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This issue of the ASEV Technical Update contains interpretive abstracts written by authors of articles published in the four issues of the 2017 American Journal of Enology and Viticulture. A link to the online Journal article appears at the end of each abstract.

Effects of Immersive Context and Wine Flavor on Consumer Wine Flavor Perception and Elicited Emotions

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Food studies have shown that emotional responses can be influenced by food alone and where it is consumed (environmental context). The influence of context on the perception and liking of red wine flavors and on the emotions evoked is poorly understood. The aim of this research was to determine how wine flavors and context change the consumers' perceived intensities of green and floral flavor characters in wines, their liking of these wines, and the emotions elicited during wine consumption. Red wine consumers (n = 105) tasted three Cabernet Sauvignon wines: control wine (CW), green flavored wine (GW), and floral flavored wine (FW). All wines were tasted in two types of rooms: a room arranged with flowers and a room with green potted plants. The wine consumers were asked to taste and rate how strong the green and floral flavors were in the wines, their liking, and the emotions elicited. The results showed that in both rooms, FW was stronger in floral flavor and GW in green flavor. The CW and FW were significantly more liked than the GW. In general, consumers felt more positive emotions when consuming the CW and FW relative to the GW, whereas consumers felt more negative emotions when consuming GW. The decor of the room in which wines were tasted did not influence any of the measurements. When consumers were separated into three groups based on their liking of wines tasted, the emotions felt by each group were different. The rating of wine liking and emotions by the three groups were consistent with their liking of verbal flavor terms.

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Water Versus Source–Sink Relationships in a Semiarid Tempranillo Vineyard: Vine Performance and Fruit Composition

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Grapevine yield and fruit composition largely depend on vine water status, which can be manipulated, especially in semiarid climates, by irrigation strategies and training systems. The objective of this research was to study how canopy height can influence vine growth, yield, and berry traits of Tempranillo vines when plants are water stressed to a greater or lesser extent. Two canopy heights and three irrigation strategies, similarly applied in the two training systems, were tested in combination. Over two years (2010 to 2011), elevating the canopy resulted in a 26% increase in leaf area per vine but also resulted in a higher water stress. As a consequence, yield was 12% reduced by the elevated canopy on average for the three irrigation levels due to lower cluster and berry weights, and berries had increased total soluble solids

Water Versus Source–Sink Relationships in a Semiarid Tempranillo Vineyard: Vine Performance and Fruit Composition *(continued)*

and higher anthocyanins concentration, lower total acidity, and lower malic and tartaric acid concentrations. There were only slight differences in yield under the different irrigation regimes. However, berry anthocyanins concentration was higher when an early deficit irrigation strategy was applied. Midday stem water potential, rather than the leaf-area-to-yield ratio, was the indicator that better explained treatment-to-treatment differences in vine performance and fruit composition, suggesting that vine performance in the study area was more influenced by water availability than by the amount of sunlight intercepted by the vineyard.

Am J Enol Vitic 68:11-22 (2017)

Influence of *Oenococcus oeni* and *Brettanomyces bruxellensis* on Hydroxycinnamic Acids and Volatile Phenols of Aged Wine

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In this study, the effect of two *Oenococcus oeni* strains, Viniflora CiNe and Viniflora CH11, with and without cinnamoyl esterase activity, respectively, on the contents of the hydroxycinnamic acids (HCAs) *p*-coumaric and ferulic acid and their respective volatile phenols, 4-ethylphenol and 4-ethylguaiacol, was investigated during a period of six months in Cabernet Sauvignon wines inoculated with two different *Brettanomyces bruxellensis* strains, CBS 73 and CBS 2499. Both CiNe and CH11 showed growth and malolactic fermentation (MLF) in the wines. There were no clear growth interactions between *B. bruxellensis* and *O. oeni*. Furthermore, *B. bruxellensis* did not inhibit MLF by CiNe or CH11. The HCA concentrations in all wines increased until 114 days of fermentation, after which they decreased from day 114 to day 180. Wines inoculated with CiNe had the highest concentrations of HCAs throughout the fermentations. Even though CiNe degraded more of the tartaric ester bound forms of HCAs into free HCAs, there was no significant difference in the production of volatile phenols as compared with wines inoculated with CH11. However, there was a significant difference in the level of volatile phenols and HCAs on day 180 between wines with the two strains of *B. bruxellensis*. Thus, it seems that the level of volatile phenols in wine depends more on strain differences of *B. bruxellensis* than on cinnamoyl esterase activity of *O. oeni*.

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Effect of Bentonite Fining on Polyfunctional Mercaptans and Other Volatile Compounds in Sauvignon blanc Wines

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Bentonite fining is the most common process used in the wine industry to remove proteins from wine; however, it is known that bentonite can potentially affect the aroma of wine. In this study, the influence of fermentative and post-fermentative fining on aroma compounds found in Sauvignon blanc wines was evaluated. Sauvignon blanc musts from different vintages were fined using bentonite at different stages of vinification. Conventional enological parameters, together with more than sixty volatile compounds, including varietal thiols, were determined in the bottled wines. The results showed that bentonite fining was more effective for protein removal when carried out on finished wines. Several volatile compounds were influenced by bentonite fining depending on the timing of addition and the vintage. Varietal thiols, key compounds of Sauvignon blanc wine aroma, were significantly reduced when the wines were fined with bentonite, particularly when fining took place during fermentation. This study suggests that bentonite fining of musts could damage the organoleptic quality and varietal character of Sauvignon blanc wines because of its impact on the decrease of varietal thiols.

Am J Enol Vitic 68:30-38 (2017)

Relating Expert Quality Ratings of Australian Chardonnay Wines to Volatile Composition and Production Method

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Chardonnay is a neutral grape variety offering a diversity of wine styles popular among consumers. This study explored the links between wine production methods and Chardonnay wine aroma in relation to quality, as assessed by wine experts. Over 80 commercial Australian Chardonnay wines without any identifying information were assessed by the experts who were asked to define four distinct levels of quality. Details of production methods were provided by producers, and a range of wine aroma compounds were measured by gas chromatography-mass spectrometry. Statistical techniques and network analysis were then used to examine the relationships between wine aroma, price, and quality, as defined by the experts. Of 39 aroma compounds, nine (including oak and wine age-related) were positively related with Chardonnay wine quality, whereas 11 compounds (including fruity esters and grape-derived aromas) were negatively related. Compounds arising from oak and malolactic fermentation were present at highest concentrations in higher quality wines, as perceived by the experts. Lower scores were attributed to younger wines, which were without faults but less complex, being richer in fruity esters and other grape-derived aroma compounds. A prediction model was developed based on these results, which permitted the classification of the Chardonnay wines into high-, medium-, and low-quality brackets depending on their relative concentrations of compounds that contributed either positively or negatively to the model of wine quality. A positive correlation was found between retail price and quality score, thereby implying the utility of price as an indicator of quality, although it failed to entirely explain quality (as judged by experts) and should be used in conjunction with other quality cues.

