesticide use reports. Automated data entry is also coupled with GPS tracking of vineyard work to track which vineyard blocks have been sprayed, time of application and duration. All data is recorded automatically in the Process-2Wine system and managers can even monitor work being done in real time through the web and mobile application. process2wine.ca



Scott Labs to distribute PALL

Scott Laboratories announced it is now the exclusive distributor of new machines and all parts, service and technical support for existing and new PALL Oenoflow crossflow systems in the North American wine industry. Scott Labs technicians and PALL staff will be working together on service appointments in the upcoming months to ensure a seamless transition, according to the press release announcing the agreement. scottlab.com

New line of bottles

Quest unveiled "The Unstandard" collection of 24 wine and spirits bottles at the recent Wine & Spirits Wholesalers of America conference. The new line features bottles from a collection of manufacturers including Estal, Pavisa, Verallia, Allied, Bormioli Luigi and Piramal. The inspiration for the



new collection came from popular movies, and Quest is using the collection to "showcase the transformative power of great design, technique and the latest technology." byquest.com

'Avant-Garde' bottle option

Saverglass added the Aikido bottle mold to its Avant-Garde collection of glass. The bottle features "slanted shoulders punctuated by a chiseled" edge in a design that also is inspired by the "assertive lines from the world of spirits." The bottle is available in 750 ml and in antique green or clear glass. saverglass.com

Centrifugal pump with helicoidal impeller

Inoxpa debuted the RVN Helicoidal Pump that is a centrifugal pump with a helicoidal shaped impeller. The supplier reports the pump is ideal for pump overs that require a high flow rate with minimal impact on the must and can even contribute to better extraction with reduced lees formation. The pump can also be used for wine transfers and other cellar operations. Other features include a close-coupled NEMA motor, pump casing with drain port, sanitary clamp connections and can be mounted on a cart with a variable frequency drive. inoxpa.com

Broad-spectrum biofungicide

Isagro USA announced the California EPA has approved Taegro 2, which is a broad-spectrum biofungicide. The new compound can be used as protection from major soil-borne and foliar diseases and is suitable for conventional crops as well as on organic fields as it is listed with the Organic Materials Review Institute. According to the supplier, Taegro 2 features a unique mode of action and requires low application rates and "user-friendly formulation with flexible application methods." isagro-usa.com

ANDY STARR

Lot Traceability and Quality Assurance to Reduce Risk

You bottled 1,000 cases of 2016 Chardonnay over two days. Near the end of the run, your sterile filter plugs, with about 80 cases left to bottle. You grumble about using another expensive filter cartridge. You have an eight-person bottling crew waiting around, so you rush the filter preparation process and skip bubble testing. Three months later, you learn that you've had a few customer complaints of cloudy wine that's also a little fizzy. You're worried that you have a giant problem and might need to recall the entire vintage from the market and your warehouse.

A scenario such as this will test your quality-assurance and lot-traceability systems. For many, lot traceability is considered another "have to" of useless government paperwork or is easily dismissed because wine isn't cheese. It can't kill you.

Siemens is Europe's largest industrial manufacturing company, making everything from skyscraper fire-safety systems to medical diagnostic devices to industrial-automation equipment. Its quality standards are among the highest in the world, and if the company makes things incorrectly, it *can* kill you. On Siemens' website, Lot Traceability is defined as the "readily available access to the complete history of all manufactured lots, batches and serialized units, spanning production in multiple plants. It includes materials consumed, processes and equipment utilized, parametric and quality data collected, exceptions, rework, dates and times, and electronic signatures." Sounds as if they gave this some thought.

The 2011 Food Safety Modernization Act has put a new focus on lot traceability, requiring wineries to keep records of all materials that went into the wine. In addition, the FDA has stepped up winery inspections and audits to ensure actual compliance. But even if it wasn't required by law, there are many good reasons to institute a real lot-traceability program.

In interviewing a diverse group for this column — winemakers at a small premium winery with an outstanding brand; an expert with an enormous wine conglomerate; a leading expert in bottling quality-assurance processes; and a manufacturer of packaging-identification systems — it became clear that improving quality assurance and lot traceability will provide significant value to any winery.

The single most common theme in all interviews is that your bottle's label does not define a "lot" according to Siemens' definition and that a proper approach reduces the winery's economic risk exposure in the event of a post-bottling problem.

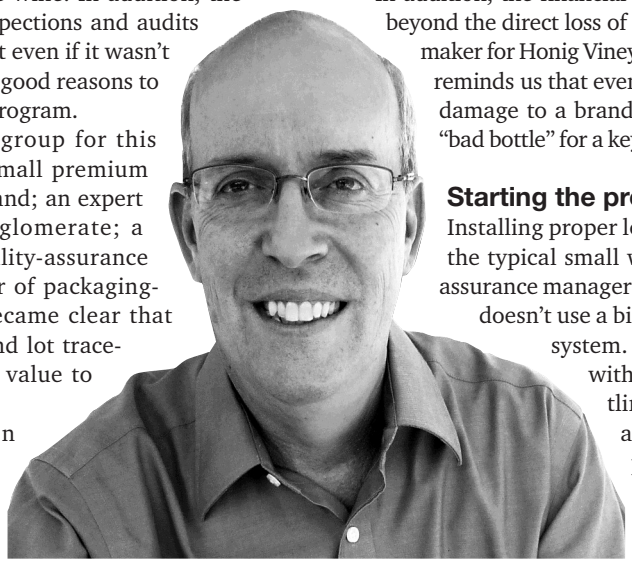
Going back to our hypothetical 1,000 case Chardonnay bottling:

Without a good lot-traceability system: Ron Varner, director of bottling and technical services for G3 Enterprises — an integrated "grape to glass" packaging and services supplier in Modesto, Calif. — said, "If you don't have the ability to isolate the problem within the run, then you have to assume the problem affected 100% of the 12,000-bottles." If it turns into a product recall and you have only the "2016 Chardonnay" label as your lot identification, then you have to recall the entire run. At $20 per bottle, the potential loss is $240,000.

With a good lot traceability system: You can have the problem bottles returned (or even just get a photo of the inkjet bottle code) and identify exactly when these were filled; what tank and sterile-filter cartridges were used; and the specific lots of glass, closures, capsules and labels by vendor, production date, etc. In addition, you'd have notes from the bottling days. With bottle codes, you'd quickly be able to narrow down the problem to that new sterile filter and read the line operator's notes that there had been some concerns about the filter. You'd recall only 1,000 bottles, or 8% of the run, while 92% remains on the market with good confidence the problem has been isolated. At $20 per bottle, the potential loss is reduced from $240,000 to $20,000.

"You can still ship the balance of the wine," Varner said of using a robust traceability system. "You can be precise. It's always better to remove just the tumor instead of an entire limb."

In addition, the financial impact of a quality problem goes beyond the direct loss of product. Kristin Belair, head winemaker for Honig Vineyard & Winery in Rutherford, Calif., reminds us that even "a few bad bottles can do a lot of damage to a brand," and anyone who has poured a "bad bottle" for a key account or reviewer would agree.



Starting the process

Installing proper lot traceability seems daunting, as the typical small winery has no dedicated quality-assurance manager or purchasing manager and likely doesn't use a big JD Edwards enterprise software system. Your week is already jampacked with getting your barrels topped, bottling supplies ordered and making a Costco run to get more toilet paper. (The Costco comment honors the life of my friend, winemaker Dave Stevens, whom we all miss dearly.)

Yet every interviewee thought a small winery can and should do this and offered advice on how to do so.

Jennifer Murray is vice president of quality for wine and spirits for Constellation Brands, the owner of Robert Mondavi, Clos du Bois, Simi, Ravenswood, Estancia, Black Box and many, many others. With extensive experience in quality and regulatory issues, Murray recommends starting by forming a cross-functional team to include production, quality assurance, procurement and accounting. In a small winery, that may be just the owner, winemaker, bookkeeper, plus whoever orders packaging supplies, as they are the first control in the process, and the person who handles consumer complaints, as they cover the last control point in the process. (In a small winery, it's likely that one of these people also does the Costco run when you're out of town.) This team should meet to develop a process and activity map that identifies and documents your everyday activities and answers questions such as:

- What are all the steps in the production and bottling process?
- Who is the owner of each step?
- Where do raw materials go once they are received?
- How are raw materials tracked from receipt to use?
- What are common consumer complaints?
- What adverse events make you worry?
- What data are we currently tracking?

Murray said "going through the process can be an eye-opener," as it shines light on gaps in your current methods and record-keeping. After completing the process map, then create a document list so that you can confirm completion of each activity. This document list forms the start of your lot-coding system. Ultimately, all numbered documents will culminate in a unique master number, your lot code, which identifies every piece of documentation for the lot. At Constellation, lot-traceability and coding processes are continually being evaluated and improved.

Log the data: Ashley Egelhoff is assistant winemaker for Honig Vineyard & Winery, responsible for its quality-assurance programs. According to Egelhoff, logging the data is straightforward as "existing wine production software is already set up for this."

Honig uses the blend software and cellar-tracking module from Orion Wine. Varner at G3 adds, "You can record with ink and paper at the bottling line, and then transfer later to an Excel spreadsheet or your production software."

Pre-bottling: Much of what you should be doing pre-bottling is ensuring quality and preventing problems. In addition, Egelhoff notes that any future insurance claim requires the winery to provide baseline pre-bottling data showing the wine was in good condition at bottling. Honig does these pre-bottling analyses: free and total SO_2, pH, TA, VA, dissolved oxygen, residual sugar (even if you believe it's dry), CO_2, heat and cold stability for whites, malic acid for reds, and microbiological testing for sterility; plus tests for spoilage byproducts such as 4EP and 4EG for Brettanomyces and TCA for wood corks.

Even if it wasn't required by law, there are many good reasons to institute a real lot-traceability program.

During bottling: This is where your planning gets tested. Varner said you should keep it simple and recommended using — and logging the use of — product sequentially, e.g., cork box No. 1, cork box No. 2, etc. on bottling day. Varner stressed the need for good record-keeping for anything that touches the wine, such as bottles, closures and sterile filters. Belair stresses testing filter integrity at the start *and* end of each day, and logging the time and date when you change to a new one.

Bottle coding: The group consensus is that lot traceability works only with a bottle code. While case coding should be done as well and is helpful at the warehouse level, the consumer buys and makes a complaint about a single bottle. Without an identifying mark on that bottle, you will likely return to recalling your entire run of 2016 Chardonnay.

Chad Carney, vice president of marketing and corporate communications for Squid Ink in Brooklyn Park, Minn., sells inkjet bottle-marking machines starting at $6,800. Laser etching is more expensive and provides a permanent mark, as it etches rather than relying on ink. Squid Ink's marking device mounts on the bottling line conveyor and prints on bottles as they move by. Carney said data collected should be compatible with whatever software a winery is using, from an Excel database to winery production software to a JD Edwards platform.

Squid Ink's case-marking equipment starts at $1,800, and its products are sold through bottling-equipment distributors, including Epic Labeling and Veritiv in Northern California. Honig uses a Markem laser etcher for bottles and a case printer with time and date as well as any other required information.

Bottling marking is becoming standard on mobile wine lines, as well. It helps the winery and provides protection to the operator from insurance claims. Squid Ink supplies glass and case-marking systems to many mobile-bottling companies. As an example, all three of G3's mobile glass-bottling trucks have integrated bottling marking.

Along with a lot number, the bottles should be marked with a dynamic time and date stamp. Varner recommends using Julian dates, a numerical date format that combines the current year and the number of days since the beginning of the year. For example, 10:33 a.m. on Feb. 1, 2018, is represented as 10330322018.

"Laser printing adds credibility, which really helps regulatory agencies feel better about what you are doing," Belair said, adding it shows a winery can properly address safety concerns from consumer or supplier. Belair and Murray both noted that the FDA has inspected their respective facilities, with plans to eventually inspect every winery.

Post-bottling: This is the time to log any handwritten notes. Honig has a thorough post-bottling checklist. The winery keeps reference samples of everything bottled and measures free SO_2 on a regular basis. Winery staff regularly taste all wines post-bottling, every two to three months for whites, and every six months for reds. Belair said that it is worth the extra time to look at wines post-bottling to assure that standards are being met.

The future: Squid Ink's Carney said lot traceability is consistent with consumers' desire to know the exact sourcing of their food and beverages. "People want to know what they are putting into their bodies," he said. In produce fields, some are taking farm-to-fork to the extreme, tying a tag to each unit of organic produce, which is tracked via GPS to the field location where it grew.

Belair said that while doing lot traceability may be challenging, and it continues to become more complex, "it enables us to use data to determine cause and effect quickly and efficiently, as well as giving us the ability to determine if a potential issue is isolated to a single bottle or if it is of broader concern."

And as Varner said: "It's never an issue until you have an issue."

Andy Starr, founder of StarrGreen (starrgreen.com), is an entrepreneur, marketing manager and winemaker who provides strategy, management and business development consulting services. A resident of Napa Valley, Calif., he holds a bachelor's degree in fermentation science from the University of California, Davis, and an MBA from UCLA.

Tasting Room Tech

How wineries use existing software and a look toward the future for solutions

By Stacy Briscoe



"WINEMAKING IS THE SAME no matter what winery you go to, regarding the nuts and bolts of it," said David Crum, senior director of direct-to-consumer membership and operations at Duckhorn Wine Co. in St. Helena, Calif., who spoke at the Direct to Consumer Wine Symposium in January. He was addressing why there are several companies offering programs that can assist vintners in streamlining their winemaking process and organizing their data — from vineyard management to bottling and labeling. →

But what happens after that — booking appointments, consumer marketing, campaigning and everything else that goes into *selling* the wine — isn't as seamless a process.

"It's tougher for software to be tailored for the DtC part of the business because it's so customized. Everyone has different needs," Crum said. The winery experience is different from venue to venue, and thus each tasting room is tasked with finding a software solution — or combination of solutions — that caters to its specific style of service and sales.

Patchwork programming

"To be honest, there isn't one piece of software that's superior to others," Crum said. "We've gone through three different DtC softwares in the 13 years since I've been here, and none are perfect." Today, Duckhorn's tasting room software system is what Crum refers to as a "Frankenstein," as he and his team have created a patchwork of several systems to make their day-to-day operations work.

For customer-facing software — processing in-person orders, e-commerce and managing the wine club — Duckhorn utilizes WineDirect (formerly vin65). "The most important thing that WineDirect provides is a way to create customer notes," said Crum, who emphasized the importance of documenting customer details, whether purchase history or a favorite seat in the tasting room, during his panel discussion at the DtC Symposium.

Keeping these records assists the Duckhorn team in creating personalized experiences for each guest. "It's also how we communicate," Crum said, explaining that the notes they take within the software "speak to" the winery's other brand locations: Paraduxx, Goldeneye and Calera. So guests who visit or buy wine from any one of those locations will receive the same kind of service.

When it comes to booking, however, Duckhorn uses OpenTable. "We're the first and last winery OpenTable has on their platform," Crum said. "We were one of the early adopters back in 2004 and, at the time, one of the only wineries that offered a seated tasting experience."

Because Duckhorn is an appointment-only venue, seating multiple private parties throughout the winery property, Crum said the hospitality team needs to run the tasting room more like a restaurant.

What OpenTable provides is a visual layout of the space, detailing where each booked guest is seated. What it doesn't provide are notes on said guests. "We have a person on the team who will spend about half a day going through the weekend's appointments, manually adding the notes from WineDirect into the reservation system," Crum said.

While it's a tedious and time-consuming task, Crum said, it helps the front room staff prepare appropriately.

> **"It's tougher for software to be tailored for the DtC part of the business because it's so customized. Everyone has different needs."**
>
> —David Crum, Duckhorn Wine Co.

Another piece to the Frankenstein puzzle: point of sale (POS). WineDirect does include a POS feature. "Our iPad-based POS provides tasting room staff with all the relevant details for club members, return visitors and pre-booked guests, including essential details like club membership status, lifetime value and food or tasting preferences," said Jim Agger, vice president of marketing and business development for WineDirect, in an email to *Wines & Vines*.

Crum said that he wishes he could use the WineDirect POS system and that using iPads would greatly assist with both taking notes and immediate, tableside sales. However, Duckhorn created its own customized POS system using Microsoft RMS, which, according to Crum, helps them keep better track of their multiple inventories across their multiple brand locations.

Despite having to look elsewhere to fulfill certain business-specific needs, Crum said, WineDirect's ability to share customers' stories across his hospitality team is the most essential.

He added he appreciates that he's allowed to provide direct feedback to WineDirect and participate in the company's roundtable discussions, alerting the company as to how it can help him better build and maintain his clientele.

Single-venue solution

Neil Bason, director of hospitality for Goosecross Cellars in Yountville, Calif., said that he, too, has been through a couple of software providers and that, across the board, the functionality is broadly similar. "There will be key areas where one solution stands up better than the other. You just have to pick the one that works for your company," he said.

Goosecross recently transitioned its tasting room software from bLoyal to eCellars, and Bason said the key to making that decision was customer support. "The solutions we used in the past were created by folks outside of Napa, sometimes even outside of California," he said. "We wanted someone with a brick-and-mortar office so we can knock on the door and ask for help if we need to."

Like Duckhorn, Goosecross runs its tasting experience much like a restaurant, booking groups by appointment and catering to any specific needs. "The eCellars reservation component is very useful," said Bason, explaining that the booking feature not only pulls up customer information, but also allows the staff to send reminder and thank-you emails before and after the appointments. "It provides a



Duckhorn Cellars (above) is the only winery using Open Table reservations. Goosecross Cellars (left) uses eCellars to organize reservations, wine club information, email campaigns, sales and shipments.

KEY POINTS

Identifying the specific needs of your tasting room will help identify the proper software solution(s).

Find a software company that provides adequate customer support.

Keeping an organized database of customers' purchases, visits and preferences will help boost overall DtC sales.

The new program Customer Vineyard aims to boost amount of consumer details available to wineries.

heightened sense of service."

According to eCellars Founder and CEO, Paul Thienes, a major tasting room trend is appointment-only style tastings, or a mixture of appointments and walk-ins. "We are the only vendor in the entire wine industry that has a completely integrated reservations system that complements our Point of Sale, ecommerce and wine club modules," said Thienes in an email to *Wines & Vines*.

Thus, the system provides a seamless POS integration for Goosecross. Unlike Duckhorn, inventory data is needed for just the one location. Again, purchase history, frequency, and preferences are all documented within the same system.

The only "missing link" Bason mentioned is the online booking component. Previous to eCellars, Goosecross used CellarPass, arguably one of the most popular booking agents in the wine industry, according to Bason. "CellarPass provides a certain amount of co-marketing," he said.

He said he was worried at first that taking Goosecross off the third-party website would decrease traffic. "That doesn't seem to be the case," he said. "We get more traffic through Google search, TripAdvisor and Yelp than we ever did from CellarPass."

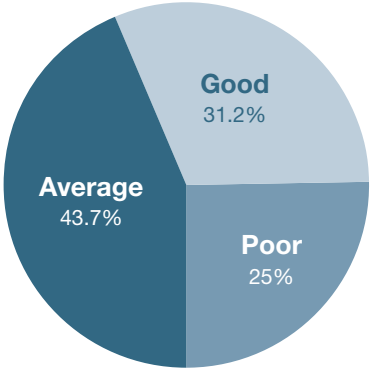
Digging up data

Flora Springs Winery & Vineyards' tasting room in St. Helena, Calif., falls somewhere in the middle. The venue does book by-appointment tastings, but it also sees a steady stream of walk-ins throughout the day. Like Crum and Bason, Elisa Sherburne, director of direct-to-consumer for Flora Springs, has been through a couple of software programs during her time at the winery.

Her hospitality team currently uses eCellars, which they use to make reservations, process wine club information, email campaigns and track e-commerce sales and shipments. She said that while she's able to keep general DtC information within the system, if she ever wants to look up something specific — like which wines sold most frequently during a certain time during the day — she has to "dump it into an Excel file" to better sift through the data. This goes for campaign management as well, such as email open rates, clicks and navigation toward the winery website. "I really just want more customization at the user level, so I can customize the reports I want to look at," she said.

