VINTAGE REPORT
Napa 2016

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VINTAGEREPORT
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Event Report

The 2016 Napa Vintage Report took place on January 18, 2017, at the Westin Verasa in Napa, CA.

The gathering was the seventh iteration of the annual conference in Napa. The 2016 Vintage Report aimed to provide an engaging platform for winemakers and grape growers to share their experiences with the 2016 vintage, and share new technology and research advances and their impact on future winemaking and vineyard management practices. The content of the conference was organized based on the plant calendar for a growing year, proceeding from winter/spring to fall harvest.

Keynote: Tim Mondavi

Tim Mondavi kicked off the 2016 Vintage Report with an overview of the Mondavi family history in the Napa Valley, past challenges faced in the region, and hurdles to overcome in the future. Historically, challenges for the region in the past century include prohibition during the 1920s and the second coming of phylloxera during the 1980s, while the challenge of today and the future is climate change. When the Mondavi family bought Charles Krug wine in 1943, they began a post-prohibition battle to sell a non-fortified bottle of wine to the public during a time of high alcohol craving in the United States. During this time, an environment of cooperation began in the Napa Valley in an effort to revive California wine and recreate the California wine culture. During the later part of the 20th century, attention shifted out of the cellar and into the vineyard during the phylloxera outbreak of the 1980s. New technologies allow growers to focus on vineyard details on the vine level, from biomass, to yield, to sap-flow sensors. These new technologies and studies allow us to give attention to each vine, and the site in which it grows, to help truly understand wine as art. The Mondavi's Continuum Estate on the valley's hillside represents the family's progression to understand site-specific farming capacity and the advancements of Napa Valley wine. The future of the wine industry is understanding the physiology of the vine, in order to understand the health of the vine in order to make better wine. Tim concluded his keynote address by highlighting the importance of sharing information within the Napa wine industry, and the industry as a whole, especially with the implementation of new technology in an era of a rapidly changing climate.

GRAPEVINE SHOOT DEVELOPMENT AS A FUNCIONT OF ARM POSITIONING

As the first scientific speaker of the day, Jean Dodson Peterson, PhD of the Cal Poly San Luis Obispo Department of Wine and Viticulture, shared her research on shoot development and vineyard uniformity related to arm positioning. The goal of her research was to determine the role of shoots meter-1 in normalizing the growth along cordons and the impact of adjustments on solving weakness and development delay issues. The study analyzed three different pruning methods (5.5 shoots meter-1, 11.1 shoot meter-1, and 11.1 shoots meter-1 with leaf removal) and their impact on final pruning weights, cluster weights, shoot lengths, and spur diameter. The study revealed that overall, shoots positioned at the end of an arm were stronger than shoots near the mid and trunk sections of the cordon. Additionally, reducing the shoots meter-1 homogenized the shoots along the cordon according to shoot lengths and pruning weights. Understanding how pruning strategies and changing shoots meter-1 effect homogeneity in the vineyard allows a grower to make quick vineyard changes from one year to the next. This will be key to align vine health and sustainability during a changing climate. Dr. Dodson Peterson ended her presentation by sharing the goals to expand this research in the future to study the effects of shoots meter-1 on cluster variability, and rootstock effect on pruning response.

VULNERABILITY EMBOLISM AND XYLEM REFILLING UNDER TENSION IN VITIS: DO WE NEED A MIRACLE?