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A Multivariate Methodological Approach to Relate Wine to Characteristics of Grape Composition: The Case of Typicality

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Typicality is defined as the characteristics of a product relating to a terroir, meaning that it is representative of its terroir. In a Protected Designation of Origin (PDO) wine, a typicality assessment can be used to sum up the global quality of the wine. In the literature, a number of papers deal with the question of "how to define the level of typicality," and different chemical and sensory approaches have been suggested. This study provided a two-phase multivariate methodological approach to select grape and wine chemical markers to define the typicality of a PDO wine, and it then applied the approach to a case study of Chianti Montespertoli PDO wine. A panel of wine professionals evaluated the typicality of a series of selected PDO wine samples, and a partial least squares (PLS) regression model was used to associate wine typicality and chemical composition. The model was used to predict wine typicality from the chemical data of experimental wines (2009, 2010, and 2011 vintages) produced from grapes growing in the PDO area. Finally, regression coefficients of the PLS model were analyzed to select which grape chemical parameters were significant in describing the typicality of the wine. These could be considered the main parameters to take into account in order to control the process and ensure the typicality of this wine. It is important to stress that a specific model has to be defined for every type of wine in order to identify the chemical profile of the raw material as a base for realizing a product control system and choosing the relative process. It will be necessary to study the grapes and wines of more vintages in order to test these results and optimize the model.

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Predicting Key Phenological Stages for 17 Grapevine Cultivars (*Vitis vinifera* L.)

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Weather conditions have a significant impact on crops, and temperature is one of the main factors that controls both vegetative and reproductive development. Thermal time models based on temperature have been applied to predict the development of many species. To implement these models, the determination of a proper base temperature (T_b) is required to characterize the differences among developmental stages and cultivars. The goal of this study was to determine the unique T_b and degree-days (DD) to predict budbreak, bloom, and veraison for 17 cultivars. T_bs were estimated through the minimum variance method using phenological data collected during 23 years in Prosser, WA. T_b increased throughout grapevine development and ranged from 6.1 to 8.4°C for budbreak, from 7.2 to 10.5°C for bloom, and from 9.4 to 12.8°C for veraison. Starting DD accumulation on 1 Jan and using the T_bs estimated for each individual cultivar, duration to budbreak ranged from 78 to 180 DD, from budbreak to bloom ranged from 240 to 372 DD, and from bloom to veraison ranged from 556 to 800 DD. Errors in prediction varied between 4.8 to 7.8 days to budbreak, 1.9 to 5.5 days to bloom, and 7.1 to 12.4 days to veraison. Based on the errors in prediction, models that used an estimated T_b specific for a phenological stage showed a better performance compared to the models that had a fixed T_b of 0 and 10°C. The estimated thermal time parameters provide a simple approach for characterizing differences among cultivars and for assisting growers and industry in implementing management practices through simple decision support tools based on thermal time models.

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Evaluation of Chinese *Saccharomyces cerevisiae* Wine Strains from Different Geographical Origins

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Saccharomyces cerevisiae plays a critical role in the development of aromas, flavors, and wine matrix properties in wine production. The contribution of *S. cerevisiae* to wine is dependent upon the particular strain used. Novel strains can be generated by cross-breeding of strains with valued properties. The purpose of this study was to evaluate the relatedness at the genomic level of a collection of strains isolated from native fermentations in two distinct wine production regions in China. One region relies heavily on table grapes for wine production. The data were then compared to that of an analysis of strains of international and commercial origins. The Chinese strains represented multiple genetic lines, and strains from the two regions were distinct, confirming the lack of exchange of grapes or equipment between these regions. The Chinese strains were also distinct from the other commercial and international isolates tested, confirming the lack of exchange of materials between these two regions in China and other old-world grapegrowing regions. The distinctness of the Chinese strains indicates that they may be useful in genetic crosses with strains from other regions for the generation of novel strains producing unique impacts on wine composition.

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Impact of Yeasts Present during Prefermentation Cold Maceration of Pinot noir Grapes on Wine Volatile Aromas

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Wine aroma is a major component of wine quality and can be impacted by a number of viticultural and winemaking practices. One such practice is a prefermentation cold maceration, commonly known as cold soak (CS), in which red grapes are held at a cold temperature in tanks after harvest for a set period of time before the beginning of alcoholic fermentation. It is thought that this process can impact the final aroma of a wine through either extraction of flavor compounds from the grape skin or through the growth of cold tolerant yeast naturally present on the grapes. This study

Impact of Yeasts Present during Prefermentation Cold Maceration of Pinot noir Grapes on Wine Volatile Aromas *(continued)*

investigated the impact of yeast typically present during the prefermentation CS on Pinot noir wine aroma. Pinot noir grapes were treated with high hydrostatic pressure so as to remove any background microorganisms. This allowed the specific impact of added yeast species to the grapes to be determined. A number of yeast previously isolated from a prefermentation cold maceration of Pinot noir grapes were inoculated into the high hydrostatic pressure-treated Pinot noir grapes, and a seven-day prefermentation cold maceration was performed, followed by alcoholic fermentation conducted by *Saccharomyces cerevisiae*. The yeast added to the prefermentation cold maceration were selected based on their β-glucosidase activity and included both non-*Saccharomyces* and *Saccharomyces* yeast. Pinot noir grapes were also cold macerated without the addition of any yeast, while fermentations were also undertaken with no cold maceration. Volatile aroma analysis of the wines demonstrated that the presence of the different yeast species during the prefermentation cold maceration altered the volatile aroma composition of the wines. Volatile aromas were impacted by the CS process itself, as well as by the presence and growth of various yeast species. This study demonstrated that prefermentation maceration can alter the volatile aromas of Pinot noir wine, and that these changes are due to both the physical and chemical process of the cold maceration as well as the growth and metabolic activity of cold tolerant yeast.