AS PART OF THIS REPORT on winery software, *Wines & Vines* surveyed winemaking and sales staff at small wineries (making 5,000 to 50,000 cases per year) with an average bottle price between $30 and $60 about the software they use. Of those who responded, 86% use software specifically for the wine industry and 70% use separate systems for winemaking and other operations such as sales and marketing. Of all winery operations, 71% said software for managing wine clubs and direct-to-consumer sales is of paramount importance but 25% said existing options are "poor" and only 33% use a system to schedule and manage tasting room visits.

1. How would you describe existing software options for winery sales and marketing?





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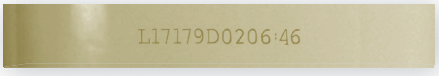

Laser code on bottle



CIJ code on label



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When asked about how she uses the information she *can* gather to better the DtC sales for Flora Springs, Sherburne said it works well for those who have some longevity with the winery, either through club memberships or frequent in-person visit. And she's able to better prepare for those who book their time at the tasting room instead of walking in. "Acquisition is tricky," she said. "It has to happen over time, through hosting relationships."

The future of DtC wine sales and marketing

A new program called Customer Vineyard, founded by Mary Jo Dale, marketing director of Vinventions, is aiming to provide a more organized and intuitive way to access consumer information. Dale said Customer Vineyard is not a quick fix to the lack of seamless software for the tasting room, but it can boost the amount of detailed customer information available to wineries and tasting rooms and, thus, boost DtC sales.

According to Dale, Customer Vineyard leverages the power of big data, allowing wineries to market and sell wine more profitably. "What we mean by big data is this — we look at certain existing information about customers, such as purchasing, behavior, key interests and financial metrics," Dale said in an email to *Wines & Vines*. "We then deliver the insights back to the winery down to the customer level."

The program pulls data from across wineries' existing DtC and POS systems, working with outside professional data houses to pull relevant information. "It further interprets the information with a series of proprietary algorithms," Dale said.

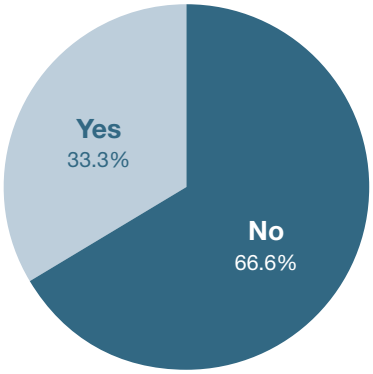
The data is then returned to the winery and "certain attributes" can be added to existing customers' profiles — whether they're one-time visitors, make only online purchases or are regular members of the wine club.

The "attributes" attached to the customer profiles can get quite detailed, right down to interests outside of food and wine.

Based on these details, wineries and tasting rooms can then market wines of various price points to the proper audience, customize wine club programs and events targeted to a specific demographic, and just generally boost the winery and tasting room experience for their guests in a more personalized manor.

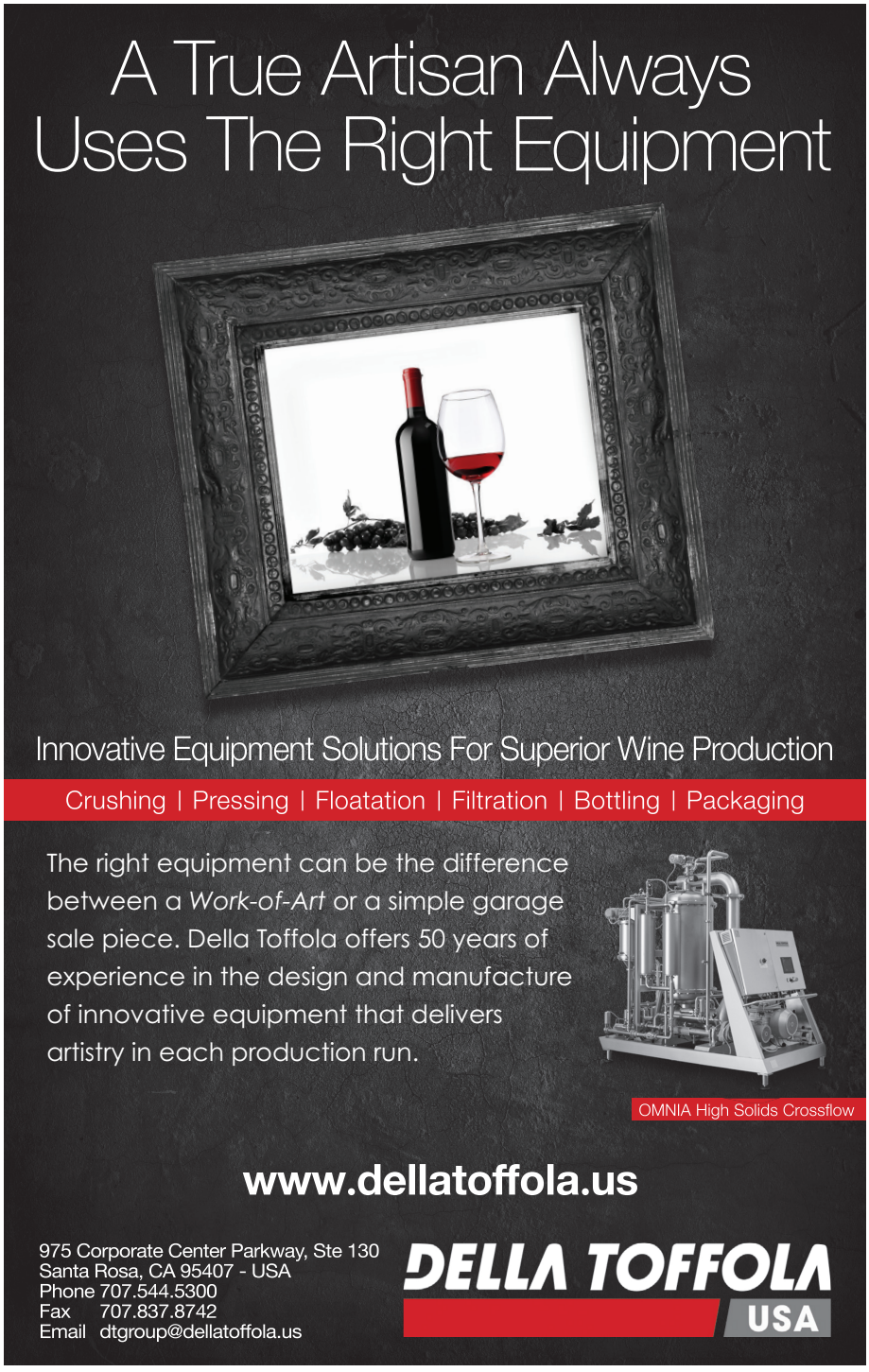
"Customer Vineyard isn't meant to replace any current DtC system, but it certainly can support them," Dale said.

2. Do you use a separate system to enable customers to schedule tasting room visits?



3. If you use a separate sales, CRM and wine club system, where could it be improved?

41.1%	Sales reports
17.6%	Depletions and wholesale sales management
17.6%	Wine club management
11.7%	Marketing analytics
5.8%	Better integration with winemaking
5.8%	Tasting room bookings and scheduling



TECHNICAL SPOTLIGHT

Crocker & Starr

New estate winery in Napa Valley is the product of 20 years of dreaming

By Jim Gordon



After 20 vintages, Crocker & Starr opened its estate winery in St. Helena, Calif. in time for the 2016 vintage.

It's not uncommon for a winery startup to use a custom-crush facility for a few years while the brand is building a reputation, and Napa Valley's Crocker & Starr is no exception. Winemaker and co-owner Pam Starr made the first wines in 1997 at the Napa Wine Company in Oakville, Calif., six miles down Highway 29 from where the grapes were grown on the 114-acre property in St. Helena that co-owner Charlie Crocker had bought in 1971.

In 1997 she began dreaming of building a dedicated winery. But it was not until the 20th vintage in 2016 that Starr's dream was realized. In between those two dates the University of California, Davis, graduate and former winemaker for Spottswoode Vineyard and Winery had more than enough time to design the winery in her mind. While sharing space and equipment with dozens of other winemakers, she mentally outfitted the dream winery with everything she would need to coddle the estate's Cabernet Sauvignon, Cabernet Franc and other wine grapes grown on 85 acres of vines.

"Oh my God, I dreamt about it every day I was there," Starr said. "I would dream, I would reconfigure. I've been designing my whole life, whether it be a wine, a label or in this case a winery."

Gesturing around the 10,000-square-foot winery that eventually materialized on Dowdell Lane about a quarter-mile east of Highway 29 at the southeast end of St. Helena, she added, "Really this was all about being able to put as much flexibility in the winemaking program as possible for the physical aspects of it. Now we can run 100 tons through this winery with three people."

She and Crocker were cautiously conservative and wanted to wait until the winery's sales generated enough money to pay for its own facility. But they hadn't planned to wait 20 years. By 2006 Crocker & Starr wines had earned accolades from critics and a good following among consumers. "Charlie and I realized we were spending as much to use a custom-crush facility as it would be to finance a building," Starr said. "Either to rent one or pay for a new one over time."

They commissioned preliminary plans from the San Francisco architectural firm of Taylor Lombardo and applied for a winery permit, but got turned down by the city



Pam Starr tastes her latest vintage of Cabernet Franc.

KEY POINTS

Winemaker Pam Starr now vinifies her Bordeaux-varietal wines in an efficient, roomy winery on the Crocker Estate in St. Helena, Calif.

After 20 years of custom crushing, now the estate grapes don't leave the property, and Starr has a well-outfitted cellar for a small production of 3,200 cases.

A gravity-flow approach is enabled by elevators, while custom tanks automate most of the fermentation process.

of St. Helena. "They are not easy," Crocker said, "and that's a euphemism for being damned difficult."

With progress stalled, Starr continued to make the wine at the Napa Wine Company while in 2009 opening a tasting room on the vineyard property that allowed a few visitors per day by appointment only. Crocker and Starr continued to strategize about getting the needed city approval until, as Crocker put it, "We finally found a city council that understood what we wanted to do," which was largely to convert the estate-owned grapes into wine without trucking them off the property.

The winery takes shape

The city granted their permit in August 2014, and construction began in 2015. The winery was ready for the harvest of 2016, in time for Crocker & Starr's 20th vintage.

Taylor Lombardo Architects designed a building that pays homage to Italian 16th-century architect Andrea Palladio, whose buildings in the Veneto region Crocker had admired. He said they typically have a central, large stone section with a balcony on the second floor, and two wings extending out on either side, and that's the general layout of the winery. "The exterior is meant to have what I call a tie to the great classics," he said.

HOW A 20-YEAR PARTNERSHIP BEGAN



The partnership that Charlie Crocker and Pam Starr struck in 1997 is a straightforward one. Crocker — from a prominent San Francisco family whose business ventures had included building a railroad and founding a bank — brought his land and his existing vines to the deal, and Starr, with a fermentation-science degree and 18 years working in wineries, brought the winemaking skills. The two are co-owners of Crocker & Starr, and Starr is the winemaker and general manager.

Crocker had bought the property in 1971 and planted Cabernet Franc and Cabernet Sauvignon from 1978 to 1980. The property already had a long history in grapes and wine dating from 1872, when James Dowdell purchased 25 acres here, later adding at least 36 more adjacent acres and planted Zinfandel, Riesling and hops, according to the winery's research. The Dowdell brandy house and winery opened in 1886 and produced 50,000 gallons of wine.

In 1997 Starr was winemaker for Spottswoode Vineyard and Winery but was thinking about starting a wine-consulting business when she visited the Crocker vineyard and liked the site and soils. Crocker and Starr soon met, had several discussions about making wine and later that year reached the agreement during a meeting in San Francisco at 1 Post Street.

The first Sauvignon Blanc vines went in during 1998. The winery released its first Cabernet Franc (1997) in 1999, its first Cabernet Sauvignon (1997) in 2000 and its first Sauvignon Blanc (2001) in 2002. In 2017, to commemorate the partnership they began 20 years earlier, Crocker & Starr released the inaugural vintage of 1 Post Cabernet Sauvignon, made from the estate's heirloom selections and priced at $200 per bottle.



Crocker & Starr Winery uses 70-gallon steel fermentation tanks by Mueller and tanks by Criveller.



Crocker & Starr Wines

700 Dowdell Lane, St. Helena, Calif. 94574 • crockerstarr.com • 707-967-9111

OWNERS/PRINCIPALS
Pam Starr and Charlie Crocker

WINEMAKER
Pam Starr

ASSOCIATE WINEMAKER
Evyn Cameron

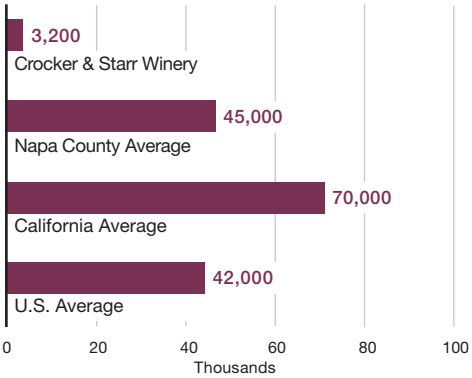
CELLAR MASTER
Samantha Johnson

YEAR FOUNDED
1997

DIRECT-TO-CONSUMER SALES
90%

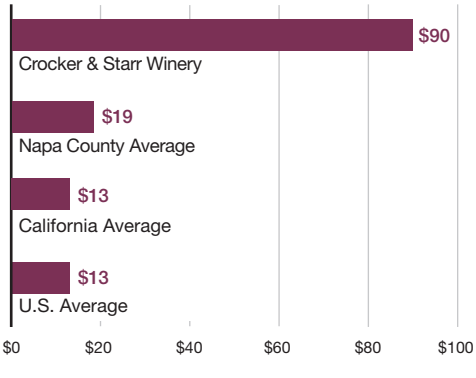
VINEYARD ACREAGE
85

WINERY CASE PRODUCTION



Source: Wines Vines Analytics

WINERY AVERAGE BOTTLE PRICE



Source: Wines Vines Analytics

The Technical Spotlight is a regular feature highlighting wineries in North America that have recently opened or undergone major renovations and improvements. *Wines & Vines* seeks to report how facility design and winemaking equipment is used to achieve a particular winemaking style while also exploring new trends and techniques being used in the industry. If you think your winery would be a good candidate for the feature, contact us at edit@winesandvines.com.

BUILDING THE WINERY

Architect	**Taylor Lombardo**, taylorlombardo.com
Excavation	**RCX, Inc.**, rex-inc.com
General contractor	**Cary & Associates**, carybuilders.com
Landscape architect	Charlie Crocker
Concrete	**RCX, Inc.**
Plumbing	**TRIMYC Mechanical**, Inc, trimyc.com
Drains/flooring	ACO Drain, **ACO Polymer Products, Inc.**, acousa.com; **North Coast Concrete, Inc.**, northcoastconcrete.com
Catwalks, metal fabrication	**Wolff's Welding & Fabrication**, (707) 933-8590
Electrical	**Napa Electric**, (707) 252-6611

PACKAGING AND OTHER SERVICES

Glass	**Saverglass, Inc.**, saverglass.com; **TricorBraun**, tricorbraun.com
Corks	Nomacorc, **Vinventions USA**, vinventions.com; **Ganau America, Inc.**, ganauamerica.com; **Amorim Cork America**, amorimca.com
Capsules	**Ramondin USA, Inc.**, ramondin.com; **Rivercap USA**, rivercap.com
Label printing	**Herdell Printing, Inc.**, herdellprinting.com; **Multi-Color Corp.**, mcclabel.com/wine-spirit.html
Label design	James Cross

MAKING THE WINE

Sorting table	**Burgstahler Machine Works**, (707) 967-0553
Destemmer	**Bucher Vaslin North America**, bvnorthamerica.com
Press	**Diemme Enologia**, diemme-enologia.com
Fermentation tanks	**Criveller Group**, criveller.com
Pumps	**ColloPack Solutions**, collopack.com
Harvest boxes	**API Kirk Containers**, apikirkcontainers.com
Barrels	Tonnellerie Bossuet, **The Boswell Co.**, boswellcompany.com; Vincent Darnajou Cooperage, **The Morlet Selection, Inc.**, mortletselection.com; Tonnellerie Orion, **Tonnellerie Orion**, tonnellerieorion.com; Taransaud, **Tonnellerie Taransaud**, taransaud.com; Sylvain, **Tonnellerie Sylvain**, tonnellerie-sylvain.fr
Additions, enzymes and nutrients	**Scott Laboratories, Inc.**, scottlab.com; **Enartis USA**, enartis.com; **Gusmer Enterprises**, gusmerwine.com
Hoses, clamps and other fittings	**Burgstahler Machine Works**
MI Bacteria	**Gusmer Enterprises**



A stand-alone tasting room opened in 2009.



An exterior stone facade mimics the Palladian buildings of Veneto.

"This is a kind of a *mélange* or mix of a whole series of Palladian buildings."

The front of the winery is faced with local stone, giving the Palladian effect even though the entire structure was built from pre-fab sections of thermal-insulated aluminum exterior panels on a steel framework by Metallic Building Co. The panels were manufactured off site before an eight-week construction period supervised by general contractor Cary Associates during which the walls and sloping shed roof took shape.

Outside stairs lead up to a second-story balcony that opens into a mezzanine level tasting area inside. Just beneath, the ground-floor doors lead into the central room, where grape processing and fermentation takes place.

A right turn from the central room leads to the east cellar, where Sauvignon Blanc ferments and ages in a combination of oak barrels, 70-gallon steel barrels by Mueller and concrete ovoid tanks by Oeuf de Beaune, Mark Nomblot's new French company. Starr soon will have a half-dozen "eggs" when the current four are supplemented by two new ones that come with bases that can be moved more easily on pallet forks. To the left is the west cellar, devoted to red wines maturing in barrels by Bossuet, Darnajou, Orion, Taransaud and Sylvain.

The two barrel rooms have cooling and ventilation built in and are sealed off from the outside and the other rooms by insulated slide-up doors, 10 feet wide for the interior ones and 12 feet for the exterior doors. A Smart Fog system provides humidity control. Starr takes advantage of these conditions to use one or the other barrel room for cold soaking, to ferment Sauvignon Blanc at 50°F or to warm barrels to encourage malolactic fermentation.

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the rooms being so well sealed and ventilated was that Starr and associate winemaker Evyn Cameron were able to shut the doors during the wildfires in October 2017 and keep the ambient smoke away from the wine. Swapping out the standard filter media in the ventilation system for combination HEPA and charcoal elements, they were able to clean the smoke from the winery air in six hours, Starr said.

The winery has numerous windows, some placed high up on the walls so that ambient light provides enough illumination for most normal daytime cellar work.



Cabernet Franc and Malbec age in combination new and seasoned French oak.

In addition, when interior and exterior doors are opened, there is a clean line of sight through the whole building and out to the estate vineyard stretching to the Napa River.

Even though most of the crush operations happen inside the central room, the contractors laid a wide concrete and gravel driveway around the building, large enough to allow a mobile bottling line, tractor-trailers picking up case goods and large fire vehicle to circumnavigate the winery when necessary.

Crush operations inside

The Crocker & Starr crush equipment is light and mobile enough that Cameron and cellar master Samantha Johnson can roll the pieces into place in the middle of the winery's central bay in less than 15 minutes using only their muscles and a manual pallet jack. The whole operation takes place inside to keep the fruit cool, and the doors are closed to keep fruit flies and yellow jackets at bay.

Starr said she intentionally selected the pieces of the processing chain from multiple suppliers. "We spread ourselves around instead of having one full complete system," she said. "I didn't want to compromise one piece just to have one great, fantastic price that I might have gotten from a single manufacturer. So I asked some of the suppliers if they would give me stand-alone prices, and they were pretty cooperative."