Moving into the growing season along the Vintage Report timeline, our next scientific speaker, Sylvain Delzon, Research Director - UMR BIOGECO (INRA), highlighted new pioneering research into the movement of water within a vine's xylem tissue. The study of cavitation with vine sections has historically been a challenge because of the artifacts created when stem is physically sectioned. However, today research is using x-ray micro-CT scans and synchrotron technology to provide real-time, non-invasive views of vine vessels and cavitation. The questions of today are: is the vine as susceptible to drought and embolism as previously researched? And can the vine repair itself after embolism? Research in the 20th century concluded daily cavitation does occur, which was confirmed in 2012. However, research using these new non-invasive x-ray methods show that 50% of vine vessels are cavitating around -2.7MPa, meaning that the vines are more resilient to embolism than previously thought. Additionally, significant hydraulic segmentation occurs in the vine, meaning that there is a disconnect in cavitation behavior between the root level and shoot/canopy level of the vine - a method of defense for the vine. Other key discoveries include the finding that as a vine ages it becomes more resistant to cavitation, and xylem is only repaired after embolism under positive pressure at the base of the stem. These cavitation behavior discoveries are consistent between varietals, in an interesting addition to the iso/anisohydric debate. Mr. Delzon emphasized that according to this research *Vitis vinifera* is actually much more resilient to drought and water stress than previously thought.

MANAGING PHENOLICS IN THE VINEYARD

Following the growing season further towards fruit production, S. Kaan Kurtural, PhD, UC Davis Department of Enology and Viticulture, presented research on vineyard management effect on the phenolic compounds formed and sustained within the grape. Phenolics within the grape play an important role in a wine's sensorial properties, such as color, astringency, mouthfeel, and bitterness. For example, increasing the size of tannin molecules will increase astringency, or a higher level of epicatechin-3-O-gallate (ECG) will lead to more chalky dryness and a lower coarseness. Thus, phenolic adjustments due to vineyard management practices play a key role in final wine outcome. With a changing environment and climate on California's North Coast, studying the effect of increasing temperature and light exposure on phenology and flavonoid profiles will be key. A recent study at the Oakville Experiment Station in Napa looked at the effect of five different shade nets on anthocyanin content and the physical condition of berries in a bi-lateral cordon, relaxed shoot-positioned cabernet sauvignon under deficit irrigation strategies. The study revealed that at its most effective the shade netting reduced peak berry temperature by 3.5 Celsius, but temperature alone did not noticeably improve berry composition. However, the berries that were uncovered (the control) showed a higher percentage of sunburned berries than those under netting. One main discovery was that the Aluminet treatment net resulted in a 25% reduction in yield due to berry damage. As for anthocyanin content: blue netting increased hydroxylation of anthocyanin under regulated deficit irrigation. According to Dr. Kurtural, regulated deficit irrigation also increased total sugar across the board (regardless of net treatment).

IMPACT OF BERRY MATURITY AND WINE ALCOHOL ON ANTHOCYANIN, TANNIN, AND POLYMERIC PIGMENT CONTENT OVER TIME

Caroline Merrell, a PhD Candidate at Washington State University's Viticulture and Enology Program, brought the discussion from the vineyard into the cellar and wine production process. Her current research focuses on the effect of grape maturity, wine alcohol content, and anthocyanin:tannin ratio on polymeric pigment content and stability. The formation of polymeric pigment is key to stabilizing wine color content. Syrah and cabernet sauvignon fruit for the experiment was harvested from the 2015 vintage at three different maturity levels: 20 brix, 24 brix, and 28 brix (unripe, ripe, and overripe). Each harvest lot was then sub-divided and produced into three wine solutions replicating the sugar content of 20 brix, 24 brix, and 28 brix maturity. Each of of the nine wines was fermented in triplicate, and produced using a consistent methodology across the board, including: no acidity adjustments, 10 day maceration, and four months of aging at 30 Celcius. The study revealed that be best predictor of final polymeric pigment content in the wine (maxed at around one year in the cellar) is actually the initial concentration of anthocyanin in the wine; not necessarily the concentration of anthocyanin in the grape. In conclusion, both anthocyanin and tannin content in an initial wine are good predictors of polymeric pigment potential and stability.