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Copper-Complexed Hydrogen Sulfide in Wine: Measurement by Gas Detection Tubes and Comparison of Release Approaches

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The presence of sulfurous off-aromas, also called "reduced aromas," is a common wine fault. In recent years, it has become evident that the sulfur-containing compounds responsible for these off-aromas (e.g., hydrogen sulfide, [H_2S]) can be formed in the bottle. Recent work suggests that a major source of these sulfur-containing compounds may be stable copper sulfide complexes, which represent a pool of "bound" H_2S and related compounds. However, measurement of these bound forms requires analytical tools that are unavailable to most wineries. In this study, we show that inexpensive gas detection tubes can be used to measure bound H_2S from copper sulfide following release by brine dilution. In addition, we show that other copper chelating or reducing agents can also release bound H_2S from copper sulfide, although not as efficiently as brine. Interestingly, ascorbic acid is able to release bound H_2S, suggesting that the commonly employed "ascorbic acid test" for disulfides may instead be measuring copper sulfide complexes. In summary, our work confirms that copper sulfide complexes can stay dispersed in wine where they may serve as a precursor pool for generating reduced aromas, and that the presence of these complexes can be tested for in a winery setting.

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Biochemical Markers for Enological Potentiality in a Grapevine Aromatic Variety under Different Soil Types

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Pedoclimatic conditions affect grape and wine quality. In particular, the relationship between soil and grape quality is at the core of the terroir definition. This study focuses on cv. Aleatico, an aromatic and autochthonous grapevine cultivar grown in the northern part of the Latium region (central Italy) in a heterogeneous environment (Protected Denomination of Origin Aleatico di Gradoli). Five subareas were selected to represent the environmental variability. The grape-ripening parameters, along with volatile and phenolic compounds in wines derived from the grapes from these growing areas, were analyzed to assess the relationship between soil traits and biochemical grape and wine parameters. Pedoclimatic analysis was carried out following official protocols for soil texture determination and bioclimatic Thermal Index of Winkler computation. Solid-phase microextraction with gas-chromatographic and standard methods were

Biochemical Markers for Enological Potentiality in a Grapevine Aromatic Variety under Different Soil Types *(continued)*

used to measure volatile and phenolic compounds, respectively. Data were evaluated using descriptive statistical methods (analysis of variance and Pearson's coefficient) and multivariate statistical analyses (principal component analysis and hierarchical cluster analysis). The results showed a significant "soil effect" on the biochemical composition of the grapes and wines. The soil had a significant effect on grape-ripening parameters, as the soil sand content (%) was highly correlated with concentration of total soluble solids and phenols. Soils with a sandy-loam texture and moderate skeleton content yielded the best wine performance in terms of aroma and phenolic content. The study highlighted the importance of microzonation, even in small winegrape growing areas, for more diverse and competitive wine production. The study enhances knowledge about the relationship between soil and grapevine aromatic varieties. Data indicated that identifying biochemical parameters may be indicators of enological potential according to geographic origin.

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Aroma Characterization of Petit Manseng Wines Using Sensory Consensus Training, SPME GC-MS, and Electronic Nose Analysis

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The aromas of four Virginia Petit Manseng wines were evaluated using sensory consensus training methods and several analytical systems. Nine aroma descriptors were determined to describe the commercial wines: pear, peachy, floral, melon, exotic fruits, estery, vanilla, citrus, and honey. The four wines differed significantly ($p < 0.05$) in citrus fruit aroma intensity. The descriptor terms generated in this study differ from terms associated with Petit Manseng produced in France. We believe this is the first study that compares analytical evaluation of odor-active volatiles with sensory analysis by a trained panel for Petit Manseng aroma classification.

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Brown Marmorated Stink Bug Taint in Pinot noir: Detection and Consumer Rejection Thresholds of *trans*-2-Decenal

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Brown marmorated stink bugs (BMSB) are insects native to Asia that have become an increasingly problematic pest to agricultural crops in the United States. BMSB contamination in grape clusters results in the addition of an odor compound, *trans*-2-decenal (T2D), in wine. This compound has a green, musty aroma and is considered detrimental to wine quality. The main focus of this study was to estimate the detection threshold (DT) and consumer rejection threshold (CRT) of *trans*-2-decenal in Pinot noir, determine its impact on wine quality, and explore potential consumer segmentation. A DT is a concentration at which a difference is noted, and a CRT is a concentration at which consumers no longer accept a product. The two thresholds were measured and estimated using different methods (psychometric fit and a Thurstonian model), resulting in different threshold levels for both detection and CRTs of *trans*-2-decenal in Pinot noir. The DTs of the panel were estimated to be 0.51 µg/L from from a psychometric fit and between 0.12 and 0.31 µg/L using Thurstonian scaled values. Similarly, for the CRT, psychometric fit resulted in threshold of 13 µg/L, and the Thurstonian model produced results between 0.12 and 0.31 µg/L. Wine containing *trans*-2-decenal above its CRT was described as green, musty, and less fruity by wine professionals. When potential consumer segmentation was explored based on the detection and CRT data, there was no direct link between sensitivity and preference. Based on findings, the CRT provides a level of control or tolerance at which BMSB contamination does not affect wine quality. Contaminated grapes that result in *trans*-2-decenal concentrations above this rejection threshold will need to be treated to remove the contamination.

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Mitigating the Economic Impact of Grapevine Red Blotch: Optimizing Disease Management Strategies in U.S. Vineyards

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Grapevine red blotch disease (GRBD) is a recently recognized viral disease found across some the major grapegrowing regions in the United States. Vineyard managers were surveyed to (i) estimate the economic impact of GRBD on *Vitis vinifera* cv. Cabernet Sauvignon in Napa and Sonoma Counties in California and on *V. vinifera* cv. Merlot in Eastern Washington State and Long Island in New York State; and (ii) to identify cost-minimizing management strategies under various disease incidence rates, price penalties for suboptimal fruit quality, timing of disease onset relative to vineyard age, and costs of control. The economic cost of GRBD was estimated to range from $2213/ha in Eastern Washington, when disease onset occurs at a low initial infection level and low price penalty, to $68,548/ha in Napa County, when faced with a high quality penalty and high initial infection. Our results further suggested that roguing symptomatic vines and replanting with clean vines derived from virus-tested stocks minimizes losses if GRBD incidence is low to moderate (below 30%), while a full vineyard replacement should be pursued if disease incidence is higher, generally above 30%. These findings should help vineyard managers in the four viticultural regions examined to adopt optimal GRBD management strategies.