Vineyard crews deliver the grapes in stackable 40-pound boxes by API Kirk containers and 4-feet-by-4-feet Macrobins. Then, for red-wine grapes the flow goes up one elevator, down through a destemmer, over a shaker table for sorting and then up another elevator to the tops of stainless-steel tanks for fermentation.

The first elevator, a 4500 model by Diemme Enologia, lifts the whole bunches from a grape-receiving hopper supplied by Collopack to the top of a Bucher Vaslin Delta Oscillys destemmer, which opens wide for mainte-





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nance and has internal washing nozzles that make it easy to clean in five minutes, Starr said.

The destemmer discharges to a berry-sorting shaker table that was made by Burgstahler Machine Works, which is located practically next door in St. Helena. An air knife blows MOG out and away from the stream of berries and can be adjusted minutely to suit the winemaker's level of pickiness. Cameron showed photos from the 2017 harvest of a small bin full of raisins that the air knife deftly knocked out of the fruit flow. A sump catches any free-run juice at this stage, but Starr says she rarely uses it.



Diemme Enologia press.

A second, taller elevator made by Burgstahler lifts the whole berries from a Burgstahler hopper to the level of the catwalk on top of the stainless-steel fermentors made by Criveller. There are four 7-ton tanks, four 5-ton tanks and two 2-ton models. With a little maneuvering of the processing line and proper aiming of the conveyor, the crew has been able to reach the top ports of the tanks on both sides of the central cellar with only the aid of a jerry-rigged plastic and duct-tape "snout" to bridge from the top of the conveyor to the tank lid on top. For 2018 they have a proper steel snout ready to go.

Optimizing the tanks

The jacketed Criveller tanks and the equipment with which they would be outfitted were a central part of Starr's lengthy dreaming/planning process. Each fermentor is equipped with its own pump and pumpover system, a removable sieve-like cage that covers the tank outlet valve from inside to allow the juice out while keeping the skins inside, and a hot-water cleaning setup that's forceful enough to remove tartrates. These measures enable a no-entry policy on the tanks to insure safety.

"The only reason to put your butt in the tank is to lock in the cage, but that's when the tank is empty," Starr said. "The tanks are heated and cooled by water only. Each tank is its own enclosed system. We save water, we save energy, we save our energy, we save ourselves."

Citing the wildfire smoke, Cameron pointed out that the tanks, as closed systems that don't use sumps for tank mixing, also were effective in excluding smoky air from entering them during pumpovers.

The winemakers monitor and control the automated features via a TankNET web-based temperature-control and fermentation-management system. The tanks use two types of must irrigators, a Lotus pumpover head by Vintuitive Winemaking Tools and another type made by Burgstahler with a longer arm finished on each end with a spinning disk that spreads the must widely in the bigger tanks.


Associate winemaker Evyn Cameron checks fermentation temperatures on the TankNet management system.

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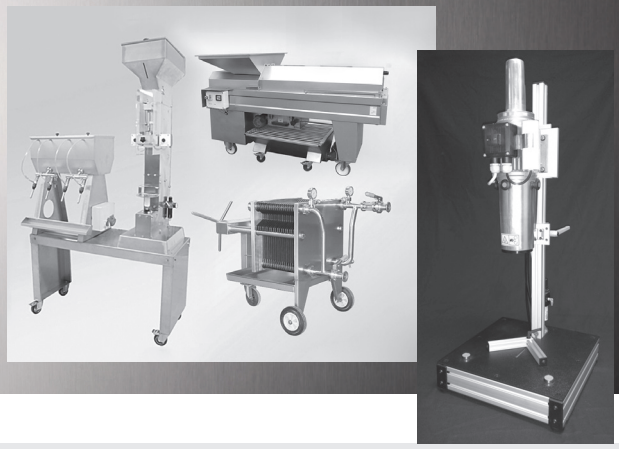

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To inoculate or not

When the fruit for Crocker & Starr's red wines goes into the tanks, it gets a cold soak for typically four days. After the wine has warmed itself, they will let it start fermenting without a yeast addition, then add a commercial strain to take over.

Starr said it was an interesting challenge to decide what, if any, yeast strain to introduce into the building. "That's one thing about a new facility. You have to decide to inoculate your building or not. I thought long and hard about it, and I felt like the smart thing to do was to inoculate this place with a really strong finisher."

She picked a *Saccharomyces bayanus* strain that she counts on for its high-alcohol tolerance and cold-temperature tolerance. She added 2 pounds per 1,000 gallons during the first harvest, instead of the more typical 0.5 to 1 pound per 1,000 gallons.

The estate grapes generally have naturally low titratable acidity in the 5-grams-per-liter range and low pH at the same time, Cameron said, adding that nutrients are added when needed. Fermentations follow a normal bell curve and top out in the low-80s-degree range. Malolactic culture is sometimes added, sometimes not. When malolactic does not occur before the wines reach dryness and are pressed, they will inoculate in the barrels.

Starr ferments a portion of the red wine in 132-gallon puncheons. A crew member removes a barrel head, puts the grapes inside, closes the head and mounts the puncheon on an OXOline rack that lets the barrel be spun by hand to mix the must rather than requiring punchdowns. Cameron said, "Through the tannin and sweet wood that we have in the new barrel, and the tannin and the sweet juice that we have, it makes this amazing combination. It's not overwhelming at all. At other places sometimes the oak takes over, but that does not happen here at all."

After fermentation, red wines spend 18 to 20 months in barrels. The percentage of new oak depends on the grape variety and vineyard block. Cabernet Franc and Malbec mature in 50 to 60% new barrels, and Cabernet Sauvignon sees 75 to 80% new oak.

Annual case production is about 3,500 spread across seven wines. The current releases consist of 500 cases of Sauvignon Blanc priced at $34 and sourced from the estate vineyard; 600 cases of $19 Bridesmaid Sauvignon Blanc; 548 cases of $80 Crocker Estate Cabernet Franc; 1,050 cases of $50 Bridesmaid Red, a Franc-based Bordeaux-style blend; 299 cases of $65 RLC Cabernet Sauvignon; 434 cases of $120 Stone Place Crocker Estate Cabernet Sauvignon; 91 cases of $200 Post 1 Crocker Estate Cabernet Sauvignon; and 255 cases of an $80 blend (55% Malbec, 45% Cabernet Sauvignon) called Casali, also estate-grown.

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The Most Important Tool in Your Tasting Room

DtC sales and wine club sign ups start with pristine glassware

By John Stallcup



Panther Creek Cellars' new tasting room in Woodinville, Wash.

Tasting rooms drive 85% of wine club growth and are the cornerstone of a winery's direct-to-consumer (DtC) business. Regardless of which type you choose, the look and feel of your wine glass helps frame the wine tasting as an experience, not just a beverage.

Far too many tasting rooms forget that how the wine glass looks plays a significant role in how your wine is regarded. First impressions matter. Humans are visually dominant. About 60% of your brain processes some form of visual stimuli. Humans believe what they see.

For a wine-tasting room, crystal-clear, sparkling-clean wine glasses with zero odor are a must-have, front-line risk-reduction touch point. Effective, energy-efficient glass-cleaning equipment for tasting room glassware is mandatory, and there are a number of glasswashers that do the job. But if you aren't careful, you can have water spots or fog from minerals in the water, as well as a chemical or soapy smell. Because aromas are processed in your amygdala, smelling a wine glass triggers either positive or negative memories and emotions. This can result in a wine-tasting experience that creates lasting negative associative memories with your brand.

Water temperature, a high flow rate and water pressure are key to cleaning wine glasses. Glasswashers today provide Energy Star savings with low water usage per cycle, while meeting the required flow rate and water pressure to clean wine glasses. A high-temperature rinse (180° F) has the blessing of the National Sanitation Foundation (NSF) for cleanliness and eliminates the need for sanitizers with their distinctive smell.

Ever wonder what it costs to provide sparkling-clean, buffed glasses for wine tasting? Add the labor cost, utilities, soap, buffing cloths, worker compensation and broken glasses while buffing, and it's a significant amount of money. Hundreds of dollars for small wineries and thousands for large, high-volume tasting rooms.

A "first growth" Napa Valley winery where I worked installed two state-of-the-art glass-washing machines in its new tasting room. It was manned by two staff to buff and restock glasses on weekdays, with four staff on weekends. Because this winery honored its wine by not pouring into a used glass, each guest tasted from a minimum of four wine glasses. With 1,100 visitors on Saturdays, that's 4,400 wine glasses washed and buffed in one day.

Buffing glasses is a time-consuming, expensive and, at times, dangerous part of wine service. How many of us have had a wine glass break in our hands while buffing, cutting a finger, hand or wrist, sometimes severely enough to require a visit to the emergency room for stitches and a workers' comp claim?

To complicate matters and make it far more difficult to have wine glasses that are clear and odor-free, many areas of wine country are cursed with hard water. A reported 65% of wine tasting rooms are on well water, which varies in terms of mineral content, hardness and odors. Hard water is the amount of dissolved calcium and magnesium in the water. Hard-water scale clogs pipes, shortens the lifespan of your glasswasher and leaves hard-to-remove spots and film on your wine glasses.

A winery can opt for a water softener to avoid clogged pipes and keep the glass-washing equipment working. But going from hard calcium-filled water to soft sodium- or potassium-filled water can be just a first step. A softener removes calcium and magnesium ions but the total dissolved solids (TDS) will not be affected significantly because the softener adds a more or less equal amount of sodium or potassium in exchange.

The minerals in soft water can and do cause mineral spotting or fogging problems for your wine glasses, especially if you use a 180°F rinse. The wine glasses still end up with spots or fog that need to be buffed. In some cases, you even need to use steam to effectively buff the wine glasses.

What if there was a way to eliminate the need to buff wine glasses? Imagine pouring

your wine into an odorless, bright, shiny, crystal-clear, unbuffed wine glass, and at the same time reducing the chances your employees will go to the ER with cuts from broken glass.

I recently worked at a Napa County winery that had hard water with so much silica it required a reverse-osmosis (RO) filter system and mixed bed deionization (DI removes all minerals). Otherwise, silica-laced hard water would destroy their filters and other equipment. After washing a rack of glasses in purified water using a standard lever down dishwasher, when you pulled a clean, dry wine glass from the rack it looked as if you had just taken it out of the box, brand new.

While working to open a tasting room in a Central Coast resort, I faced the problem of choosing between hot (120° F) softened 700 ppm TDS water or room temperature (70°F) 426 ppm TDS feed water for the glasswasher. The glasswasher using softened hot water left a fog on the wine glasses that required a couple of hours a day to buff using steam from hot water. Not a profitable use of a couple hours a day of labor.

After a great deal of testing, we decided to install a reverse-osmosis system to reduce the TDS of the water to as low as we possibly could (15 ppm TDS) to improve the glasswasher efficiency and effectiveness. When the resort engineers and I presented this solution to management, they asked the obvious questions: "What does it cost us to wash and buff a rack of glasses now, and what will it cost if we use an efficient RO filter system?"

I needed to understand how glasswasher efficiency and cost were measured. The resort had installed a Hobart LXeR glasswasher that consumes 0.6 gallons of water per cycle, with 180°F heat booster. I contacted Hobart and asked if they had research on what it costs to wash a rack of glasses.

A few weeks later, the research appeared in my inbox. The research was conducted in locations that wash 20 to 30 racks per hour, 10 hours a day, seven days per week.

Our own analysis included the cost of installing a well-designed RO filter system. An RO system will produce nearly purified water (15 ppm TDS) on the side of the membrane that serves as the feed water for the glasswasher. The brine side is equal to one-half of each gallon run through the RO filter process. There is an additional cost for the brine, or gray water, but it can be used to water plants. You reduce the amount of soap needed per wash because nearly purified water doesn't need as much soap to clean the glasses, lowering costs. The Hobart LXeR doesn't use sanitizer because the rinse is at 180°F.

When we included a slightly higher per kilowatt-electric cost and the gray water brine, the cost per rack holding 20 wine glasses went from $1.85 to $1.90. We did not bother with the reduction in soap cost. A fully loaded labor hour at $14 an hour is $20 an hour. Each hour you do not buff glasses is worth $20, not including the lack of cut fingers from broken glass. If you avoid a trip to the ER for stitches, you could pay for a brand-new glasswasher.

Every tasting room is different There are more than 4,391 wineries in California and more than 9,600 nationally. The variation in feed water is all over the map. Some areas have harder water than others. But it is well worth the effort to pour wine into crystal-clear, odorless glasses that don't need buffing.

No, we have not been able to get all the lipstick off every glass. So yes, before using, you will need to look at each and every wine glass and wipe off the small amount of lipstick residue that is left on 1% of them after a 180°F purified water rinse. What do they make lipstick out of anyway?

John Stallcup has worked in the wine industry for more than 20 years, serving as the vice president of marketing for The Wine Group and consulting for a variety of wine companies. He is currently director of wine hospitality at the Allegretto Vineyard Resort in Paso Robles, Calif. Dana Nafziger, the president of the commercial laundry, glass washing and housekeeping services provider Aqua Systems, contributed to this article.



PRODUCT FOCUS

Glasswashers for Tasting Rooms

Choosing the proper stemware washing system

By Stacy Briscoe

Alex Lewis, director of hospitality at Testarossa Winery in Los Gatos, Calif., has been working in the winery's hospitality department for more than 11 years and says the glasswasher is one of the winery's most important pieces of equipment. "Because we are showcasing world-class wines, we are diligent about our glassware," she said. The historic winery is home to a tasting room and wine bar and plays host to a wide variety of events — from intimate tastings to weddings, and even wine education courses. "On a busy Saturday, we could easily require 1,750 glasses between all departments just for that day."

To keep up with the demand and flow of wine tasters throughout the day, Lewis and her team use the D2 TimeSaver, a two-rack glass washer by Auto-Chlor System.

Big winery, large loads

The D2 TimeSaver is a low-temperature chemical-based washer that uses an integrated automatic-dispensing system to release a combination of detergent, rinse aid and sanitizer throughout each cycle — which can be as quick as 60 seconds. According to Benny Sanchez, Auto-Chlor's Santa Clara, Calif., branch manager, the amount of chemicals the machine releases is customized by the company's technicians. "It's adjusted to what you're washing," he said. "We tend to use less chemicals on wine glasses because they're not as greasy as, say, a breakfast plate that held a bunch of bacon."

The industrial machine also includes a fully enclosed pump to maximize spray pressure, a built-in pressure regulator to ensure consistent water volumes for each cycle, and a freshwater low-temperature rinse (120°F to 140°F) that uses a standard water supply, so no external booster heater is needed.

The low water usage (as little as 1.94 gallons per cycle) and low-temperature sanitization mean the Auto-Chlor System meets Energy Star requirements for energy efficiency. For a standard 90-second cycle, the machine uses only 20 amps. "We even have a line of products that meet green requirements," Sanchez said. "We can customize our washers depending on what people want because we build them right here."

Customization is key for wineries as large as Testarossa, where the washer can run anywhere from 12 to 40-plus times per day, Lewis said. Auto-Chlor provides a regularly scheduled inspection every 28 days but increases that inspection to up to three times a month for those running washers as often as Testarossa. "It's a 29-point inspection," Sanchez said. "We check everything from the correct chemical quantity to water flow, and even things you may not think to check like the motor vents."

An important check for Testarossa is the water itself. Water in Santa Clara County is considered "hard," so-called because of the excessive calcium and magnesium — minerals that will leave white, crusty residue after the water has evaporated.

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"All water to the winery for winemaking is reverse osmosis," Lewis said. "The tasting room uses the same water source as the winery, so no hard water is used in either winemaking or washing."

But she added that water quality is something that needs to be tested regularly. If she starts to see white spots or other residue left on the glasses, she'll call Auto-Chlor's 24/7 tech service immediately. "We test the chemical content of the water with a water hardness test kit," Sanchez said. "We need to make sure that if water is being treated, that treatment is working."

According to Sanchez, the test also helps determine if the amount of the cleaning chemicals released during each cycle needs to be adjusted.

One-man wash station

On the other end of the spectrum is Jeff Fadness — owner and winemaker of La Vie Dansante, and co-owner of "Blended, a Winemaker's Studio," where three wineries pour their wines in a rustic, open-air tasting room in Gilroy, Calif.

Despite the shared space, Fadness said, he and his fellow winemakers use only about 200 glasses on their busiest days. "This is about the same amount of glasses we have ready on the tasting room rack," he said, so he only needs to run his glasswasher after business hours.

The Blended co-op uses the Hobart L30H glasswasher, an older model Fadness bought used from Habitat for Humanity for $600. "Reusing and recycling is big at Blended," he said. The modest, single-rack washer washes only 25 glasses at a time, but does it in a quick, 85-second cycle.

Fadness, who's been working in the wine industry for more than 10 years, said chemical washers that pump soaps and sanitizers are the most common washers found in tasting rooms. Yet he's opted for a machine that uses heat sanitization: The Hobart L30H finishes each cycle by rinsing at 190°F.

Fadness said he prefers heat sanitization because he's experienced rinse aids and sanitizers that leave unpleasant lingering scents in wine glasses, affecting the aromas of his wines. And while he does use a low-foaming commercial dishwashing soap, he inserts the liquid himself before each load. "It's about 10 to 15 milliliters for each load," he said. "Rather than have the machine pull the soap from a bottle automatically, we just pour it on the door from a repurposed vinegar bottle. It's seems to work."

Unlike the Testarossa tasting room, Blended uses untreated well water in the winery. (The reverse osmosis system in place is reserved for the drinking water and laboratory.) Although the well water is sent in for analysis every six months to ensure there are no harmful chemicals or residue present, there are no treatments for the hard water going into the washing system. "There is a coarse cartridge filter in the water line before the dishwasher to trap any big particles," said Fadness, who hasn't found any mineral deposits or other marks





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on his glasses. "I have yet to find lipstick, lip balm or sunscreen stains," he said. "I even write on some glasses with a Sharpie during blending trials, and even the Sharpie comes off."

Since purchasing the used Hobart model in 2015, he's had a technician come out only once for a general inspection before opening his winery. "It's expensive to have them come out," he said. "And I haven't had any issues yet."

The Hobart L30H is about as water-efficient as Testarossa's larger machine, using just about 2 gallons per load. Fadness estimates he does about 10 loads per day, so he marks the low water usage as a benefit to his machine. "The downside," he said, "is that it does suck power — even more than my destemmer." The glass washer uses about 38 amps for just a few seconds because of the flash steam finish. He also mentioned that he wouldn't recommend this style of glasswasher for interior tasting rooms, as it lets out a lot of steam once the doors are opened.

Heat-chemical compromise

New to the downtown Sonoma, Calif., tasting room scene is Karen Troisi, who co-owns Jean Edwards Cellars with her husband, John. Triosi keeps her two-rack DishStar HT by Jackson Warewashing Systems (WWS) under the counter of her interior tasting room and has no problems with excessive steam affecting the environment.

Like Fadness' Hobart, the DishStar HT is a high-temperature machine that finishes each cycle by sanitizing the glasses using hot, 180°F water. "The hot water does an excellent job of removing lipstick," said Jackson WWS vice president of sales Jonathan Akin. "It's one of the most difficult things to remove from glassware and usually requires water that's at least 160°F."

Again, the flash-steam finish uses a significant amount of power — anywhere between 37.2 and 40.7 amps per load — and uses 1.1 gallons of water per rack, per load.

The machine's guidelines state that the glasswasher does require a commercial-grade detergent and highly recommends the use of a rinse aid. The built-in chemical pumps automate the distribution of the chemicals, all of which are efficiently removed by the flash-heat finish, according to Akin.

Triosi said she has yet to notice any lingering scents or stains on her stemware. "So far, the only negative has been it does leave some water on the bottoms of the stems after drying," she said. "But a nice lint-free towel takes care of that."