ADJUSTMENT OF BARREL AGING TO GRAPE PROFILE

Andrei Prida, PhD, Research and Development Manager for Seguin Moreau, provided an overview of historical and new knowledge in barrel aging and its effect on wine/grape aroma profiles. Barrels contribute to wine flavor profiles through oxygenation, natural oak-derived flavor compounds, tannin manipulation, and other oak/toasting derivatives. Many of these inputs vary during the aging process. For instance oxygen input from the barrel decreases over the duration of the aging process. With respect to oak compounds, ellagitannins have a low stability in wine, while quercotriterpenosides (QTT) are very stable in wine, and have low sensory thresholds for sweetness and bitterness. Therefore, it is significant that sessile oak (*Q. petraea*) contains significant concentrations of QTT compounds, while pedunculate oak (*Q. robur*) contains almost none; choice of oak type becomes very much a flavor wine sensory decision. A barrel's impact on wine is also driven by specific volatile oak and toasting level compounds and their interaction with a particular wine profile. For example, modulating toasting regimes will have an impact on whether the wine brings forth a sense of ripeness or brightness, as related to the "wine matrix". In conclusion, Andrei highlighted recent research into the wine matrix that may soon add detail to our understanding of barrel selection, including studies on ripeness markers such as furaneols and lactones.

NEW PhD RESEARCH

After the midday lunch break, the conference resumed with short overviews of current research from a number of PhD candidates and postdoctoral researchers. James Campbell, graduate student at UC Davis - Robert Mondavi Institute for Food and Wine Science, shared his research into tannin maturation changes within grapes from veraison to harvest. Next, Erin Galarneau, graduate student at UC Davis - Department of Plant Pathology, shared her research into the influence of phenolics on vine trunk diseases and their possible early detection uses. Finally, Luca Brillante, PhD and postdoctoral student at UC Davis - Department of Viticulture and Enology, highlighted his work on vineyard variability across time and space, and how we can understand site-specific variability management using modeling and other techniques.

THE VINTAGE REPORT MAP & DATA SUMMARY

During the Vintage Report, Thibaut Scholasch, PhD, co-Founder and VP of Research and Development at Fruition Sciences, highlighted data trends during the 2016 growing season via transitional talks between the Report's various speakers. He placed the day's speakers and topics within the context of the growing season, and shared new findings in vineyard data collected around the Napa Valley. While studying the vintage, it is important to look at data from at least two years prior to the current vintage. From the beginning of the season, before budbreak, this mean looking at rain accumulation during the winter months to get a sense of growing season water abundance. In 2016, Napa had a constant (but not necessarily large) supply of rain between November 1st and March 1st (more consistent than 2014 and 2015), with a rare late spring addition of 205mm of rain after March 1st. The thermal time before budbreak showed similar growing degree day (GDD) accumulation to 2014 and 2015, likely leading to a highly active uptake of Nitrogen in 2016. This prediction will either be confirmed or contradicted by what we find during the 2017 vintage, especially using new real-time fluorescence leaf measurement techniques to determine plant Nitrogen Biological Index (NBI). Although thermal time accumulation at the beginning of the season was similar to 2014 and 2015, the 2016 vintage showed a large difference (over 200 GDD span) across Napa sites from bud break and veraison. Due to the late spring rain in Napa (zero early season water deficit), shoot elongation was likely driven solely by this varied heat accumulation, unless nitrogen was limiting in the vineyard. Because low nitrogen during year n can lead to low yield year n+1, such as from 2014 to the 2015 growing season, the late rain and nitrogen accumulation in 2016 will be key to predicting 2017 yield and fruit quality. Will the high nitrogen uptake, on average, in 2016 lead to high yields in 2017? How will this impact grape color and phenolics in 2017? The light accumulation during and post-veraison in 2016 was a similar light regime to that which we witnessed in 2011, with more light than 2015. This likely increased color accumulation in 2016 despite high nitrogen uptake and low water deficit. New research shows that light exposure does in fact increase anthocyanin accumulation, but then peak and decline based on site-specific temperature. Studying row orientation and topography effect on color degradation is the next step in anthocyanin accumulation studies. In conclusion for 2016, Thibaut Scholasch displayed his annual vintage map, comparing vintages by rain amount, length of dry period, and frequency/intensity of heat waves.