Am J Enol Vitic 68:127-135 (2017)

Use of Minimal Pruning to Delay Fruit Maturity and Improve Berry Composition under Climate Change

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Global warming has been exerting a negative effect on the wine industry around the world, especially in warm regions. With elevated temperatures throughout the summer, sugar accumulation in berries occurs earlier and more rapidly, while the accumulation of phenolic compounds is inhibited and berry anthocyanin concentrations may not reach desirable levels at harvest if temperatures are too high. High temperatures are good for sugar accumulation but suppress phenol synthesis. Thus, the wine would lack color. Therefore, it is necessary to adopt some cultural practices to delay sugar accumulation so that more color can be accumulated under a cooler condition. One of the possible cultural practices is minimal pruning (MP), which means "no winter pruning carried out." Compared with conventional hand pruning (CHP), MP has many advantages, such as labor and cost savings, larger yield, and better grape health conditions. Due to a higher production, MP grapes usually ripen later than CHP, so the ripening stage is cooler. The results of this study showed that, in the Rioja (Spain) wine region, under nonirrigated conditions, Tempranillo grapes from MP could achieve the same sugar content as CHP (22 Brix or 13% potential alcohol content) with ~17 days' delay. Also, the MP juice color was usually better. However, the main reason for this improvement in color might be that MP berries are always smaller relative to CHP, and the color substance is more concentrated. These results indicate that MP can delay berry ripening and may help to improve wine color.

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Impact of Winemaking Techniques on Classical Enological Parameters and Rotundone in Red Wine at the Laboratory Scale

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Rotundone is a grape-derived aroma compound responsible for peppery notes in red wines. It has been identified in several red international cultivars (Shiraz, Malbec, Pinot noir, and Gamay) and in Duras, a grape variety grown in the southwest of France. Viticultural and environmental factors driving the production of rotundone in grape berries have been widely studied, but the impact of enological variables affecting its extraction from grape to wine remains unknown. A study was conducted to assess the impact of winemaking techniques (cold soak, thermovinification, semicarbonic maceration, and rosé vinification) and fermentation variables (time and temperature of maceration, yeast species, addition of pectolytic enzymes) on rotundone and classical enological parameters. The rosé vinification and the thermovinification had the largest impact on wine characteristics. In comparison with the control treatment, none of the studied treatments resulted in enhanced rotundone concentrations, which means that efforts to maximize rotundone in wine have to be conducted in vineyards. Semicarbonic maceration, thermovinification, the use of *Saccharomyces uvarum,* and the increase in time of postfermentation maceration were identified as practical approaches for lowering rotundone in wine.

Am J Enol Vitic 68:141-146 (2017)

Spatial Variability in Ontario Pinot noir Vineyards: Use of Geomatics and Implications for Precision Viticulture

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Relationships between vine water status, soil texture, and vine size were observed in four Ontario Pinot noir vineyards (2008 to 2009). The vineyards were divided into water status zones using geographic information systems to map the seasonal mean leaf water potential (Ψ) and cane pruning weights (vine size). Leaf Ψ zones were confirmed using k-means clustering. Both seasons were cooler and wetter than average, and the range of leaf Ψ defining the water status zones was narrow (-0.59 to -0.95 MPa across all vineyards). Yield, vine size, crop load, anthocyanins, and phenols had the highest coefficients of variability. Higher yields, berry weights, titratable acidity, anthocyanins, and color were occasionally associated with low water status zones. There were no berry composition variables with differences between vine size zones in all four vineyards. Higher yields, cluster numbers, and berry weights were frequently associated with high vine size zones. Principal components analysis separated the vineyards but did not create clusters based on leaf Ψ or vine size. There were notable correlations between vineyard and grape composition variables, and spatial trends were qualitatively related for many of the variables. Significant r^2 values that suggested inverse relationships were found in 2008 for leaf Ψ versus anthocyanins, color intensity, and phenols, as well as vine size versus anthocyanins, while in 2009, there were significant r^2 values for soil moisture versus anthocyanins and color intensity that likewise suggested inverse relationships. This study showed that there is potential for using geomatic techniques to understand the variability in vineyards, but erratic weather in eastern North America presents a challenge for understanding the driving forces of that variability.

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Applications of Geospatial Technologies to Understand Terroir Effects in an Ontario Riesling Vineyard

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Interest in geospatial technologies and their possible applications in precision viticulture has increased over the past decade in North America. The objective of this study was to determine whether yield components (e.g., yield, cluster number, berry weight) and grape berry composition variables (e.g., Brix, titratable acidity [TA], pH, monoterpenes) would be related to, and dependent upon, soil texture and composition, vine water status (i.e., leaf water potential, Ψ), and vine size and to determine whether spatial patterns of leaf Ψ, vine size, yield components, and berry composition might be temporally stable. Data were collected in a 10-ha Riesling vineyard at Thirty Bench Winemakers, Beamsville, ON, Canada. The vineyard was delineated using global positioning systems and >500 vines were geo-referenced in six sub-blocks. Soil water content (SWC; all sentinel vines) and leaf Ψ data (a subset of 134 sentinel vines) were measured biweekly from 2006 to 2009. Soil texture and composition data were also collected on the 134-vine subset. Yield components and berry samples were collected from all sentinel vines, with an additional berry sample for analysis for free and potential monoterpenes (FVT, PVT) from the subset. Vine size was determined by weight of cane prunings. Berry samples were analyzed for Brix, TA, and pH, and the additional berry samples for FVT and PVT. All variables were mapped using geographic information systems, which permitted verification of temporal stability as well as correlative and spatial relationships. SWC and leaf Ψ were temporally stable throughout the vineyard despite extremely different weather conditions. There was an increase in Brix and pH and a decrease in TA (≈enhanced grape maturity), with decreases in SWC, leaf Ψ, and vine size. In the case of very high SWC, decreases in leaf Ψ, vine size, and fruit maturity were observed. Sub-blocks with the highest sand and soil organic matter tended to have higher vine sizes and berry monoterpenes.