The couple purchased the single-rack DishStar HT for about $3,500 from a restaurant supply store before opening their winery in February 2018. "We haven't hit tourist season yet, which is good for a new tasting room, as it's given us time to get in a rhythm. The Jackson we purchased can do 24 loads in an hour (25 glasses per rack), which is quite a lot of clean stems, so it should be able to keep up," Triosi said.



HOBART

The Hobart LXGeR-1 handles up to 30 standard racks per hour while only using .62 gallons of water per rack. An energy recovery system enables the glass washer to run on cold water by recycling hot water vapor produced during the wash and rinse cycle, reducing the amount of steam released into the air.
hobartcorp.com



BARMAID

The GP-100 glass polisher by BarMaid features five spinning heads made of a soft microfiber twine material that simultaneously polish inside and outside of glassware, absorbing moisture as they polish. An air blower sends a steady stream of warm air through the polishing heads for drying. The machine can polish up to 350 glasses per hour.
barmaidwashers.com



MIELE

The Miele U 644-S plastic basket includes 16 compartments, 113 mm x 113 mm, with tilters that hold glasses at an angle to prevent water from pooling along the base of the stemware.
miele-pro.com



JACKSON WAREWASHING SYSTEMS

The DishStar HT-E-Seer is a hot water sanitizing glasswasher that extracts steam from the cleaning chamber at the end of each rinse cycle, which is then used to increase rinse water temperature for subsequent cycles. This is an energy savings feature that also prevents bursts of steam being released when the washer door is opened.
jacksonwws.com



AUTO-CHLOR

The U34, Auto-Chlor's most popular model, is a chemical sanitizer that can be adjusted for customers concerned about the taste impact of residual chlorine. The machine can be used with Auto-Chlor's Oxymize, a peracetic acid sanitizer, to eliminate chlorine as well as an integrated fresh water post sanitizing rinse to remove residual chemicals. The wash compartment holds standard 20 x 20 dish racks and 13-inch tall ware.
autochlor.com

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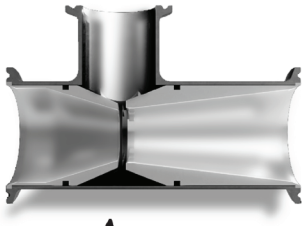

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Skipping the Hydration Step in Fermentation

A new line of yeast strains that do not need to be rehydrated prior to being added

By Richard Carey

About five years ago, Fermentis began to develop a brand of yeast that the company trademarked as E2U, which stands for Easy to Use. The goal was to develop a type of yeast that would make starting fermentations simpler. As all winemakers know, harvest is a crazy time of year where all manner of tasks can require more time and effort than there is time to complete them. If some critical elements could be simplified, it would help winemakers manage the craziness of that time of year.

I met with the Fermentis staff at the 2018 Unified Symposium to learn about the newer yeast strains they had recently released and the efforts they had taken with the E2U brand, in particular. The company's re-introduction of the E2U brand was part of a program to re-evaluate their entire yeast product line and to understand how their yeasts strains perform in a wide range of fermentation sources that are different from their primary target.

Etienne Dorignac, technical manager of Fermentis, headed a project starting in 2016 to characterize many of the properties of the company's yeasts to ensure that the strains would produce the appropriate aromatic and structural elements in a reproducible manner in the wine, while also meeting the E2U mandate to be simple to use.

A summary of the E2U process

A symposium at the 10th edition of Enoforum in Vicenza, Italy, (May 16-18, 2017) included a discussion of the E2U process. The following summary of the E2U process is based on a YouTube video of that symposium.

KEY POINTS

Fermentis has developed new yeast strains that do not need to be rehydrated to conduct a fermentation.

A plant-based emulsifier and fluid bed dryer provide a gentle drying process to protect yeast cells.

A small scale trial fermentation finished dry with expected flavors and aromas.

In the process of industrial yeast strain preparation, the first step is to find a strain of yeast that has the characteristics needed for the desired wine style. Once the strain is identified, the yeast production company has to design a method to grow the strain in a culture and environment that will create the largest biomass in a healthy state. The goal is to synchronize the growth of the yeast so that the majority of the yeast culture can be harvested at the ideal time — when the cells can be preserved in optimal condition for regrowth in the wine. From the standpoint of the yeast producer, this is where the rubber hits the road.

As winemakers we understand that the rehydration stage is when yeast is at its most delicate and fragile condition in the fermentation process. We know that small errors in this process can significantly affect the growth of the yeast in the fermenter and therefore affect the quality of the wine.

The drying process must carefully reduce the moisture in a way that preserves the yeast membranes. One of the significant components of yeast membranes are phospholipids. These elements give the structural support to the membranes upon rehydration. Typically, winemakers add yeast hulls to the rehydration mixture of the yeast. These hulls release sterols available to be absorbed by the freshly rehydrated yeast thus strengthening their membrane structure. Helping the cell walls at this stage provides the initial vigor necessary to adjust to the osmotic pressure the sugars present and then the toxic effect the ethanol presents to the yeast throughout the fermentation.

Dehydrating yeast too quickly can crystalize the phospholipids, which will destabilize the yeast membrane on rehydration, because as the yeast cells are dried, the cell shrinks in size from its fully hydrated state and it bends into overlapping folds. To ensure the best resistance to the drying process, Fermentis shapes the yeast in order to get, among others, a high trehalose content. This tactic provides structural help to the yeast cells and provides protection against the phospholipid crystallization.

The company also adds an emulsifier to the yeast as they are drying to provide additional

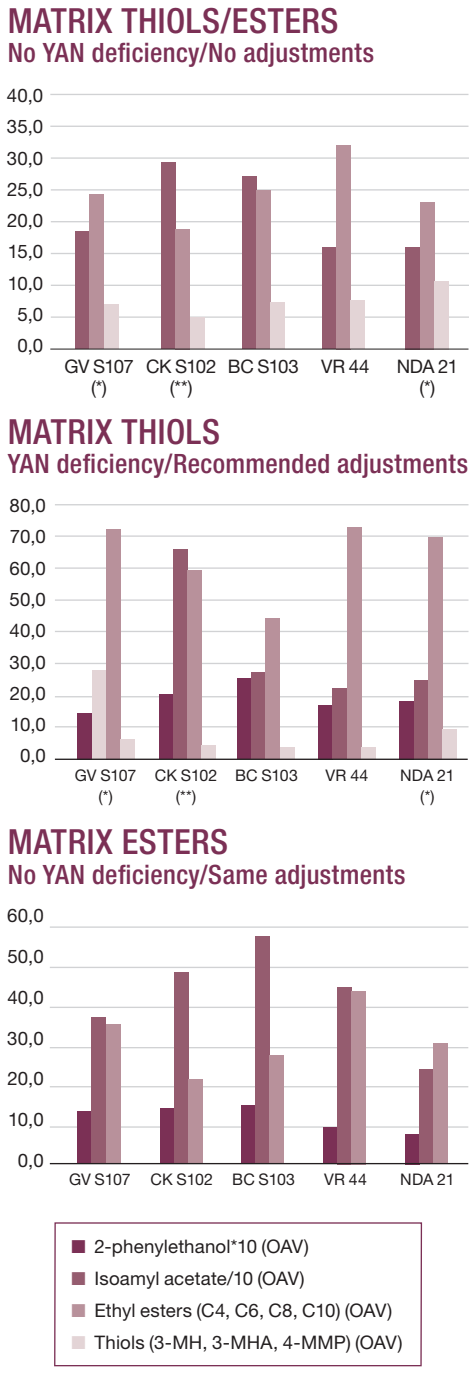


Figure 1a (top): Matrix Thiols/Esters. Figure 1b (bottom): Matrix Thiols. Figure 1c (top): Matrix Esters.

help in the process of drying and later rehydration. The emulsifier is a plant oil that aids water transport into the cells. A fluid bed dryer is utilized during the drying process so that the cells are dried in a gentle manner in order to protect them as much as possible.

Fermentis validates the drying process by rehydrating some of the yeast cells in a sugar-water solution at temperatures ranging from 10°C to 30°C while assuring their residual viability. Micro-vinifications are conducted to confirm the aromatic and structural characteristics and to be sure nothing has changed in their organoleptic qualities.

The E2U process encompasses two parts: industrial production of sustained genetic, physiological and structural qualities, and then the creation of a dried product that can withstand the rigors of rehydration. Informational materials published by Fermentis include fermentation curves comparing standard rehydration methods of the same strains with those following the E2U protocols. The results show that both the standard methods and the E2U protocols to have the same performance characteristics.

The yeast review project

As of 2018, the E2U group of yeast encompasses seven different strains with different characteristics, which gives the winemaker a range of choices for products as varied as sparkling wines and high alcohol wines. Some strains express strong thiol production, while others express strong ester production. There also is a mix of nutrient requirements from low to high levels.

As part of the project started in 2016, Fermentis compared the performance of different yeast strains with respect to many organoleptic and analytic qualities with nutrient conditions. Figure 1 shows the analytic results in a set of three graphs. Figure 1 shows the Odor Active Value (OAV), which is a compounds concentration/perception threshold. These values are standardized on a 0 to 10 scale. Note that the SafŒno GV S107 and the SafŒno VR 44 are not E2U in all three graphs in Figure 1.

Comparison of Figure 1a with Figure 1b demonstrates the effect of Yeast Available Nitrogen (YAN) deficiency with that deficiency corrected in 1b from the nutrient level of 1a. In the case of Figure 1b and 1c, ethyl esters were enhanced at varying levels, no matter whether YAN was deficient and corrected or if YAN was normal and additional nutrients added. These graphs indicate that the ability of the yeast to add additional compounds is strongly linked to nutrient concentration and, therefore, can be controlled by the winemaker.

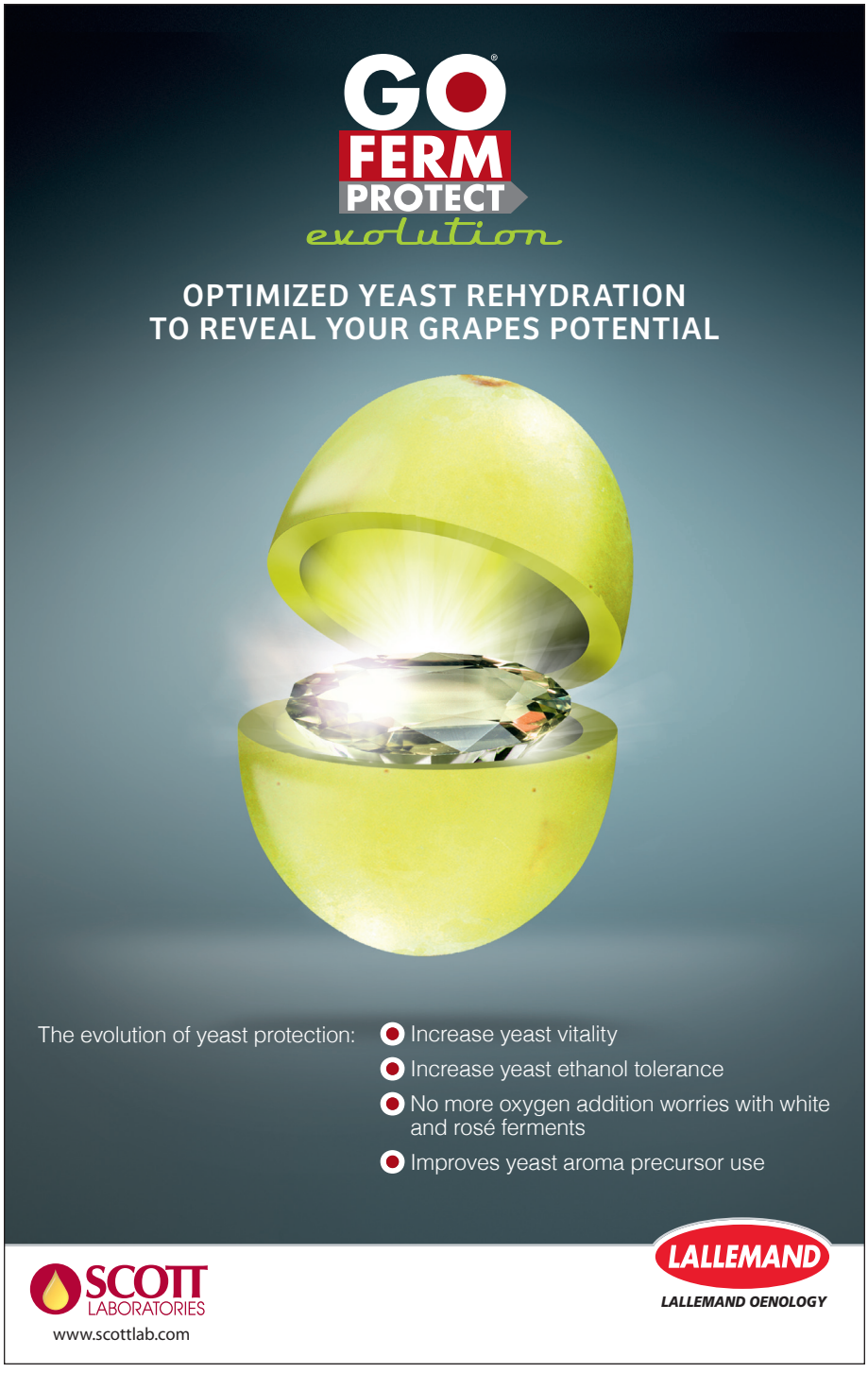
The organoleptic results are shown in spider graphs in Figure 2. These results are quite different when compared with the analytical results. For example, the thiols with YAN deficiency and recommended adjustments in Figure 2b show marked decreases in Fresh/Ripe Fruits and Reduction/Oxidation and increases in Fruity/Amylic, Vegetal, Floral and Mineral characteristics. The esters on the right side of the spider graph in Figure 2c are generally enhanced in all traits on the Reduction/Oxidation and Fruity/Amylic axis and virtually non-existent on the left side.

This set of conditions shown in both figures indicate that winemakers have control over a wide range of aromas, flavors and the balance in the wines produced with these strains.

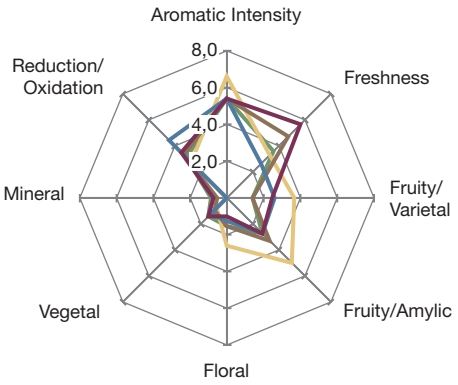
An independent yeast trial

Fermentis provided SafŒno HD S135 and SafŒno CK S102 yeasts so that I could conduct independent lab trials. March and April are not the best months to do fermentation trials, and consequently I was not surprised to have variable results on small scale fermentations. The good news was that the lab trials generally followed the data from the curves presented at the EnoForum meeting discussed above.

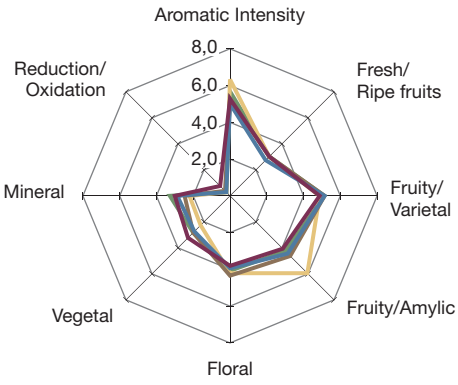
Fortunately, I did have a client who needed a larger scale fermentation (2,000L) for both white and red wines. These two wines were



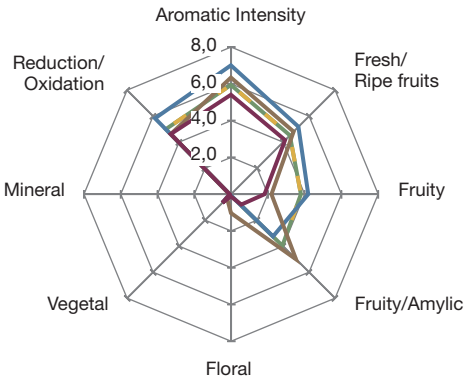
MATRIX THIOLS/ESTERS
No YAN deficiency/No adjustments



MATRIX THIOLS
YAN deficiency/Recommended adjustments



MATRIX ESTERS
No YAN deficiency/Same adjustments



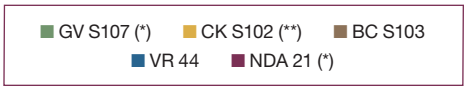


Figure 2a (left): Matrix Thiols/Esters. Figure 2b (middle): Matrix Thiols. Figure 2c (right): Matrix Esters.

inoculated with dry yeast at the recommended rates. The juice was clarified juice, which may have been the cause of a bit longer delay in the beginning of fermentation. The temperature at the start of fermentation was 51°F and ended at 64°F 21 days later. The Brix level did not show any drop for the first five days, although signs of fermentation occurred during the fourth day.

From that time forward, the fermentation followed the normal protocol of what was to be expected. We added yeast nutrients at one-third and two-thirds Brix depletion and the fermentation finished at -1.08° Brix. These fermentations were conducted on American grape varieties, and the resulting aromas and flavors were as expected from these varieties. Because these grapes have very strong aromas to begin with, I can't say definitely that there were additional aromas contributed to these fermentations, but there may have been some aromatic components contributed.

In the future, I would like to see this different type of fermentation protocol conducted using *vinifera* or hybrid grape varieties and at the normal time for harvest and fermentations. With a significant increase in solids potentially provided by more yeast hulls or leaving some natural grape juice solids, the delay in the start of fermentation might be less of an issue.

Richard Carey is a wine consultant and owner of Tamanend Wine in Lancaster, Pa. He is a regular contributor to *Wines & Vines*.

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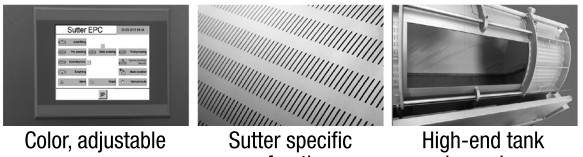

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Budgeting for Barrels

Due to demand and limited supply, new French oak barrels might double in price in five years, French miller says

By Stacy Briscoe



"It's hard to say how the wine barrel market is tracking because this year there's a lot of wineries with leftover barrels from last year," said Chris Hansen, sales manager for Seguin Moreau Napa Cooperage. According to his clients, due to the low yields harvested in 2016, some larger wineries have as many as a hundred unused barrels.This was a common comment from coopers during interviews.

Yet, data still suggests that the U.S. remains the largest purchaser of wine barrels overall. "Larger than France but a little less than Europe as a single market," said Elizabeth Van Emst, general manager of Cooperages 1912 Napa. "Why? California wineries dominate the super-premium and up categories in the U.S., and much of this is barrel-aged."

French oak prices continue to rise

French oak continues to be in the highest demand among premium wine producers. And as that demand continues to increase, so do the barrel prices. According to Van Emst, whose company sources from various French forest regions, the French National Forest Office (NFO) owns about 85% of the French oak supply. Because of the controlled supply, many French coopers have increased prices an average of 2% to 3% annually over the past four years. This, in conjunction with the rising demand for French oak, means higher prices for barrels.

When talking about the French oak market, one also has to take into consideration the fluctuation of the euro exchange rate — $1.23 as of Van Emst's interview with *Wines & Vines* versus $1.07 a year ago. "That 15% swing affects not only the cost of importing barrels, but also the cost of French oak staves for the domestic producers making French oak barrels domestically," Van Emst said.

Josh Trowbridge, vice president and general manager of Tonnellerie Ô and Creative Oak in Benicia, Calif., reported that one of his French millers estimates that because of this

trifecta — the growing world-wine market, the consistent rise in demand for premium French oak, and the poor euro exchange rate — the average price of French oak barrels will double within the next five years.