THE STATE OF THE CLIMATE

The next presenter, Gregory V. Jones, Professor of Environmental Science and Policy at Southern Oregon University, gave a detailed synopsis on the 2016 season's climate and how it fits into the patterns of a changing climate for the western United States. January through August of 2016 were all the warmest months on record for the globe, and in the arctic 2016 was the warmest year ever recorded. In California since 1995, only three years have seen below average temperatures; the rest have been well above. An moderate El Nino pattern was in place for the West Coast in 2016, but it ended up having minimal impact on the overall climate. The most important factor of the El Nino pattern was the resulting North Pacific cooldown in ocean temperature, which moderated summer temperatures (such as in July), and led to a wet October for the West Coast. As we head into the 2017 growing season, we are currently seeing a fairly weak La Nina ocean temperature pattern. In a typical La Nina we see a cool and wet season in the Pacific Northwest, while California sees a cool year in temperatures, with around average rainfall. However, due to a cold ocean mass extending towards North America in the Pacific, atmospheric rivers are flowing further south than normal. So although we are expecting to see warmer temperatures in California and the Southwest, we are currently witnessing much wetter weather than expected. The U.S. Drought Monitor currently shows a reduction by 38% in drought from what we encountered in 2015 and 2016. Additionally, California is averaging 64% capacity for all reservoirs, which is 106% of the historical group reservoir averages. In conclusion, Professor Jones is predicting a cooler 2017 than 2015 or 2016 (somewhere between 2010-2014), reduction in geographical extent of the drought, and odds in favor of a cool and dry late winter/early spring for the western U.S.

HARNESSING THE MICROBIOM: HOW THE SOIL'S MICROBIAL FINGERPRINT CAN INFLUENCE VINEYARD AND WINE QUALITY

The Vintage Report's final speaker of the day moved discussion from the climate to the soil. John DImos, PhD, General Manager at Biome Makers, present the concept of using the soil's microbiome as a sensor for a better understanding of ecological management and plant health. In a single gram of soil there can be over 10 million microbes (more microbes in one gram of soil as people living in New York City, for example). Biome Makers is attempting to connect the microbes in the soil to vineyard management practices and wine taste profiles through rigorous analysis and data analytics. The efficient NGS-DNA testings allows Biome Makers to identify exact microbes in a sample, and their concentrations compared to the other inhabitants. This new testing can be used to determine vineyard disease/pathogen abundance. For example, a vineyard soil test could identify the existence and abundance of *Erysiphe necator*, the microorganism responsible for powdery mildew. With an ability to detect disease even a slight presence of disease causing microbes, this new soil "fingerprint" could be used as an early disease detection system. The microbiome is not only important for disease prediction, but the microbes that are found in the soil are almost always reflected in the grape, and can therefore be used to predict wine contamination (i.e. *Brettanomyces bruxellensis*), or the likelihood of a safe native fermentation. Additionally, one-third of all volatile compound in wine are produced or in some way modified by microbes. Finally, the soil microbiome can be used as a biomarker, distinguishing growing regions or farming practices based on their microbial signature; differences between conventional and organic farming practices lead to unique microbial communities. In conclusion, Biome Makers is just beginning to scratch the surface of the benefits in studying the vineyard microbiome.

In conclusion

The 2016 Napa Vintage Report unfolded during the day and followed the 2016 vintage from budbreak to harvest, with discussion topics covering pruning decisions, vine water flow, phenolics in the vineyard and cellar, barrel influence on wine, vintage data trends and climate outlook, and soil microbial communities. Overall, the 2016 vintage unfolded with a steady supply of moisture into late spring, relatively high heat accumulation, and a higher light regime compared to 2015. The wines produced in 2016 will likely reflect these well-balanced vineyard conditions. Going into 2017, it will be enlightening to discuss the impact of the lack of early season water deficit and high nitrogen uptake in 2016 on the yield and fruit quality in 2017. We look forward to seeing you again next year to discuss the next growing season!

What is the Vintage Report?

The Vintage Report brings together scientists, winemakers and industry leaders from all over the world to produce a one-day seminar that engages open minds within the industry to discuss the previous harvest in light of the most recent scientific findings and newly available data.

www.vintagereport.com