Am J Enol Vitic 68:169-187 (2017)

Interactions between Storage Temperature and Ethanol that Affect Growth of *Brettanomyces bruxellensis* in Merlot Wine

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The potential for utilizing temperature and ethanol concentration of red wines to help limit infections by *Brettanomyces bruxellensis* during cellar aging was studied. Various combinations of storage temperature (12, 15, 18, or 21°C) and ethanol concentration of red wine (12, 13, 14, 15, or 16% [v/v]) were utilized. With increasing concentrations of ethanol, slower growth of two different strains of *B. bruxellensis* were observed. Neither yeast strain grew in wines containing 16% ethanol. Overall, combinations of lower storage temperatures (≤12°C) and higher ethanol concentrations (≥14%) resulted in declines of populations to below detection limits for up to 100 days. Thus, storage temperature and ethanol concentration may be used together as additional means to help reduce the risk of spoilage by *B. bruxellensis*.

Am J Enol Vitic 68:188-194 (2017)

Dormancy and Cold Hardiness Transitions in Winegrape Cultivars Chardonnay and Cabernet Sauvignon

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Cold injury is a major cause of economic loss in winegrapes (*Vitis vinifera* L.) of European origin that are grown at high latitudes. Winter survival depends upon timely cold acclimation in autumn, resistance to deacclimation during transient winter warming events, and/or reacclimation. The relationship between dormancy phases and bud cold hardiness has not been well characterized. Cold acclimation appears to be dependent upon growth cessation; however, it remains unknown whether acquisition of cold hardiness is coincident with, contingent upon, or independent of dormancy transitions. The objectives of this study were to compare dormancy and cold hardiness transitions in the winegrape cultivars

Dormancy and Cold Hardiness Transitions in Winegrape Cultivars Chardonnay and Cabernet Sauvignon *(continued)*

Chardonnay and Cabernet Sauvignon, which are known to differ in freezing tolerance. Results from the study showed that cold hardiness is acquired when buds are endodormant and steadily increases when buds are ecodormant. Chardonnay transitioned into ecodormancy earlier and acquired cold hardiness more rapidly than Cabernet Sauvignon. Resistance to deacclimation was associated with the level of cold hardiness and elapsed time since transition to ecodormancy. Results from this study show that influences of autumn weather events on dormancy and cold hardiness transitions can alter vulnerability to subsequent cold injury and have important implications for changing global climates. Autumn temperatures influence the timing of the transition to ecodormancy. Weather conditions during ecodormancy influence the level of acquired cold hardiness. Cold temperature events in autumn and midwinter increase risk of cold injury in the event of a midwinter warming by decreasing the resistance to deacclimation. Differences between cultivars in dormancy and cold hardiness transitions can be used to enhance cultivar and site selection.

Am J Enol Vitic 68:195-202 (2017)

Characterization of Wild North American Grapevine Cold Hardiness Using Differential Thermal Analysis

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Grapevine production is primarily limited by climate, specifically the low temperatures of winter. Most cultivated grapevines have evolved to survive in a Mediterranean climate where winters are cool and mild. As such, these varieties (e.g., Cabernet Sauvignon, Chardonnay, Merlot, etc.) are not particularly cold hardy and can be killed by winter temperatures below ~-20°C. In order to grow and sustain grapevine production in colder climates such as in the northeast United States, grapevine breeders release hybrid varieties bred from wild grapevine species that have evolved a greater ability to survive freezing, down to -40°C. In this study we wanted to determine the extent of cold hardiness of seven different wild grapevine species, to better understand how the level of cold hardiness changes throughout winter, and to identify new genetic sources for cold hardy varieties. We measured cold hardiness using programmable freezing chambers to identify the temperatures where the dormant buds are killed. From this study, we determined that grapevine cold hardiness changes from winter to winter and cold, sustained winters result in the greatest level of cold hardiness in all grapevine species. Additionally, the study validated previous studies that indicated that northern grapevine species are able to survive the lowest temperatures, but demonstrated that these species are also faster to respond to warming temperatures. This makes northern grapevine species more likely to suffer freeze damage if winter conditions are erratic. Southern species were not quite as cold hardy, but were more resistant to temperature shifts, making these species novel germplasm for future grape breeding. These results demonstrate the challenge facing sustainable viticulture in a changing climate. This data will be needed to help grapevine breeders produce resilient new varieties and to buffer against erratic weather conditions during winter.

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Identifying Environmental Sources of *Agrobacterium vitis* in Vineyards and Wild Grapevines

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We further verified the selectivity of a sensitive detection method used for identifying sources of the grape crown gall pathogen, *Agrobacterium vitis*, in the environment. In addition to the previously known presence of the pathogen in grape cane cuttings, we showed that it can be harbored in dormant buds as well as on surfaces of grape leaves. *A. vitis* was also shown to be prevalent in wild grapevines collected in New York and California, and it was infrequently found in association with weeds in vineyards; however, this environmental source will need to be studied further with an increased sampling of weed species. These findings will directly impact future management of crown gall in vineyards.

Identifying Environmental Sources of *Agrobacterium vitis* in Vineyards and Wild Grapevines *(continued)*

For example, if clean vines are produced through tissue culture or other means, how might they become contaminated with the pathogen and what potential environmental sources of the pathogen need to be considered in overall management of the disease?