Phil Burton, owner of Barrel Builders in St. Helena, Calif., said due to the inconsistency in the euro exchange and rising costs of raw materials, he, too, has adjusted the prices of his French oak barrels. "Our top-end Esprit French oak 48-month air-dried barrel cost 1,020 euros ($1,132) in 2016. This year the price is 1,065 euros ($1,243)," he said in an email to *Wines & Vines*. "The exchange rate makes a big difference."

Still, "French oak will always be the 'cat's meow' in Napa," said Burton, who's noticed that most clients making premium wine feel the pressure to invest in the more expensive, tighter-grained barrels. In his opinion, this isn't completely necessary.

Burton said medium-grain barrels are a viable option, especially for those aging red wines for 20 or more months. "It's more economical, and they'll see similar results as those aged in tight-grain barrels," he said, stating that his current medium-grain barrel prices average 820 euros ($957). "It's time to rethink that tighter is better."

KEY POINTS

- Euro-dollar exchange raises prices and concerns.
- Suppliers are creating "high-end" American oak barrels.
- Coopers recommend alternative solutions.

American oak market stabilized

In our February 2015 issue, *Wines & Vines* reported on increasing prices for American oak barrels, driven by surging consumer demand for Bourbon and other oak-aged spirits.

In response, barrel producers such as TFF Group, which owns Tonnellerie Francois Freres, Tonnellerie Radoux and other major cooperages and barrel brands, expanded cooperage production to serve the Bourbon market. According to the company's annual report, TFF has surpassed its business goals to serve the bourbon-specific market. "Bourbon has proven to be the major growth driver that I had announced," said CEO Jerome Francois in the report. "The year 2017/2018 is looking promising with a full order book that should allow us to double our activity."

With major coopers like TFF responding to the spirit industry, along with other, spirit-focused coopers entering the market, the added pressure on American oak wine barrel suppliers has eased. "Most spirits guys are now trying to get barrels from those guys and aren't coming after us," said Seguin Moreau's Hansen. "We do have a few craft distilleries on the West Coast that do some purchasing from us because we're local and they want a top-notch barrel, but there's not as much demand as years past."

While the competition for American oak has decreased, the price does continue to increase, though minimally. Hansen reports that the cost for raw materials has risen slowly over the past five years and that Seguin Moreau has responded with a minor increase to its American oak barrels, priced at $520 this year. Burton cited an increase in Barrel Builders' American oak barrel prices, from $510 per barrel in 2016 to about $560 per barrel in 2018.

Burton calls American oak "a relative bargain" compared to French, but aded that because of the barrels' strong characteristics and "aggressive" effects on the aging wine, the market for American oak still remains specific to certain wine producers — such as those working with hearty Zinfandel or looking to craft an "oaky" Chardonnay. So it is that American oak maintains an "alternative oak" reputation.



Tonnellerie Ô's Trowbridge reports that his company is working toward creating a higher-end American oak market. "We currently create single-mill barrels by isolating the wood source, sorting the wood for the finest grain, and seasoning it for 36, 48 or 60 months." The next phase, what he calls the "American barrel revolution," will be to approach large, private American landowners and ask to manage their forest property. "We'll put their family name on the barrels, much like they do in France. It'll be our '*crème de la crème*.'"

Less demand for Eastern European oak

When it comes to alternative oak sources, it seems that Eastern European oak is a bit of old news. "I would venture to say that Eastern European oak has flattened out at a certain market share. Most people have tried it and found a place for it in their program or moved on," said Cooperages 1912's Van Ermst, who also reported that the price gap between French oak and Eastern European oak has lessened in the last few years. Thus, those wineries that may have once looked to Eastern European oak as an economic alternative to French oak barrels no longer see the advantage and are paying the few extra dollars for the traditional French oak.

Seguin Moreau's Hansen stated that his company sells only a few hundred barrels a year of Russian oak, with an average price of $800 per barrel. When asked about Hungarian oak, he said that while the company does sell a European oak blend, it is no longer buying oak from Hungary. "Trials with Hungarian oak in the late 2000s had mixed reviews, so most people are opting for French oak."

Burton said Barrel Builders continues to seek out alternative European oak sources. "Oak from the south of Ukraine is the same species as the Hungarian oak, and it's considerably cheaper than French oak," he said, adding that these barrels can sell anywhere between €650 and €750 euros ($793-$915). He said the company is also working with wood staves from Armenia, "arguably the oldest wine region in the world," but these are still in the "experimental stages."

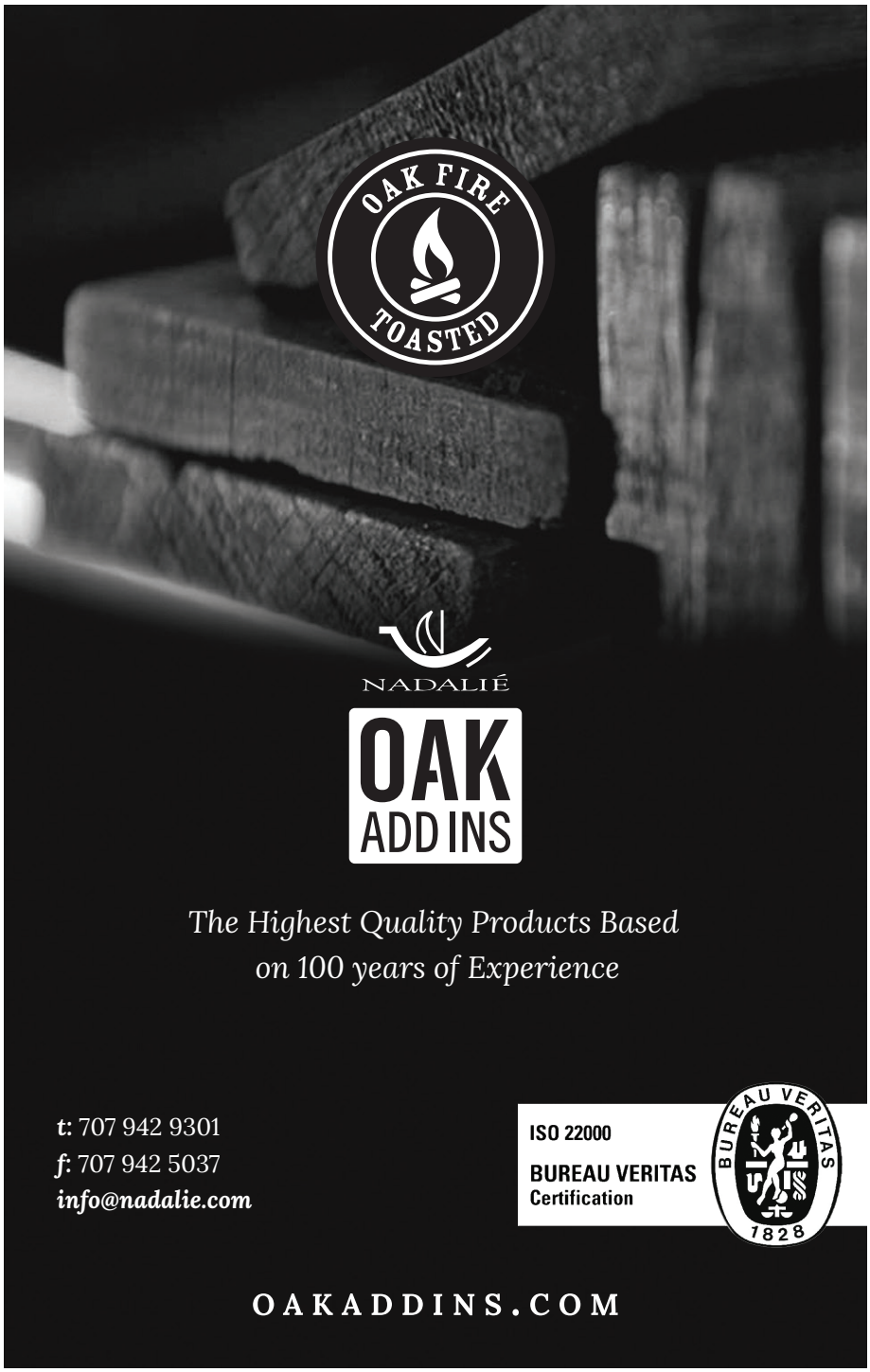
Alternative oak solutions and other trends

Tonnellerie Ô is part of the Cork Supply group, which also includes the barrel alternatives supplier Creative Oak. Trowbridge said the use of alternatives — including staves, chips and powders — has increased across the wine industry. "It's crept up from wines with an average price of $10 to wines priced around $30," he said.

While he noted that wines aged with alternative oak treatments priced between $10 and $30 are "seeing the most success" in the consumer market, Trowbridge also mentioned, without naming names, that he has one client who sells wine with a $50 price tag and 90-point score.The high-scoring, premium red wine was aged using only staves.

He doesn't want to name names because it seems that, high scores aside, it's still a bit of an industry faux pas to admit using the products. "It'll be interesting to see if that changes," he said, mentioning that Tonnellerie Ô makes forest-specific oak alternatives that can home in on specific flavors and textures and create good-quality wine — for significantly less money.

Looking toward the future, Trowbridge said that Tonnellerie Ô plans to start a "question everything" research-and-development program. The new program will bring on young coopers as well as winemakers who want to be part of the committee and steer those questions being asked. "We feel strongly that we're making good barrels that customers love based on tradition and intuition," he said, "but we want to look at those traditions and challenge them and either prove or disprove them, and evolve accordingly."



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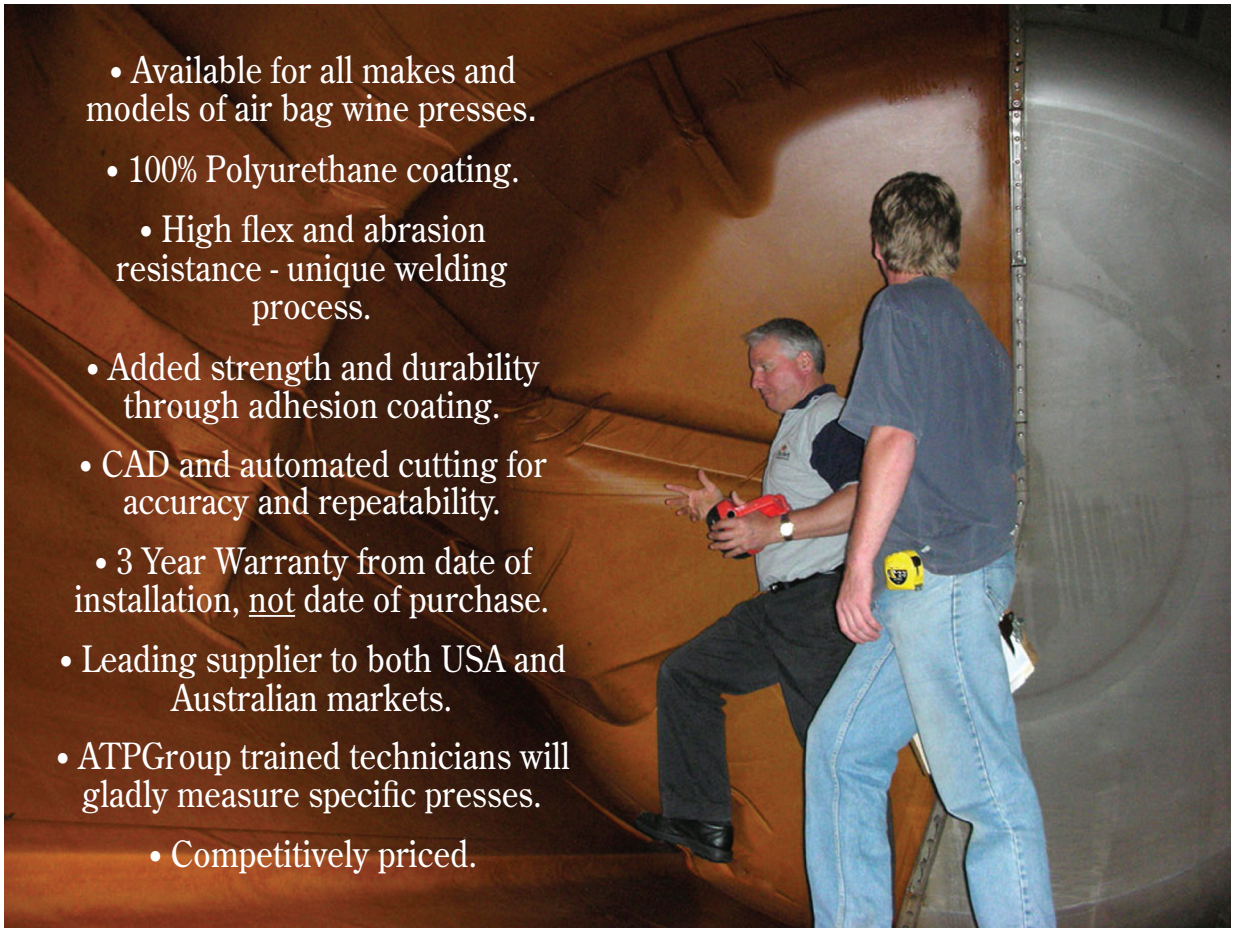

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Growing a Revolution

An excerpt from a book that examines the roots of the underground economy and how to improve soil health

By David R. Montgomery



The author's hands showing khaki colored, low-carbon soil (left) from his yard prior to his wife restoring soil organic matter to build a garden with dark brown, carbon-rich soil (right).

KEY POINTS

Most conventional thinking on soil is rooted in a soil chemistry perspective.

Advances in soil ecology and microbiology offer new perspectives on soil fertility and plant nutrition.

Cultivating beneficial soil life can build healthy soils that support crop health.

For much of human history, the role of organic matter in soil fertility was no secret. Farmers and philosophers alike believed that humus — soil organic matter — nourished plants. Until, that is, two key discoveries undercut this long-held belief. The first was the discovery of photosynthesis — that plants obtained their carbon, and thus most of their mass, from the air and not the soil. The second was the observation that most humus was insoluble and could not be sucked up by plant roots. So soil organic matter did not feed plants.

What replaced the humus theory was the idea of the soil as a chemical reservoir from which plants drew sustenance. In the first half of the 19th century, German chemist Justus von Liebig demonstrated that a lack of availability of key nutrients could limit plant growth. He also established that adding elements in relatively short supply dramatically boosted plant growth. Farmers working degraded fields found that adding calcium, phosphorus, or potassium could bring crop yields back up to levels not seen since their grandfather's day.

So did the addition of nitrate- and phosphate-rich guano, bird droppings that were aggressively mined from South Pacific islands. As the supply began to run low in the late 19th century, European and North American crop yields were threatened due to centuries of soil loss and degradation. Getting enough nitrogen to crops became a top priority.

Nitrogen gas (N_2) bathes our world — it makes up almost 80% of Earth's atmosphere. So you might think that plants could grab all the nitrogen they need from the air. That's what they do for carbon through photosynthesis. But the triple bond between the two atoms in a molecule of nitrogen gas is incredibly stable. While nitrogen is essential for making amino acids, proteins, and DNA, not much of it is biologically available. This means that nitrogen is often the limiting element for plant growth — especially in soils with little organic matter.

But there was another strategic motivation for securing a steady supply of nitrogen: it was essential for making high explosives. In 1909, a pair of German chemists — Fritz Haber and Carl Bosch — figured out how to synthesize ammonia (NH_3). Using hydrogen gas as a feedstock, they developed a high-pressure, catalyst-based process that worked at high temperatures. The ability to manufacture nitrogen both prolonged the nightmare of the First World War and produced the miracle of cheap fertilizers that could boost crop yields on degraded land, of which there was no shortage.

After the war the Allies demanded the secret to the Haber-Bosch process so they could modernize their own munitions factories. Decades later, after the Second World War, the same Allied countries converted idled munitions factories to fertilizer production, a change that could have been quickly reversed had the Cold War heated up. The widespread availability of cheap fertilizers, coupled with the new fertilizer-loving wheat and rice varieties of the Green Revolution, doubled global crop production.

EDITOR'S NOTE

Growing a Revolution, Bringing our Soil Back to Life **introduces the reader to farmers around the world at the heart of a brewing soil health revolution that could bring humanity's ailing soil back to life remarkably fast. It is available from books.wwnorton.com. The following excerpt draws on visits to farms in the industrialized world and developing world to show that a new combination of farming practices can deliver innovative, cost-effective solutions to the problem of soil degradation.**

Although fertilizers can quickly boost crop yields on degraded land, the increase in returns on rich, fertile soil is marginal at best. And as it is, only about half the nitrogen applied as fertilizer gets taken up by crops. The part that isn't does not stick around, causing problems off the farm. Most chemical fertilizers readily leach into groundwater because they are soluble by design. Add a lot in the fall and by spring much of it can end up in a river, reservoir, or water well.

Law of return

Soon after Haber and Bosch uncorked the nitrogen genie, an observant English agronomist began to question the new agricultural gospel. Based on years of work developing large-scale composting methods for commercial plantations in India, Sir Albert Howard proposed his Law of Return in the 1930s to explain why returning organic matter to the fields was essential to soil health, healthy crops, and bountiful harvests. At a time when there was little knowledge of how nutrients reached plants, Howard thought that mycorrhizal fungi played a big role.

In his experience, well-made compost boosted growth of mycorrhizal fungi. And fields with abundant mycorrhizae consistently produced abundant healthy crops. This led Howard to see fungi as nature's recyclers. He suspected that mycorrhizal fungi fed on decaying organic matter and served as root extensions that provided essential nutrients to plants. In Howard's view, chemical fertilizers could not replace soil organic matter, because adding a few elements could never provide all the mineral nutrients and substances in soil that fungi rounded up and delivered to plants.

While Howard grasped the general pattern, he could not really explain why fungi helped nourish plants. To agronomists, Howard's talk of altruistic fungal magic seemed just that. Still, he was sure that the agrochemical bandwagon was speeding down a dead-end street.

"There is a growing conviction that the increase in plant and animal diseases is somehow connected with the use of artificials. In the old days of mixed farming, the spraying machine was unknown, the toll taken by troubles like foot-and-mouth disease was insignificant compared with what it is now. The clue to all these differences—the mycorrihizal association—has been there all the time. It was not realized because the experiment stations have . . . [thought] only of soil nutrients and have forgotten to look at the way the plant and the soil come into gear." (*An Agricultural Testament*, A. Howard, 1940, London, Oxford University, p. 158.)

Howard's lack of an explanation for exactly how fungi and other microbes helped plants undermined the scientific community's interest in his challenge to conventional wisdom. Besides, the clear evidence of the near-miraculous effects of fertilizers in reviving flagging crop yields on degraded fields spoke for itself. In short order, Howard's ideas were eclipsed by the Green Revolution's fertilizer-intensive approach to boosting crop yields.

Life of the soil

Another influential agricultural myth is an innocent half-truth I learned in college — that chemistry and physics govern soil fertility. In particular, I was taught that a soil's fertility lay in its cation exchange capacity — its capacity to hold positively charged ions, essential nutrients like potassium (K^+) and calcium (Ca^{2+}), loosely enough for soil water to take them up. This is not wrong, there's just more to the story.

When farmers send samples off to a commercial lab to find out what is in their soil, it is with an eye toward what they need to add to boost plant growth. But the standard soil chemistry tests only measure the soluble fraction of what is in the soil, the stuff that water percolating through the soil can readily pick up and hand off to plants.



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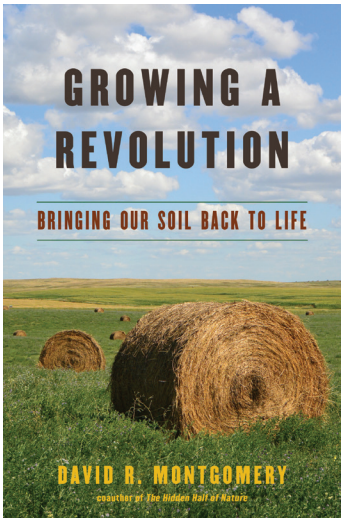
Nutrients tightly held in soil organic matter do not show up in conventional soil tests. Neither do all the nutrients locked up in slow-to-dissolve minerals. At any one time, just a fraction of the elements in a soil is in an exchangeable, soluble form plants can take up. Standard soil chemistry lab reports are missing something big: the potential for soil life to convert nutrients from mineral soil and organic matter into forms plants can use. Since the 1980s, advances in soil ecology and microbiology have radically changed our understanding of how microbial life and organic matter interact to govern nutrient cycling and influence soil fertility.

This wouldn't have surprised Sir Albert Howard, or the philosopher — farmers who founded this country. It should not surprise farmers today. Good farmers may not know all the details behind what makes for fertile soil, but they know it when they touch and see it. I have seen how they pick up soil and rub it between their fingers, asking themselves: Is it crumbly or dusty, slick or firm? Does it aggregate and hold together, or disintegrate into dust at the touch? Above all, how much organic matter does it hold?

In a way, it is easy to see whether soil is healthy or degraded. The darker the soil the more organic matter — and carbon — it contains. Several generations ago, the amount of organic matter in the soil set the price of agricultural land. Every farmer knew that soil rich in organic matter was more fertile, and so did their bankers.

You might think of healthy soil as a particular mix of soil organisms, organic matter, and minerals that forms a thin skin on our planet, like a grand version of lichen coating an alpine boulder. Part alive and part dead, the average thickness of topsoil ranges from about one to three feet. Soil accounts for a thin sliver of Earth's 4,000-mile radius, but its proportions belie its importance. This delicate blanket of rotten rock is what makes our terrestrial world habitable. As the dynamic frontier between the living world of biology and Earth's rocky bones, soil is the realm in which microbial life recycles the remains of higher life into the raw materials for new life.



The history of life on land is a collaborative tale of plants harvesting solar energy, and microbial life mining and recycling nutrients. The first land plants evolved some 450 million years ago. They had partners right from the start — mycorrhizal fungi that hooked up with their roots.

Like today's plants, the earliest ones periodically shed dead roots and leaves, and eventually died. All that organic matter became food for soil organisms that then mined more nutrients from the mineral soil and recycled the dead stuff back into nutrients for the plants to consume. More plants led to more organic matter, which led to richer, more fertile soil. Soon, and for ages ever since, vegetation covered all but the rockiest, driest, or ice-covered landscapes.

Why was this partnership crucial? Consider where plants get their elemental building blocks. They use solar energy to combine carbon dioxide from air with hydrogen from water to make carbohydrates (sugars). Plants also get their nitrogen either indirectly from the air, with microbial assistance from nitrogen-fixing bacteria living in specialized root nodules, or from nitrates they absorb through their roots. Other elements plants need to make their bodies come from rocks and decaying organic matter. Mycorrhizal fungi and soil-dwelling microbes extract mineral nutrients from soil particles and rock fragments and help break organic

matter back down to soluble nutrients that plants can suck up through their roots.

Yet roots are not simply straws. They are two-way streets through which carefully negotiated and orchestrated exchanges occur. Plants release into the soil a variety of carbon-rich molecules they make, and which can account for more than a third of their photosynthetic output. For the most part, these exudates consist of proteins and carbohydrates (sugars) that provide an attractive food source for soil microbes. In this manner, plant roots feed the fungi and bacteria that pull nutrients from the soil — from the crystalline structure of rock fragments and organic matter.

When enough microorganisms are present, root exudates do not last long. Microbes chow down on and assimilate most within hours, modifying and re-releasing them in other forms. In addition, with the help of soil-dwelling bacteria certain mycorrihizal fungi use their thread-thin, root-like hyphae to seek out and scavenge particular biologically valuable elements, like phosphorus, from rocks or decaying organic matter. Then they trade the scavenged elements, now in plant-available form, for root exudates. This sets up an exchange through which both sides benefit from the commerce of the original underground economy.

Likewise, the dead cells that roots slough off last for only a few days before microbes consume and reprocess them. The resulting microbial metabolites include plant-growth-promoting hormones and compounds that bolster plant health or aid in plant defense. Some form stable carbon-rich deposits that, in turn, help structure communities of beneficial bacteria in the rhizosphere, a biologically rich zone around plant roots.

Curiously, rhizosphere-dwelling bacteria are more effective at promoting plant growth once a critical microbial density is reached, triggering a process known as quorum sensing. When enough individual bacteria of the right kind are present, they coordinate the release of compounds that aid in promoting plant growth. But, if the population of soil microbes drops too low, they turn off the tap. In other words, they only work if there are enough of them to make a difference to the plant, which in turn produces a healthy exudate return for the microbes. By pushing enough exudates out into the soil, the plant can cultivate microbial populations that produce compounds useful to the plant. The complexity and adaptation belowground, mirrors that aboveground, as plants recruit and feed specialized communities of bacteria and fungi in relationships every bit as specialized as those between flowers and pollinators.

Where do you think you would find the most bacteria in soils? Where the food is, of course — around plant roots. And where are the most bacteria-eating protists and nematodes? Also around the roots, where the bacteria are. This is another link in the soil food chain — after saprophytic fungi and bacteria consume organic matter, they become enriched with nutrients. Predatory arthropods, nematodes, and protozoa feast on them, then release those nutrients back into the soil in plant-available forms. Because the excrement of these microscopic predators is rich in nitrogen, phosphorus, and micronutrients, it makes excellent micro-manure.

In these ways, soil life makes soil fertile. Major elements like calcium, magnesium, phosphorus, potassium, sodium, and sulfur that plants need to make their bodies, and we need to make ours, ultimately come from rocks via the soil. So do essential trace elements like copper, iodine, manganese, molybdenum and zinc. At every step along the way microbes are intimately involved in making most mineral-derived elements available to plants. And the more of these microbes that are on the job, the more nutrients that are available to plants.

Most (though not all) soils have enough of most elements to grow healthy plants — as long as those elements are unbound from mineral grains and organic matter and in forms that plants can take up. This is the microbes' job. Microbes

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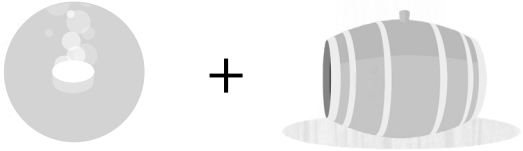

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facilitate getting a suite of essential micronutrients into plants — things like copper and zinc that we don't tend to think of as nutrients but that healthy plants and people alike need in small quantities. Soil-dwelling microbes work like little chemists to convert nutrients to plant-available forms. But in a soil sparsely populated with life, crucial nutrients remain parked outside of a plant's root zone, like goods on a ship stranded at sea far from port.



Inspecting earthworms, which are one sign of healthy, fertile soil.

Biological bazaar

From bacteria to beetles, soil life forms an underground community that breaks down organic matter, yielding organic by-products and metabolites rich in nitrogen and mineral-derived elements. Soil life also influences the ability of plants to defend themselves — when insects or herbivores graze on foliage, some plants exude compounds that rhizosphere-dwelling microbes metabolize. Plants then use the microbial metabolites to drive away the herbivores. In other words, plants outsource the production of pest repellent to microbes that get paid with root exudates. When the rhizosphere is full of beneficial microbes, pests and pathogens have a harder time finding a seat at the crowded table.

The slow pace of rock weathering and limited availability of biologically-critical elements on Earth's surface means that recycling these elements is essential to growing and sustaining abundant life. Over geologic time, microbially-mediated processes refined and built up the stock of ingredients circulating through terrestrial ecosystems. Soil life not only turns the wheel of life, it procures and stores nutrients essential for new life and keeps them from leaching out of the soil.

Heavy fertilizer applications can alter soil microbial communities, make the soil acidic and harm beneficial microbial life. Although

crops have access to nitrogen through the fertilizer, elements that microbes previously converted into usable forms may remain inaccessible when the right soil organisms are not around to do their job. When plants get all the macronutrients they need for free from fertilizers, they shut off their expensive exudate faucet, denying the microbes that are left in the rhizosphere a much-needed food source. This turns crops into botanical couch potatoes and helps make degraded farmland dependent on nitrogen fertilizers. It also means that while plants may get certain major elements they need to grow, they lose out on the microbial allies that help procure the mineral micronutrients they need to be healthy and mount a robust defense against pests and pathogens.

More than one-half century after Sir Albert Howard first proposed his Law of Return, we finally understand how it works. There is a biological basis for the central role soil organic matter plays in growing healthy crops and sustaining bountiful harvests. Fertility isn't only about chemistry and physics. Soil ecology and nutrient cycling driven by microbial life also matter. Even when standard soil chemistry tests say you need to add fertilizers, the right soil life — if present and abundant — may be able to supply what plants need.

Growing evidence shows that synthetic fertilizers work like agricultural steroids, propping up short-term crop yields at the expense of long-term fertility and soil health. Consider fertilizers and agrochemicals as like antibiotics — a godsend if you really need them, but foolish to rely on for regular use. And this, of course, is exactly what we've been doing for decades.

In hindsight, we know that our dependence on the plow and fertilizers to pump-up crop yields depleted soil organic matter and disrupted the beneficial fungi that extract crucial micronutrients from rocks and deliver them to crops. When we take out mycorrhizal fungi — eliminating or limiting their role in nutrient acquisition — and compromise microbial roles in pest and pathogen control, we have to replace them with fertilizers and pesticides.

But we can reverse this by cultivating beneficial microbial life. The key to doing this seems to be practices that build soil organic matter — feed them and they will come. Farming practices that maintain high levels of soil organic matter support the diversity of beneficial soil life that in turn supports plant health. Organic-matter rich soils promote beneficial soil nematodes over plant-parasitic nematodes as well as bacterial communities that suppress pathogens. And it is well established that they are more fertile.

Speaking at farming conferences for the past few years, I met farmers discovering how to rebuild fertile soil. They are showing how highly productive agriculture can cultivate soil fertility, using modern technology to update traditional methods and restore productivity to degraded farmland, while sustaining high yields with decreasing energy and input use. Their experiences challenge the wisdom of currently conventional agronomic practices and prove that farming practices that build soil health can reverse trends millennia in the making.

The key to maintaining soil health lies in the world of soil life, in the microbial cycling and recycling of nutrients from mineral and organic matter. Herein lies the good news. For the short lifespan of microbial life means that restoring life and fertility to the soil—and increasing the productivity of marginal farms — is not only possible, but can happen faster than we ever imagined.

David R. Montgomery is a professor of Geomorphology in Department of Earth and Space Sciences, University of Washington, and author of *Dirt: The Erosion of Civilizations and Growing a Revolution: Bringing Our Soil Back to Life*, and co-author of *The Hidden Half of Nature: The Microbial Roots of Life and Health*. Connect with him at Dig2Grow.com or on Twitter (@Dig2Grow).



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2017 Cashmere Rosé

Cashmere is a brand produced by Cline Family Cellars in Sonoma, Calif. The winery produces a red, white, "dark red blend" and rosé Cashmere. The family-owned company updated the Cashmere packaging for national distribution and debuted the new look with the 2017 rosé.

Designed in-house, the brand artwork is centered on the "O" centered on the label that "radiates out to create a color-coded graphic bullseye, which is embossed and silk-screened for dimension and sheen," according to the winery.

The "O" is intended to refer to the Clines' founding vision and dedication to producing blended wines. The closure also features a repeating ray pattern to complement the label. Cashmere rosé and white are closed with screwcaps.

The origin of the brand dates back to 1998 when the Clines, who are members of the Rhône Rangers group, created and donated a half-barrel for the Hospice du Rhône auction. The blend was composed of Grenache, Syrah and Mourvèdre and had a supple, smooth style that Nancy Cline compared to cashmere. That first half-barrel was the top-selling lot, and Cashmere has been used for other charitable causes, raising a total of more than $330,000.

Screwcap: **Amcor Flexibles**, American Canyon, Stelvin

Glass: **TricorBraun**, tricorbraun.com

Label printing: **CCL Label**, ccllabel.com

Label design: in-house



Bottling: in-house with an **Orbijet** (orbijet.com) sparger, 32-head **Cobert** gravity filler, eight-head **Bertolaso** vacuum corker, six-head Zalkin capper, **Robino & Galandrino** (robinoegalandrino.com) cap applicator, 12-head **Bertolaso** (bertolaso.com) spinner and 12-head pressure-sensitive **Cavagnino & Gatti** (cavagninoegatti.com) labeler. The line operates at around 125 bottles per minute, with less than 0.5 ppm dissolved oxygen pick up.

Have a brand packaging or redesign story to tell? Contact: edit@winesandvines.com

2014 Rennie Cabernet Sauvignon

2017 marked the 40th anniversary of the founding of Flora Springs Winery & Vineyards in St. Helena, Calif. To celebrate, the winery created a special bottling of the 100 cases of 2014 Rennie Reserve Cabernet Sauvignon.

The label is a rendering of an original painting commissioned when owners Jerry and Flora Komes purchased a 325-acre ranch with 60 acres of vineyards from the Martini estate. Label artist Cynthia Fitting included the Komes toasting their new lives in front of the "ghost winery" that was on the property. The ghost winery dates back to a period after a 1900 fire destroyed the original winery that had been founded by brothers James and William Rennie in 1885 after immigrating to Napa Valley from Scotland.

Named after the Rennie brothers, the 2014 Rennie Reserve Cabernet Sauvignon is made from 100% Cabernet Sauvignon grapes harvested from estate vineyards. The wine was aged in French oak barrels (39% new) for 22 months.

Foil: **Ramondin USA, Inc.**, ramondin.com

Cork: **Scott Laboratories**, scottlab.com

Glass: **TricorBraun**, tricorbraun.com

Label printing: **Multi-Color Corp.**, mcclabel.com

Front label design: commissioned art by Cynthia Fitting

Back label design: Picturewords, Andy Sundblad



Bottling: In-house at 31 bottles per minute with **Poggio** (poggio.com) 16-head bottle rinser, **Fillmer** 16-head bottle filler with one-head vacuum corker, **Bertolaso** five-head capsule spinner (**ColloPack Solutions**, collopack.com) and a two-station **Impresstik Labeling Systems** labeler (impresstiklabelers.com).

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New Guidelines from TTB

Washington, D.C.–The Tax Cut and Jobs Act signed into law on Dec. 22, 2017, provided excise tax relief for wineries, regardless of size. It was a comprehensive, complicated law that was written quickly and passed without detailed review, but it did include a version of the Craft Beverage Modernization and Tax Reform Act. The new law reduced federal excise taxes on wine through a system of tax credits and other means, and it was thought that all wineries would see lower excise tax rates.

Although the federal excise tax on table wine would remain steady at $1.07 per gallon, a new tax credit of $1 would be allowed on the first 30,000 gallons of wine produced, which lowered the effective tax rate to 7 cents per gallon. The amount of the new tax credits changed as the size of the winery increased, with 750,000 gallons being the ceiling for the tax credit.

Glitches in the Tax Cuts and Jobs Act soon became apparent. The wine industry knew a two-year "sunset" provision had been included in the legislation that would eliminate the tax reductions as of Dec. 31, 2019. What was not anticipated was that additional, incorrect language had been included that could nullify the benefits for many wineries if they used custom crush facilities or stored wine off-site at bonded wine cellars.

When the Alcohol and Tobacco Tax and Trade Bureau (TTB) issued guidelines in the Industry Circular 2018 - 1 on March 2, it was clear that TTB had interpreted those changes in language to mean that the tax cuts would apply to wines fully controlled by the producer from production to final sale. Because the tax bill was passed a week before provisions were to be implemented on Jan. 1, 2018, the TTB created the "alternate procedure" in March to allow wineries to collect tax credits until June 30.

Many wineries, especially those making less than 250,000 gallons, were concerned that on June 30 the federal excise tax reductions for wine produced at custom crush facilities or stored at bonded wine cellars would be eliminated. The excise tax rate would then increase to the full rate of $1.07, a 15-fold increase for small wineries. In addition, wineries were uncertain if alternate premises were permissible.

In May, TTB allayed those concerns with the release of two Industry Circulars, Number 2018 - 1A and Number 2018 - 3. The first circular was released on May 17. That circular, titled "Alternate Procedure for a Wine Producer to Tax Determine and Tax Pay Wine of Its Production That Is Stored Untaxpaid at a Bonded Wine Cellar," states that producing wineries may "tax determine and tax pay, upon removal from bond, wine of their production stored untaxpaid at a bonded wine cellar (BWC) or bonded winery, as if it were removed from the producing winery's bonded premises." In addition, the expiration date for the alternate procedure has been extended through Dec. 31, 2019.



The next step occurred on May 30 when the TTB issued Industry Circular Number 2018 - 3. It advised wineries, breweries and distilleries that they may submit requests to use alternate premises. The circular provided guidelines to proprietors "who wish to 'alternate' their premises in a way that varies from TTB requirements for the purpose of storing tax-determined and non-tax-determined products in a more flexible or efficient manner." Those guidelines suggest, for example, that the proprietor should have a "good cause basis to use the alternate method or procedure" and that TTB will review the proprietor's compliance history. Additional points address such issues as record keeping and inventory discrepancies, amendments to the information associated with a permit, and modification or rescission of the permit by TTB.

Michael Kaiser, vice-president of WineAmerica, the National Association of American Wineries located in Washington, D.C., stated, "While the TTB amendment is very encouraging and a big relief, ultimately a formal change in the legislation would be far preferable. In addition, currently the tax reductions are scheduled to end on Dec. 31, 2019, and WineAmerica will seek to make them permanent."

—Linda Jones McKee

Millions for Vineyard and Wine Research

Harrisburg, Pa.—The grape and wine industry on both sides of the country received a $2.4 million boost in funds during May.

Gov. Tom Wolf announced on May 16 that the Pennsylvania Liquor Control Board (PLCB) awarded funds totaling $999,989 to seven grant projects that will develop and promote the state's wine industry. Five days later, Tony Stephen, chairman of the American Vineyard Foundation (AVF), reported that the foundation is providing $1,387,400 in new funding for 24 viticulture and enology research projects in California, Oregon and at the USDA Agricultural Research Station (USDA-ARS).

The Pennsylvania Wine Association (PWA), will receive the largest grant, $519,500, from the PLCB. The organization plans to use the funds for its Pennsylvania Wine Lands statewide marketing and promotion program, expansion of the Pennsylvania Wine Month promotion in October 2018, and sustained support of a cooperative wine trails grant program representing more than 100 wineries. The balance of the grants will go to four research projects at Pennsylvania State University, with smaller amounts supporting the 2018 ASEV-ES conference in King of Prussia, Pa. in July and a joint project with Cornell University.

The American Vineyard Foundation, based in Napa, Calif., solicits voluntary contributions to support ongoing as well as new high priority research projects to help the grape and wine industry. The foundation's members are surveyed periodically to determine the issues that are most in need of research and then are asked to make donations to fund research projects.

A total of six universities or other wine organizations received funding for 2018-2019. The University of California, Davis, received 12 grants totaling $722,600; Oregon State University was funded for six grants with $398,900; and the USDA-ARS received three grants totaling $139,900. Three other institutions each received a grant: the Lodi-Woodbridge Winegrape Commission ($21,800), the University of California, Berkeley ($61,900), and the University of California Cooperative Extension ($42,300).

—Linda Jones McKee

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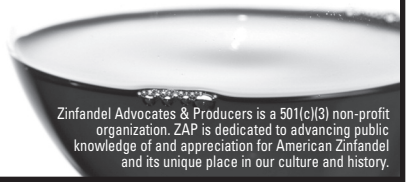

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Viticultural Mapping by UAVs, Part 2

Applying unmanned aerial vehicles in viticulture

By Andrew G. Reynolds, Ralph Brown, Marilyne Jollineau, Adam Shemrock, Hyun-Suk Lee, Briann Dorin, Mehdi Shabanian, Baozhong Meng

Attempts have been made, with limited success, to identify unique zones using remote sensing and to associate regions with variables such as vine water status, soil moisture, vine vigor, yield and berry composition.