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Population Diversity of Grape Phylloxera in California and Evidence for Sexual Reproduction

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Until recently, the foliar forms of grape phylloxera have been absent or very rare in California. Recent discoveries of the foliar-feeding morph of grape phylloxera at rootstock nursery plantings and root tip feeding on resistant rootstocks prompted an investigation into the origin of the foliar phylloxera in California and its relationship to root-feeding strains. This study also sought to understand whether root-feeding strains of phylloxera are adapting to resistant rootstocks and whether sexual reproduction has an influence on phylloxera's population diversity. We collected a total of 235 foliar phylloxera samples from six commercial rootstock nursery plantings in Yolo and Solano counties, from the National Clonal Germplasm Repository in Winters, CA, and from the Foundation Plant Services at UC Davis. We also collected a total of 233 root samples of phylloxera from a rootstock trial at the UC Davis Oakville, CA, research station, from commercial vineyards in Napa and Sonoma counties, and from the UC Davis campus vineyards. DNA markers were used to define four genetically distinct populations named Foliar, Davis, Napa1, and Napa 2. The Foliar group collected from infested leaves of 101-14Mgt, St. George, 1103P, and 110R rootstocks had very low levels of genetic diversity, suggesting a recent and common origin. The Davis, Napa1, and Napa2 groups collected from root tips of seven rootstock varieties were much more genetically diverse. Comparisons of the Napa1 and Napa2 group also found evidence of sexual reproduction. These results document the establishment of a foliar strain of phylloxera in California. They also show that phylloxera have adapted to feeding on the root tips of multiple resistant rootstocks; however, vine decline was not associated with the root-feeding phylloxera.

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Effect of Phenolic Compounds on Viability of Wine Spoilage Lactic Acid Bacteria. A Structure-Activity Relationship Study

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During vinification, some lactic acid bacteria (LAB) can produce alterations in wine, resulting in a final product unacceptable for consumption. Phenolic compounds (PCs) are secondary metabolites widely distributed in most vegetables and fruits. Depending on their structure, PCs can be classified as phenolic acids (hydroxybenzoic and hydroxycinnamic acid), flavonoids, and stilbenes. Several biological activities, mainly antimicrobial and antioxidant, have been attributed to PCs. In this research, we assayed for the first time the effect of the phenolic compounds naturally present in red wine on the growth of spoilage LABs. The presence of hydroxybenzoic and hydroxycinnamic acids at concentrations of 400 mg/L produced growth inhibition, with *trans*-caffeic and *trans-p*-coumaric acid showing the highest growth inhibition of the bacteria assayed and also altering the bacterium cell integrity. In order to establish a structure-antibacterial activity relationship (SAR) of the assayed PCs, a computational study was performed, revealing that *trans*-caffeic and *trans-p*-coumaric acids have similar chemical structure and electronic distribution, these structural requirements being necessary to determine a pattern of pharmacophores responsible for antibacterial activity. The results presented in this work contribute new knowledge regarding the effect of the phenolic compounds present in wine on spoilage LABs and may allow elimination or at least a reduction in the use of sulfite in wineries.

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Early Leaf Removal has a Larger Effect than Cluster Thinning on Grape Phenolic Composition in cv. Teran

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In viticulture, crop level is regulated primarily by winter pruning, and, when further tuning is needed, cluster thinning (CT) is the most common option. However, cluster thinning time is consuming and expensive, and in several cases, the balance between overall costs and greater quality of the remaining crop is negative. More recently, preflowering early leaf removal (ELR) has been successfully tested as an indirect regulator of cropping through its capacity to limit fruit set and/or berry size. These two techniques were compared in a two-year study conducted on the vigorous cv. Teran grown in Croatia, and a nondefoliated, unthinned control (C) was included. ELR involved the removal of six basal leaves at the preflowering stage, while in CT, 35% of clusters were removed at the onset of veraison. Both ELR and CT resulted in lower yield per vine compared to C (22% and 37% less, respectively) and greater Brix in berries at harvest (+1.3 and +1.0, respectively). The concentration of total phenolics in grapes increased 19% in ELR and 6% in CT compared to C, while total anthocyanin concentration increased only in ELR (+20% versus C). Despite greater yield and lower leaf area/yield ratio compared to CT, ELR achieved higher total anthocyanin and phenolic concentration, suggesting that this practice is more suitable than CT for the production of high quality Teran grapes. In addition, while ELR can also be quite easily mechanized, there are still unresolved technical issues with the mechanization of CT.

Am J Enol Vitic 68:234-242 (2017)

Natural Flavor Additives Influence the Sensory Perception and Consumer Liking of Australian Chardonnay and Shiraz Wines

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Australian wine consumers have previously indicated they would accept the use of natural flavorings in wines for the purpose of improving quality. Indeed, consumers were found to be significantly more accepting of natural flavorings than many of the additives currently used in winemaking (e.g., acid, tannins, and oak chips). In this study, we investigated the potential for natural flavorings to enhance wine aroma and flavor in order to (i) improve the quality of wines, and (ii) explore consumer liking of flavored wines. Natural flavorings were added to four inexpensive wines (two Chardonnay and two Shiraz) to intensify desirable aroma and flavor characters. A panel of judges (n = 12) determined the flavor profiles of wines and concluded that the addition of flavorings enhanced desirable attributes (e.g., citrus and honey) and/or diminished undesirable characters (e.g., green and earthy notes). Following flavor profiling, consumer tastings (n = 218) were conducted to assess liking of control versus flavored wines. Three distinct consumer groups were identified based on individual liking scores. For Chardonnay wines: Group 1 (G1) liked all wines but especially liked wines with enhanced passion fruit; Group 2 (G2) liked wines with stone fruit, honey, and oak; while Group 3 (G3) liked wines with enhanced butter and honey. For Shiraz wines: G1 liked wines with intense red fruit, confectionary, and chocolate characters; G2 preferred wines with red berry, green, and oak flavors; and G3 liked red fruit, confectionary, and oak-flavored wines. Research findings suggest natural flavorings can be added to wines to enhance sensory characteristics and that their addition will enhance some consumers' acceptance of wines.

Am J Enol Vitic 68:243-251 (2017)

Genetic Diversity of Wild Grapevine (*Vitis vinifera* L. subsp. *sylvestris* [Gmel.] Hegi) in the Eastern Adriatic Region

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Natural populations of wild grapevine (*Vitis vinifera* L. subsp. *sylvestris* [Gmel.] Hegi) in the eastern Adriatic region were identified in their natural habitats, and their genetic diversity was studied and compared to both local and widespread European cultivars. Ninety-two grapevine genotypes were determined at 21 nuclear microsatellite loci, including 53 wild grapevine individuals, 32 diverse local Croatian and west European cultivars, and seven commonly used rootstocks. The genetic diversity of the wild grapevines was slightly lower than that observed in cultivars. Distance- and model-based cluster analysis differentiated three main groups, indicating clear separation between wild, cultivated, and rootstock accessions. This study greatly contributes to knowledge of genetic diversity in local wild grapevine populations in Croatia and Bosnia and Herzegovina, and provides necessary information for their conservation and further characterization.