Although less laborious than manual data collection and production of a multitude of maps, use of conventional aircraft can be costly, and remote sensing in agricultural systems is often imprecise.[30] Data must be converted to variables, e.g., normalized difference vegetative index (NDVI) data through environmental software such as Environment for Visualizing Images (ENVI).[9] Moreover, validation of data acquired by remote sensing is still necessary to determine whether ostensibly unique zones are relevant from a standpoint of physiology, yield, and berry composition. One particular challenge involved masking of cover crop NDVI from all images to assess the vine canopy-specific NDVI.[15, 16]

In viticultural applications, remote sensing has been used in modelling vegetative growth, and to infer grape composition from those measurements. Remotely sensed multispectral data was used to delineate a Chardonnay vineyard into small-lot production zones.[12] Vine size (weight of cane prunings; an estimate of vigor) was related to vigor zones identified by airborne images. Vigor zones also were related to vine water status and grape composition variables. Thus, indirectly, remote sensing was used to predict vineyard status and grape composition, with direct implications for wine quality.

Relationships between vegetation indices (VIs) and vegetative growth were explored by Dobrowski et al.[7] There were strong, positive correlations between extracted VIs and vine size over two years. Additionally, relationships established in the first season were able to predict the vine size in the second season.

Remote sensing can be used to predict grape composition variables.[14] Re-sampling the image to a final pixel size approximately equal to the distance between rows, effectively combining vine size and density information into a single pixel, resulted in the strongest correlations to color and phenols. The strongest negative correlations between NDVI and color and phenols occurred around *veraison*.

In Languedoc (France), Acevedo-Opazo et al.[1] investigated remotely sensed VIs, vine water status, and grape composition on a number of wine grape varieties in non-irrigated vineyards. Temporally stable relationships occurred between zones based on the NDVI and vegetative growth, vine water status and yield. These zones also were consistent with soil type.

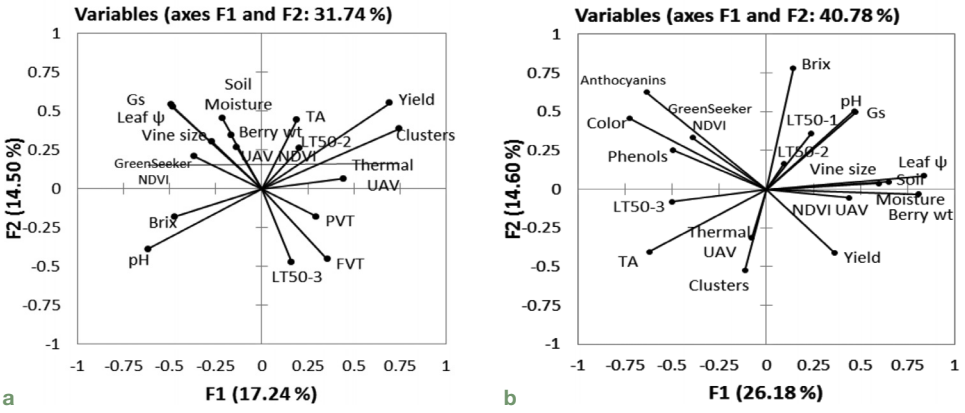

Figure 1: The principal components analysis for two vineyards in 2015. Figure 1a (left): the Buis Riesling vineyard in Niagara-on-the-Lake, Ont. and Figure 1b (right): the George Cabernet Franc vineyard in Vineland, Ont.

EDITOR'S NOTE

This is the second installment of a two-part series on using unmanned aerial vehicles (UAV) to obtain data to help vineyards implement precision viticulture. In the first article, the authors looked at the different UAV platforms, hardware, sensors and image processing. Here, the authors discuss the use of UAVs in viticulture and include the results of a study done in Ontario vineyards.

KEY POINTS

Remote sensing by unmanned aerial vehicles (UAVs) has been useful in monitoring vineyard vegetative growth and to make inferences about grape composition.

A study in Ontario used UAVs to examine correlative relationships between vegetation indices and vineyard variables including vine size, yield, berry weight, berry composition and winter hardiness.

UAVs have significant potential to identify zones of superior fruit composition and potential wine quality.

They concluded that a combination of remotely sensed data with intimate vineyard knowledge, especially of the soil, is needed to predict grape composition and ultimately wine quality.

Remote sensing has proved to be a useful tool for monitoring vineyard vegetative growth, and for making inferences about grape composition from multispectral measurements. In Ontario, NDVI data from remote sensing was associated with numerous variables in Riesling vineyards, including vine water status, yield components and berry composition.[16] Similar applications were made in Pinot Noir vineyards, and proved to be a good tool to determine color and phenolic potential of grapes, in addition to water status, yield and vine size.[15] These studies were unique in their employment of remote sensing in cover-cropped vineyards and thereafter using protocols for excluding the spectral reflectance contributed by inter-row cover crops.

UAV-based remote sensing likewise has been used for making inferences about grape composition from multispectral measurements.[23] However, use of UAVs for remote sensing in vineyards is a relatively new area of research, thus far untested in Canada, and capable of acquiring high-resolution spatial data without the high cost of conventional aircraft. As with proximal sensing, there has been little published, and most of that has confirmed an ability to acquire NDVI and related images. Relationships were found between photosynthesis and chlorophyll fluorescence by hyperspectral imagery captured via UAVs, as well as between both photosynthesis and chlorophyll fluorescence vs. remote measurements.[35] Other relationships were demonstrated between both chlorophyll a/b and leaf carotenoids vs. several VIs based on multispectral images acquired by UAVs.[38]

UAVs were used for assessment of vineyard water status by correlation of stem Ψ with NDVI.[2] Further relationships were observed between several Vis, including NDVI vs. vine water status [leaf water potential (Ψ) and stomatal conductance].[38] Addition-

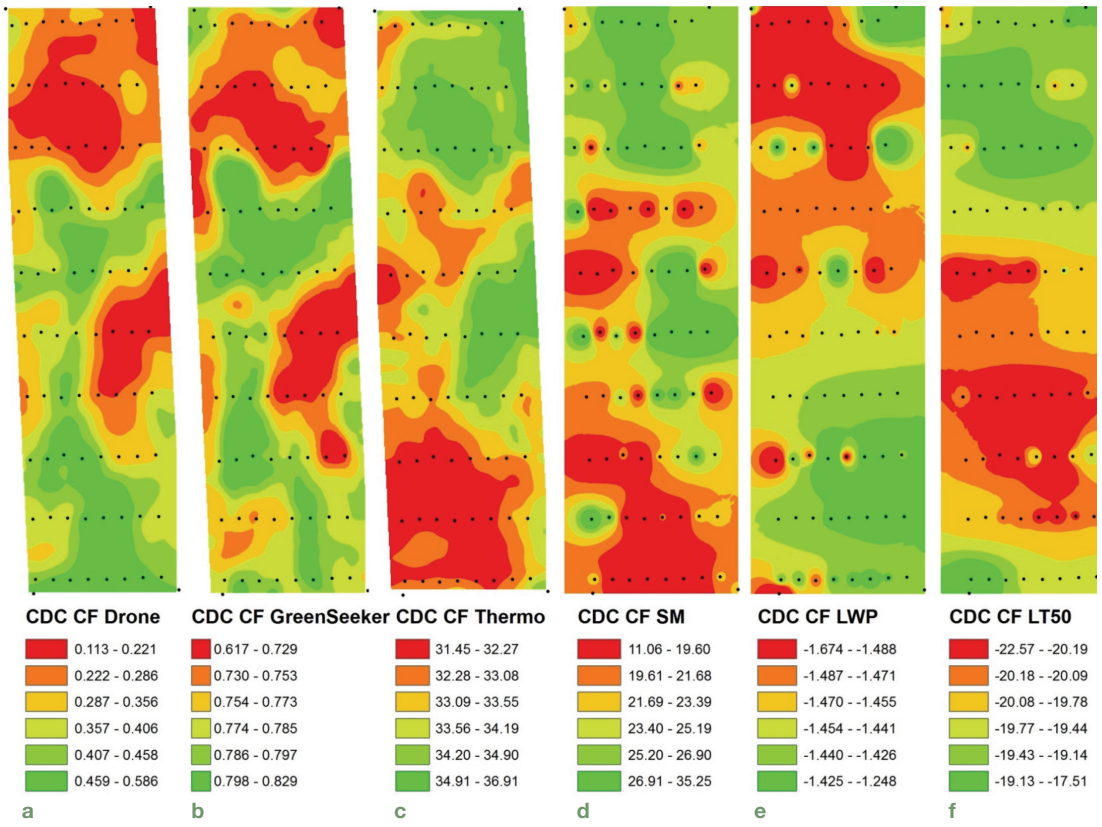

Figure 2: Spatial maps of the Cabernet Franc vineyard at Chateau des Charmes (CDC), St. Davids, Ont. in 2016. 2a: UAV-based NDVI; 2b: GreenSeeker-based NDVI; 2c: UAV-based thermal image; 2d: Soil moisture; 2e: Leaf water potential; 2f: LT^{50} (winter hardiness). Scale 1 =2167.

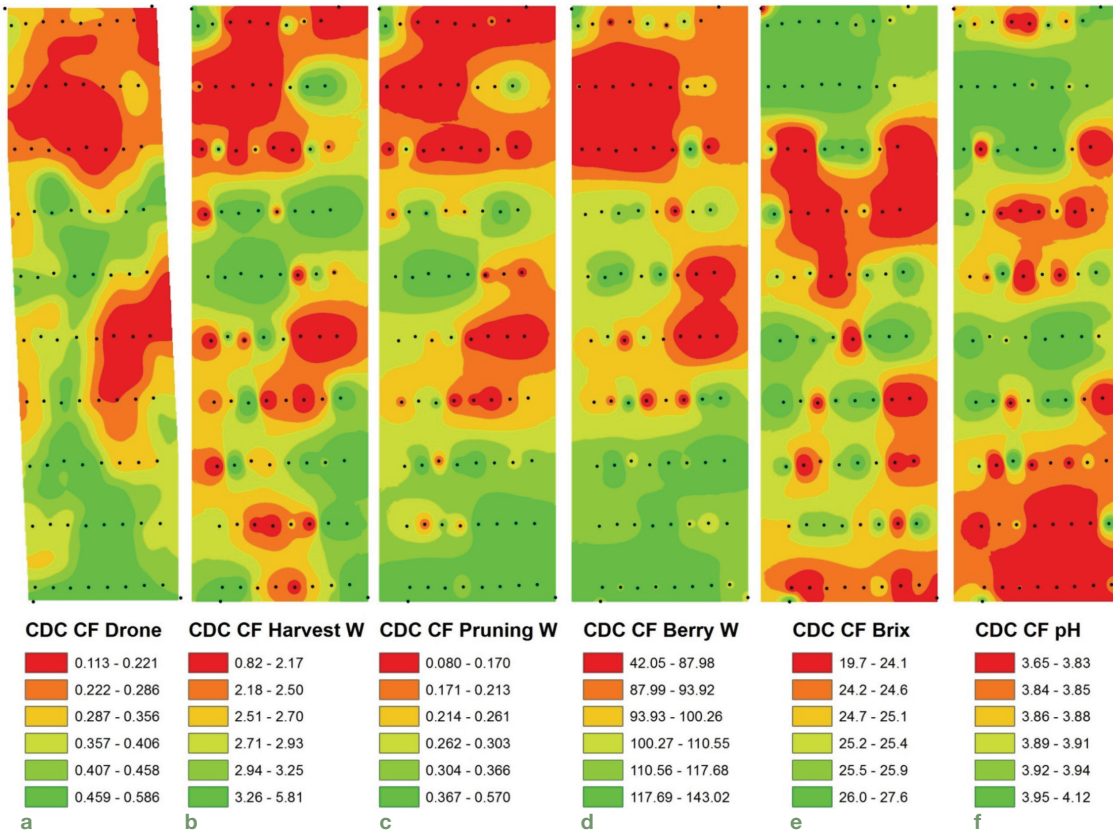

Figure 3: Spatial maps of the Cabernet Franc vineyard at Chateau des Charmes, St. Davids, Ont. in 2016. 3a: UAV-based NDVI; 3b: Yield per vine (kg); 3c: Weight of cane prunings per vine (kg); 3d: Berry weight (g): 3e: Berry soluble solids (Brix): 3f: Berry pH. Scale 1 = 2167.

ally, several other VIs were correlated to water-status variables.[37] Nutritional deficiencies also have been detected by UAVs; e.g., NDVI was correlated with levels of iron chlorosis, carotenoid pigments in leaves, and anthocyanins in leaves and grape berries.[21] More recently a crop water-stress index was calculated based upon a combination of leaf Ψ and stomatal conductance and was associated with UAV-derived thermal images.[29] UAVs have been successfully linked to wireless sensor networks to assess correlations between VIs and thermal zones in vineyards.[6]

Recently in Ontario, UAVs were used to examine correlative relationships between VIs and several vineyard variables.[25] Vine size, LT_{50} (winter hardiness), yield, berry weight and berry composition data were correlated in several vineyards to NDVI and other data acquired with the UAV and GreenSeeker, while soil and vine water status, and yield components showed direct relationships with NDVI. Spatial relationships were apparent from examination of the maps. Multivariate statistical analysis (e.g., principal components analysis; PCA) confirmed these relationships.

Spatial analysis also was performed (e.g., Moran's *I* and k-means clustering) to verify the existence of actual discrete zones in the study vineyards. The NDVI values were considerably higher in GreenSeeker maps vs. those from UAV flights, primarily because reflectance data were acquired from the sides of the canopies with GreenSeeker and from the tops of the canopies with UAVs. Vine water status and several fruit-composition variables were correlated with UAV-derived NDVI. This suggests that UAVs have significant potential to identify zones of superior fruit composition and potential wine quality.

Case study in Ontario

We used this technology in a case study of vineyards in Ontario to create maps illustrating spatial variability in both ground-based variables and UAV data, and its usefulness in understanding and improving potential wine quality.

The Ontario wine industry produces about 65,000 tons of grapes and consists of cultivars such as Riesling, Chardonnay, and Cabernet Franc, with lesser quantities of Merlot, Cabernet Sauvignon, Sauvignon Blanc, Pinot Gris, and Pinot Noir (grapegrowersofontario.com). Soils are characterized as variable, a result of widespread glacial activity more than 10,000 years ago, and consequently many vineyards are situated on several soil series that can range widely in texture, depth and water-holding capacity.[13] This variability can impact vine vigor, yield and water status. A significant growth in the number of small artisanal wineries has permitted production of wines that are unique to individual vineyard sites and in some cases unique to specific vineyard blocks. In the past 10 to 15 years this interest has expanded to include identification of unique portions of vineyard blocks, some less than 1 hectare, that might be capable of producing extremely high-value wines based upon yield, vine size or water-status-based quality levels.

Researchers chose six vineyards each of Cabernet Franc and Riesling (1 to 2 ha in area) in different Niagara sub-appellations. The sites included the following sub-appellations: Niagara Lakeshore, Creek Shores, St. Davids Bench, Lincoln Lakeshore north, Lincoln Lakeshore south, and Beamsville Bench.

Soil types[13] varied substantially in these sub-appellations from well-drained, coarse-textured Tavistock and Vineland series (Niagara Lakeshore, Lincoln Lakeshore north), to moderately well-drained Chinguacousy (Creek Shores, Beamsville Bench), and poorly drained Jeddo (Lincoln Lakeshore south) and Beverly/Toledo soils (St. Davids Bench). This array of soil types provided a significant range of water-holding capacities that affected vine water status.

Vineyard blocks were GPS-delineated to determine shape, and 80 to 100 sentinel vines were identified within each vineyard and geolocated by GPS. Post-collection differential correction was performed to sub-meter accuracy (about 30 to 50 centimeters). Field measurements and berry samples were taken on these vines over two years, and we are completing our third year of data collection.

Vineyard soil moisture was measured by time domain reflectometry. Measurements took place at berry set, lag phase and *veraison* on all sentinel vines. Vine water status was mea-

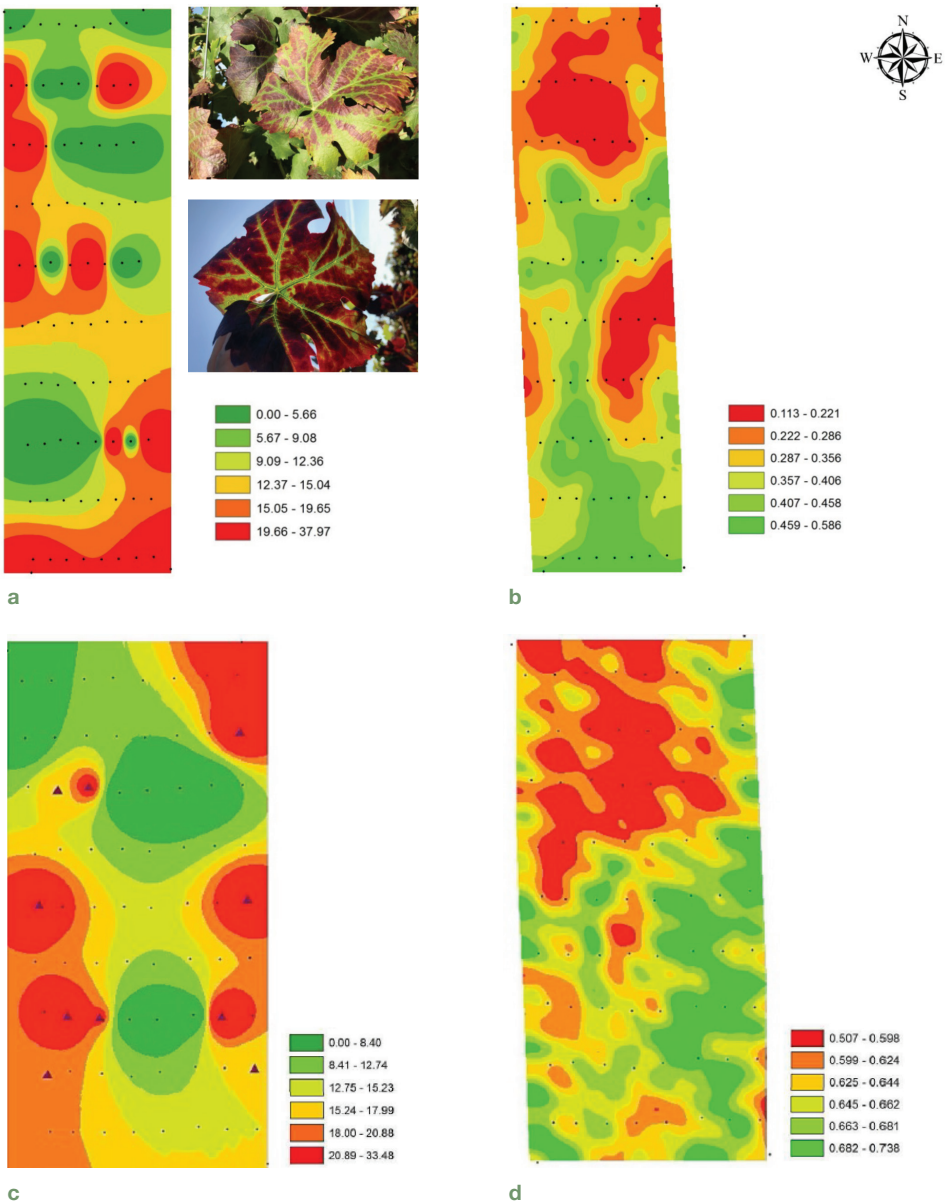

Figure 4: Maps of two Ontario Cabernet Franc vineyards in 2016 showing GLRaV3 titer [quantification cycle (Cq) value] (a, c) vs. their respective corresponding UAV-based NDVI (b, d). Scale (a, b): 1 = 2167; (c, d): 1 = 1240.