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Grapevine Cultivar Mantonico bianco is the Second Parent of the Sicilian Catarratto

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Pedigree studies have considerable scientific and economic interest because they contribute significantly to the knowledge of grapevine evolution and increase the commercial appeal of traditional grape cultivars. They also offer an opportunity to re-evaluate and reconsider some ancient and little known varieties that gave rise to today's popular varieties, especially those of high economic relevance. This study adds another piece of knowledge to the puzzle of pedigree relationships among present grapevine cultivars, highlighting the role played by some ancient and almost extinct varieties. Using molecular markers, we showed that Mantonico bianco is the "missing" parent in some previously depicted pedigrees, and that it played an important role in generating a number of southern Italian grapevine varieties. This ancient variety was recognized as the complementary genitor, with Garganega (syn. Grecanico dorato), of Catarratto, currently the main autochthonous white wine grapevine of Sicily and one of the most cultivated varieties in Italy. We showed that Mantonico is also the complementary genitor, with Sangiovese, of Mantonicone, a minor local variety of the Calabria region. Moreover, we discovered a first-degree relationship between Mantonico bianco and Guardavalle, one of the main and most diffuse autochthonous white winegrapes of the Calabria region. We shed some light on the identity of a number of cultivars with very similar names, like Mantonico bianco, Mantonicone, Montonico bianco, Montonico Pinto, Montonico di Rogliano, and Montonico nero. Finally, we verified a long list of Montonico bianco synonyms, showing its wide diffusion in central and southern Italy and supporting the ancient presence of this interesting, and now declining, cultivar. The habit of using a common name for several different cultivars may create misunderstandings when exchanging information on specific varieties and probably results from an overlap of the names of the wines with those of the varieties used to produce them. In the present research, we faced a similar case with Mantonico/Montonico cultivars.

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Effect of Commercial-Scale Filtration on Sensory and Colloidal Properties of Red Wines over 18 Months Bottle Aging

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Filtration is essential for red wine stability, but its effect on wine colloids and sensory properties, such as texture, remains a concern. Small-scale investigations have demonstrated the loss of color and polysaccharides; however, the effect of commercial-scale filtration on red wines is unknown. Samples of four commercial wines (Cabernet Sauvignon and Shiraz from 2013 and 2014 vintages) were collected from two commercial bottling facilities before and after cross-flow

Effect of Commercial-Scale Filtration on Sensory and Colloidal Properties of Red Wines over 18 Months Bottle Aging *(continued)*

filtration, before and after lenticular filtration, and after filtration through 0.65 µm and 0.45 µm membranes. Cabernet Sauvignon 2014 wines were filtered through both polyether sulfone (PES) and nylon 0.45 µm membranes. The average size of particles in all wines decreased significantly with cross-flow filtration, and the concentration of polysaccharides decreased with 0.45 µm filtration, while tannin and color remained unchanged. After 18 months bottle-aging, the average particle sizes of filtered and unfiltered 2013 wines were similar, while the filtered 2014 wines contained smaller particles than the unfiltered wines. Sensory analysis showed no consistent filtration-related trends in textural attributes across all wines, although there were some significantly different aroma or flavor attributes for samples of different filtration grade within each wine. These results suggest that commonly applied commercial-filtration practices have no impact on wine color and minimal impact on sensory profiles of red wines.

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ABA Application during Flowering and Fruit Set Reduces Berry Number and Improves Cluster Uniformity

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The major limitation of the very early ripening *Vitis vinifera* cv. Early Sweet, which otherwise presents a plethora of desirable traits, is its cluster compactness and significant variability of berry size. In this study, we tested the ability of abscisic acid (ABA) to reduce the number of berries per cluster and improve berry size uniformity. Data collected from a commercial vineyard, in three successive growing seasons, suggest that ABA application: (1) induces a significant reduction in berry number per cluster in a concentration-dependent manner, (2) improves uniformity of berry size within a cluster, and (3) has no significant effect on rachis length. The results also suggest that the thinning effect of ABA depends on the blooming status of the inflorescence, with limited or no effect when applied at preanthesis and a very significant effect when applied at full bloom and soon after the anthers are detached. Accordingly, the effect of a semicommercial application of ABA on number and size of berries was significantly affected by asynchronous blooming. Completion of bloom may serve as a clear phenological marker for optimal application timing that allows uniform and effective thinning.

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Microvine: A New Model to Study Grapevine Growth and Developmental Patterns and their Responses to Elevated Temperature

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Overall, climate changes are predicted to negatively impact grapevine production in quantity and quality. Understanding the way grapevines will adapt their physiology to the simultaneous variations of different factors associated with climate change is an important step toward optimizing vineyard management in the future. *Microvine* is a new grapevine model recently proposed to address this issue. This natural mutant of grapevine is insensitive to the plant hormone gibberellin. The mutation confers on *Microvine* a dwarf size and an annual and continuous reproductive development along the vegetative axis, in contrast with cultivated grapevine where the number of inflorescences per shoot is limited and their development is spread over two consecutive seasons. This study evaluated the regularity of *Microvine's* vegetative and reproductive developmental patterns along the main axis and how these patterns react to temperature elevation. *Microvine* leaf and berry growth dynamics were regular and reproducible under standard temperatures (25/15°C days/night) in the greenhouse. Moreover, similar growth dynamics were obtained when comparing the changes of organ

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size over time with those calculated from a single time measurement along the shoot and the development rate. Using this property, the changes of the calculated main berry quality components (sugars, organic acids, and potassium) in *Microvine* were similar to those generally reported for grapevine. In addition, we found, from a series of experiments performed in growth chambers, that elevated temperatures (30/25°C) disrupted the equilibrium between vegetative and reproductive growth, resulting in an acceleration of vegetative growth at the expense of berry ripening. Because it can be easily manipulated in growth chambers and it shows simultaneously all stages of development, *Microvine* is a promising tool to address the impact of the many factors associated with climate change, either one by one or in combination.