GORDON ROBERT

sured using midday leaf Ψ by pressure bomb. Measurements were made only at designated leaf Ψ vines (about 15 per vineyard block), on the same days as SWC measurements, from 1000h to 1400h (ca. solar noon), under full sun. Leaf *gs* was measured by a hand-held porometer on those vines used for leaf Ψ.

Fruit from each sentinel vine was harvested, cluster number determined, and fruit weighed. Cane prunings were weighed to determine vine size. A 100-berry sample was taken from each sentinel vine, weighed to determine mean berry weight, and thereafter soluble solids were measured using a refractometer, pH by a pH/ion meter and titratable acidity by autotitrator.

Monoterpene aroma compounds [free volatile terpenes (FVT) and potentially-volatile terpenes (PVT)] were analyzed on Riesling samples taken from leaf Ψ vines based on a distillation method. Cabernet Franc juice sample absorbance was measured using a spectrophotometric method at 420 nm and 520 nm, with color intensity calculated as $A_{420}+A_{520}$, and hue as A_{420}/A_{520}. Total anthocyanins were quantified using the pH shift method, while total phenols were quantified using the Folin-Ciocalteu method.

All vines designated for leaf Ψ and gs measurements were sampled September 2016 to determine grapevine leafroll-associated virus (GLRaV) titer. Total RNAs were isolated from leaf samples using a method recently developed in the Meng lab. Total RNAs were used in reverse transcription using primers specific to GLRaV-2 and 3, followed by amplification through PCR using broad-spectrum primers to identify virus presence. To determine virus titer for comparison and correlation to the UAV and GreenSeeker data, quantitative qPCR was conducted by Power SYBR Green PCR Master Mix and StepOnePlus qPCR (Applied Biosystems).

GPS coordinates from vineyard blocks and sentinel vines were imported into a GIS environment (ArcGIS) and linked to all point data collected from sentinel vines. Spatial interpolation techniques (i.e., kriging) applied to these data were used to estimate the value of vineyard variables at unsampled locations. This permitted further spatial data analyses, including the integration of these data with the remote-sensing datasets.

A GreenSeeker unit (Trimble Navigation) mounted on a four-wheel-drive vehicle was used to collect NDVI data on dates close to soil moisture and leaf Ψ data collection. An additional reading was collected in mid-September. Data were imported into Farmworks software and spatial maps created. Shapefiles were thereafter imported into the ArcGIS database. GPS coordinates identical to the sentinel vines were identified, and NDVI data corresponding to these coordinates were extracted for statistical analyses.

The UAV flights corresponded to the *veraison* soil moisture, leaf Ψ, and GreenSeeker data collection. Image acquisition was performed using the SenseFly eBee UAV (see Figure 2A) supplied by Air-Tech Solutions, Inverary, ON. The UAV had 30 minutes of endurance, a 9-kg payload, and was equipped with an autopilot system allowing a 1000-m visual range and 5-km radio line of sight. The UAV was flown at both 90 and 120 m elevations in separate flights and a maximum speed of 60 km/h.

Two sensors were used for image acquisition. The first operated in the visible and near-infrared portions of the electromagnetic spectrum (EMS) utilizing five spectral bands (blue, green, red, red edge, near-infrared) equipped with an incident light sensor. The second sensor operated in the thermal–infrared (IR) portion of the EMS. It ensured acquisition of imagery in the thermal-IR range covering 750 to 1350 μm. This equipment was complemented by a ground receiving station that provided real-time feedback on the position of the aircraft and its imaging.

Image acquisition was performed over each

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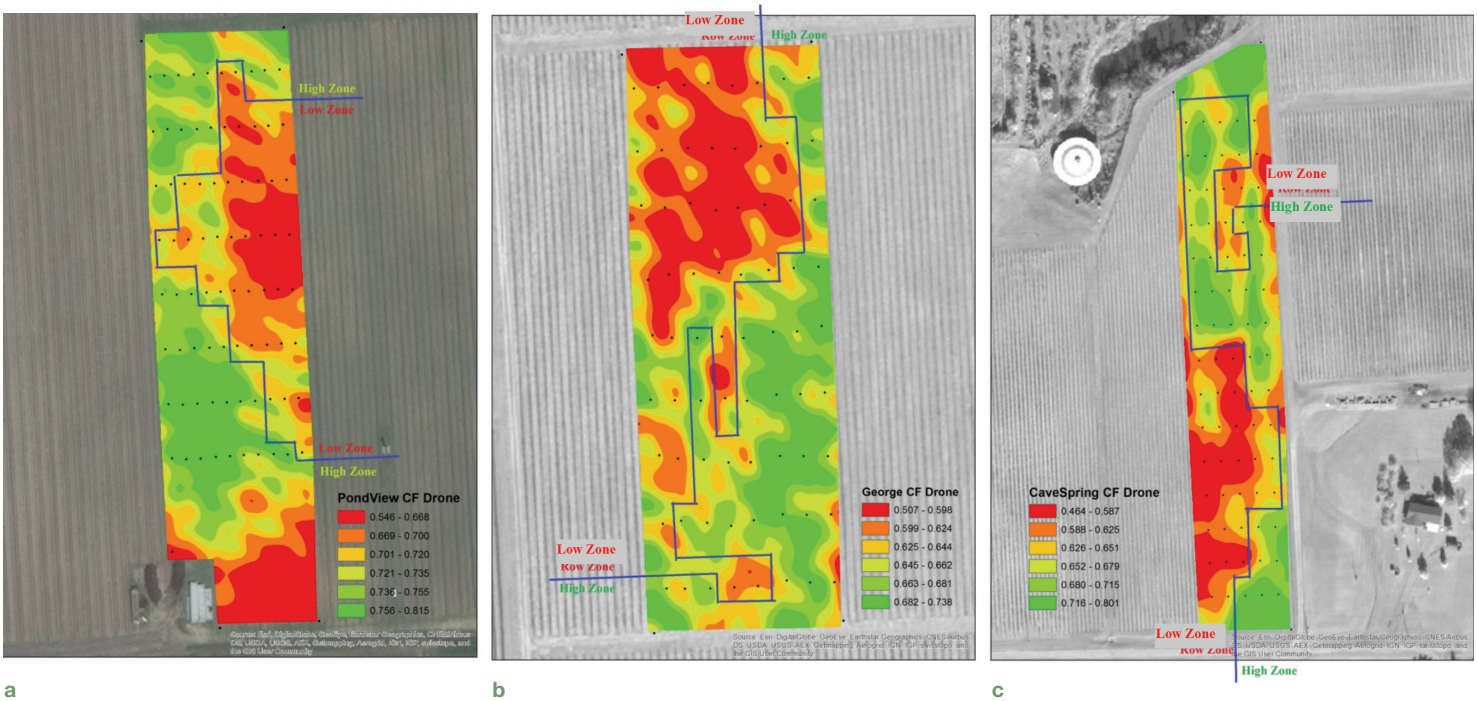

a b c

Figure 5: These maps were derived from UAV data and are examples of NDVI-based zones in three Ontario Cabernet Franc vineyards. 5a is Pondview in Virgil, Ont.; 5b is George in Vineland, Ont.; and 5c is Cave Spring in Beamsville, Ont. Scales are 5a: 1 = 1039; 5b: 1 = 1240; and 5c: 1 = 1581.

vineyard block. Data were stored onboard and retrieved after the flight mission. Geometric correction was performed to correct the image geometry. Georeferencing was achieved by identifying control points (targets) on the ground. Geometric distortions caused by changes in UAV attitude and altitude were corrected using the information provided by the inertial station.

The series of images acquired during each flight was assembled into mosaics by selecting the overlapping areas to limit the viewing angle and the problems of directional effects. Once assembled and corrected, NDVI was calculated on mosaics. The NDVI pixel values corresponding to the field points were extracted and compiled into a geodatabase that included all field-based variables (e.g., leaf Ψ).

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An example of UAV correlations with other variables is shown in Figure 1 (page 60). It should be noted that mathematical relationships between NDVI and other variables of importance never will be exactly the same for every vineyard. There is substantial variability between vineyards, varieties and years. That is the nature of making biological measurements and attempting to correlate those to a physical measurement such as leaf reflectance.

The UAV NDVI and thermal indices were correlated with vine size in all Riesling vineyards in 2015, including that of the Buis vineyard in Niagara-on-the-Lake depicted in Figure 1a. The application of PCA provides a pictorial method of portraying correlations between multiple variables in a large data set. The variables represented by lines (eigenvectors) are considered correlated if the eigenvectors are parallel to each other, and inversely correlated if they are roughly 180° from each other.

In Figure 1a, NDVI acquired by UAV was correlated with GreenSeeker NDVI, soil moisture, leaf Ψ, gs, and berry weight, and inversely correlated to thermal data, FVT and PVT in Riesling. This suggests that zones of low NDVI might be linked to fruit with higher terpenes, and by inference higher-quality wine.

Noteworthy associations in other Riesling vineyards included UAV indices and berry weight (five sites), TA (two sites—Buis, George), FVT/PVT (three sites), and GreenSeeker NDVI (four sites). Inverse correlations of note with UAV data included soil moisture and leaf Ψ (five sites). Direct correlations also were noted for NDVI and at least one LT_{50} measurement for four sites: LT_{50} measured in March (Buis), January LT_{50} (Pondview), February LT_{50} (Hughes, Cave Spring). This suggests that high NDVI was associated with low winter hardiness, since LT_{50} is a negative value. Yield was not consistently related to NDVI; yield and NDVI were inversely correlated in three sites (Buis, Hughes, Pondview) but unrelated in two others. For the most part we found similar patterns in all Riesling vineyards in 2016.

In Cabernet Franc, UAV NDVI was associated with soil moisture, leaf Ψ, gs, yield, and berry weight, and inversely correlated to color, anthocyanins and phenols in the George vineyard in Vineland in 2015 (Figure 1b). UAV NDVI was correlated with vine size in all other Cabernet Franc vineyards. Other noteworthy associations included UAV indices and soil moisture (three sites), leaf Ψ (two sites), berry weight (five sites), TA (three sites), yield/cluster number (four sites), and GreenSeeker NDVI (four sites). NDVI was in-

versely correlated with anthocyanins, A_{520} and total phenols in four of five Cabernet Franc vineyards in 2015. This suggests that zones of low NDVI might be associated with grapes of higher color and phenols, and possibly higher wine quality than high-NDVI zones. Application of PCA of 2016 data revealed similar relationships.

This project has produced literally hundreds of maps! With 12 vineyards under study, three seaons of data collection, and a minimum of 14 variables, that means more than 500 maps. Maps for Chateau des Charmes Cabernet Franc vineyard 2016 are depicted in Figure 2 (page 61). The UAV NDVI map showed a low NDVI zone in the north end of the vineyard (Figure 2a). This corresponded closely with maps produced using GreenSeeker (Figure 2b), highest regions from the thermal camera (Figure 2c) and soil moisture (Figure 2d), and lowest regions of leaf Ψ (Figure 2e), and higher LT_{50} (i.e. less winter hardy; Figure 2f).

Zones of low UAV NDVI (Figure 3a) (page 61) were associated with low yield (Figure 3b), vine size (Figure 3c), berry weight (Figure 3d), higher Brix (Figure 3e) and higher pH (Figure 3f), once again suggesting enhanced fruit maturity in low NDVI zones. Conversely, those high-NDVI zones identified by the UAV were typically low in thermal camera data and high in GreenSeeker NDVI, leaf Ψ, soil moisture, vine size, berry weight and TA, and lower in LT_{50} (i.e., more winter hardy).

Other Cabernet Franc vineyards showed associations in the UAV data between low NDVI and high thermal zones. These corresponded to low GreenSeeker NDVI, soil moisture, leaf Ψ, vine size and berry weight, and higher LT_{50} zones. There was some spatial correlation with high-TA and low-Brix areas, but pH and overall yield usually were not strongly related spatially.

In most vineyard blocks the UAV NDVI maps were comparable to GreenSeeker NDVI maps. In general, there were good direct spatial correlations between UAV and GreenSeeker NDVI vs. leaf Ψ, leaf g_s, soil moisture, vine size, LT_{50} and TA, and inverse ones with Brix and pH. There were also many situations in which maps from thermal data were inversely correlated spatially with NDVI.

Most frequent spatial correlations in Riesling with UAV and GreenSeeker NDVI zones were leaf Ψ, *gs*, soil moisture, vine size, berry weight, yield and TA. Noteworthy inverse spatial correlations included Brix, pH, FVT and PVT. The 2016 patterns in leaf Ψ, soil moisture, yield components and berry composition were for the most part consistent with those observed in 2015 for both Riesling and Cabernet Franc.

GVLRaV3 titer was determined in 2016 in all vineyards for all vines used for leaf Ψ. Zones of low GLRaV titer corresponded spatially with zones of low NDVI in two Cabernet Franc vineyards (Figure 4) (page 62). The same trend was apparent for three Riesling vineyards. However, low NDVI zones also corresponded in some cases with low leaf Ψ, low soil moisture and high concentrations of anthocyanins and phenols. This is a major challenge, because we need to identify unique spectral signatures that designate virus-affected areas that do not correlate spatially with other variables such as leaf Ψ; otherwise there is a strong possibility of misdiagnosis. Consequently, more research is needed to identify other vegetation indices that are unique and specific to zones of varying virus status. This work is ongoing.

Maps also identify management zones within vineyards that might correspond to fruit of different potential wine quality. This is, in essence, the raison d'être of precision viticulture. Figure 5 depicts three Ontario vineyards that show clear zones of high and low NDVI determined by UAV. During harvest, it was clear that the high NDVI zones had larger clusters, larger berries, generally higher yields per vine and, in the case of Riesling, more bunch rot than low NDVI zones.

Conclusions

Unmanned Aerial Vehicles (UAVs) are a valuable tool to acquire high-resolution aerial images of vineyards. The data within the high-resolution aerial images can be used to determine the spatial distribution of a variety of canopy variables within a vineyard block and between different vineyard blocks. In this way UAVs can be used to measure the spatial distribution of vigor, water stress, nutrient status, disease, yield components and berry composition. One of the major challenges is the massive amount of data that are collected, the time required for post-flight data processing and the need to derive useful vegetation indices that are specific to variables of interest.

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52	Electro-Steam Generator Corp.	electrosteam.com
45	Fermentis	fermentis.com
39	Flavourtech	flavourtech.com
16	GAI America Inc.	gai-america.com
35	Government Liaison Services, Inc.	trademarkinfo.com
40	Gusmer Enterprises	gusmerwine.com
14	GW Kent, Inc.	gwkent.com
54	Inoxpa USA, Inc.	inoxpausa.com
52	Kennedy/Jenks Consultants	kennedyjenks.com
59	Lakewood Cork	lakewoodcork.com
43	Lallemand, Inc.	lallemandwine.com
5	Live Oak Bank	liveoakbank.com/winery
48	Nadalié USA	nadalie.com
34	Napa Fermentation Supplies	napafermentation.com
57	Oztera, Inc.	oztera.com
57	Pasco Poly, Inc.	pascopoly.com
38	Quality Stainless Tanks	qualitystainless.com
51	Redback Boots	redbackboots.com
2	Rivercap USA	rivercap.com
20	Sanitary Stainless Welding	sanitarystainless.com
53	Scott Laboratories, Inc.	scottlab.com
19	Seguin Moreau Napa Cooperage	seguinmoreaunapa.com
31	Shelco Filters	shelco.com
35	Spec Trellising	spectrellising.com
32	Spokane Industries	spokaneindustries.com
26	Squid Ink Manufacturing	squidink.com
3	StaVin, Inc.	stavin.com
68	Tonnellerie Ô	tonnellerieo.com
53	Unitech Scientific	unitechscientific.com
18	VA Filtration USA	vafiltration.com
65	Vance Metal Fabricators	vancemetal.com
55	Vintegrate Enterprise Winery Software, a division of KLH Consulting, Inc.	vintegrate.com
41	Vintuitive Winemaking Tools, LLC	vintuitivewmt.com
58	Waterloo Container Co.	waterloocontainer.com
31	Wine Compliance Alliance	winecompliancealliance.com
7, 9	Wines & Vines Packaging Conference	wvpack.com
67	Wines & Vines Analytics	winesandvines.com/marketing/dms
15	World Cooperage	worldcooperage.com
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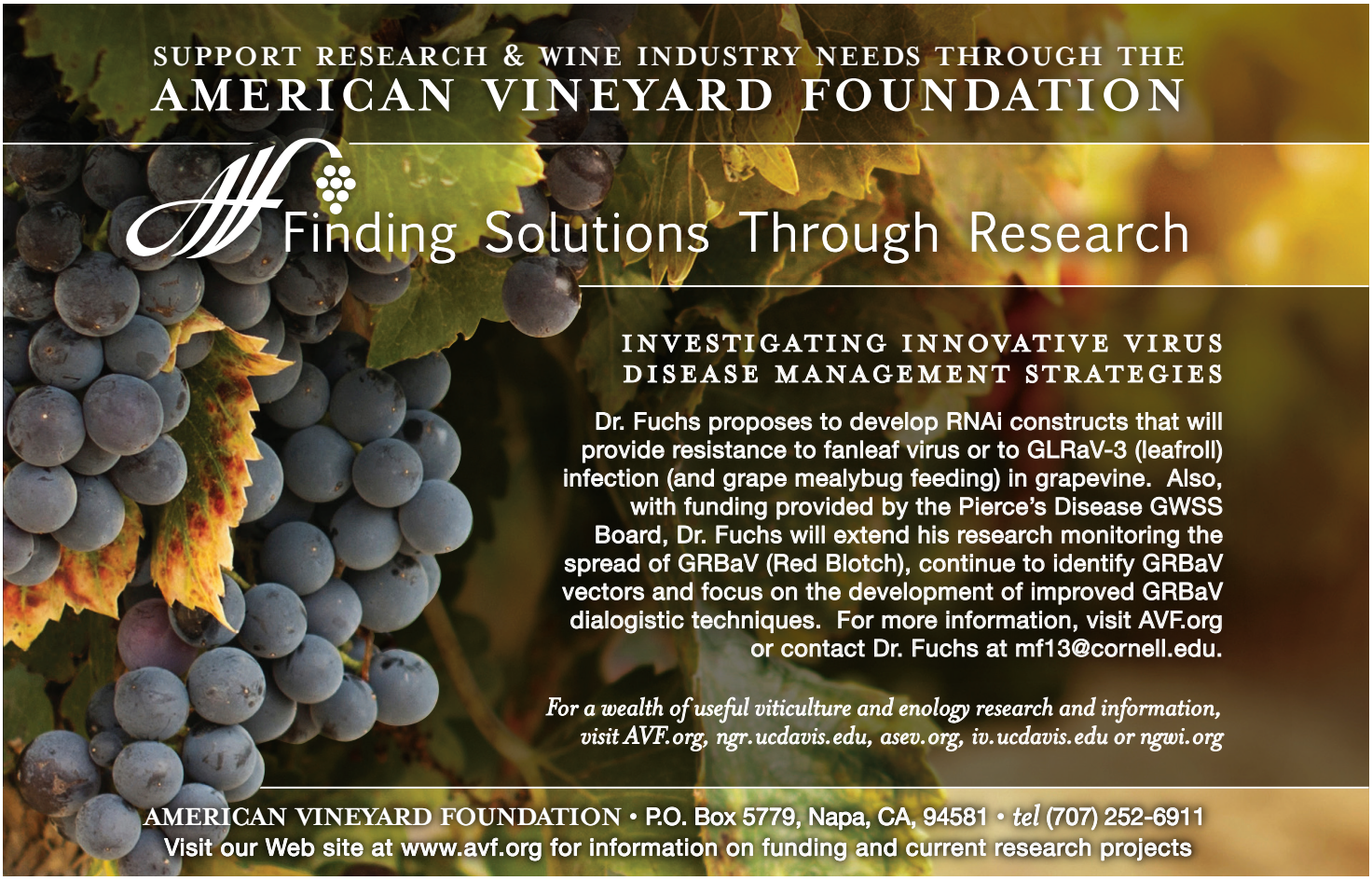

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