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Irrigation Strategies Impact Baco noir Grapevines in Ontario. I. Vine Physiology, Vine Size, and Yield Components

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The objective of this research was to study the effect of different levels of water deficits and the timing of irrigation imposition on vine physiology and yield of Baco noir grapevines. Although there have been irrigation studies on Concord and other *Vitis labruscana* cultivars, there have not been any on French-American hybrids. Moreover, this study was conducted in an area classified as a cool climate. It was hypothesized that by controlling the vine water status at various vegetative stages, one could manipulate vine metabolism, increase yield, and ultimately minimize possible negative dilution effects of irrigation on grape composition and wine quality. Baco noir vines responded not only to the amount of water used but also to the berry development stage when irrigation was first applied. High variation in vine physiology and yield components from season to season suggested that besides soil water status, other factors such as solar radiation and wind might have a significant impact on vine performance because both impact evapotranspiration. This study showed that irrigation is definitely needed in hot and dry seasons to optimize vine water status and yield. Since climate change will increase the frequency of extreme weather conditions during the growing season, this study will provide guidance on how to cope with drought seasons without impairing yield and potential wine quality. Regulated deficit irrigation treatments increased most yield components relative to nonirrigated treatments. This study revealed that even in regions considered cool, vines undergo periods of water stress which could affect fruit composition. Drip irrigation systems are very profitable management tools in the vineyard, even in seasons with high precipitation that is distributed erratically.

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Irrigation Strategies Impact Baco noir Grapevines in Ontario. II. Fruit Composition and Wine Sensory Analysis

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Recent climate change-related weather patterns in eastern North America have led to much warmer growing seasons with less precipitation than long-term averages. Consequently, many growers have made use of irrigation, and a few have installed drip irrigation systems. However, fundamental questions such as time of initiation and amount of water to apply are heretofore unanswered. This article describes the first research conducted on a French-American hybrid cultivar and the effects of several irrigation initiation timings and crop evapotranspiration (ET_c) levels on Baco noir berry, must, and wine composition as well as wine sensory attributes in Ontario, Canada. The effects of three irrigation levels (two regulated deficit irrigation treatments [RDI] at 25% and 50% of ET_c and 100% ET_c) combined with three timings of irrigation initiation (fruit set, lag phase [LP], veraison [VRN]) were studied. In 2005, RDI treatments applied at LP increased total soluble solids (Brix), while in 2007, similar results were obtained in VRN-applied treatments. Berry titratable acidity increased slightly in irrigated treatments compared to the control in each season. LP-applied RDI treatments produced higher berry pH values or close to those from the control, while berries from

Irrigation Strategies Impact Baco noir Grapevines in Ontario. II. Fruit Composition and Wine Sensory Analysis *(continued)*

VRN-applied RDI treatments showed lower values. Anthocyanins and total phenols in berries increased in almost all irrigated treatments in 2005, while in 2006 and 2007, the highest concentrations in berries were found in LP treatments. Multivariate analyses showed that soil and plant water status were well correlated with typical descriptors for Baco noir wines. Highest intensities of flavor and aroma attributes were associated with 50% and 25% ET_c levels (i.e., RDI treatments) applied at LP or VRN. However, principal component analysis indicated that severe water deficits negatively affected the varietal aroma profile. The sensory profiles, therefore, showed that wines could be manipulated by RDI strategy, even in conditions with occasional to frequent precipitation and soils with high clay content. However, vintage variation indicated that other factors related to canopy microclimate could have also been involved.

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Leaf Removal and Cluster Thinning Efficiencies Are Highly Modulated by Environmental Conditions in Cool Climate Viticulture

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In cool climates, canopy management techniques are pivotal to achieve optimal fruit quality and enological targets. Leaf removal and cluster thinning are the cultural practices most commonly applied to adjust crop load and to improve fruit-zone microclimate conditions. In this work, we evaluated the effects of cluster thinning and cluster zone leaf removal, applied separately or in combination at veraison, on Cabernet franc in two consecutive years, 2011 and 2012. Leaf removal and cluster thinning increased colors and phenolics content of Cabernet franc grapes, especially in the first stages of ripening, after veraison. As expected, the simultaneous application of both techniques had additive effects, with higher efficacy in comparison with vines where they were applied singularly. Moreover, the techniques were much more effective in a season with low temperatures after veraison, whereas in a year with excellent weather conditions throughout ripening, differences between treatments disappeared. The experiment demonstrated that cluster thinning and leaf removal, especially when applied simultaneously in a cool season, lead to a more uniform fruit quality, with fewer unripe clusters in the vineyard. The results underline the fact that basic canopy management techniques are generally important in cool climate viticulture and can be essential if the season between veraison and harvest is cooler than the average for the region.

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Assessment of Mycotoxins in *Vitis vinifera* Wines of the Southeastern United States

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The southeastern United States hosts an active and emerging wine region that is faced with challenging growing conditions such as humid weather and, in some areas, circumstances favorable for Pierce's disease. As recommended by world agricultural organizations in the face of changing climatic conditions and a rising concern over mycotoxins globally, it was vital to proactively evaluate the mycotoxin risk in these wines to ensure safety. To this end, nearly 200 bottles of 100% southeastern U.S. red wines made from *Vitis vinifera* grapes of various vintages were tested, along with grape must samples taken during harvest 2013, for two mycotoxins: ochratoxin A and fumonisins. The data favor a low mycotoxin risk in red *V. vinifera* southeastern American wines when compared with worldwide averages, of which there is extensively more data for ochratoxin A. Thus, though faced with many other challenges brought on by weather and pathogens, southeastern American winegrowers at this time should not consider the mycotoxins ochratoxin A and fumonisins to be a major food safety threat to their industry.

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Impact of Grape Maturity and Ethanol Concentration on Sensory Properties of Washington State Merlot Wines

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In this study, we evaluated the effects of grape maturity and ethanol concentration on wine chemistry and sensory properties using a full factorial experimental design to unravel interactions between wine composition and sensory perception. Merlot grapes were harvested at three different maturities, and the resulting musts were divided into three lots. One-third of each must was maintained at or adjusted to the same Brix as the first harvest fruit (~20 Brix, unripe), one-third to match the second harvest fruit (~24 Brix, ripe), and one-third to match the third harvest fruit (~28 Brix, overripe). Subsequent chemical and sensory analyses demonstrated the significant influences both grape maturity and ethanol concentration (manipulated by changing prefermentation Brix content) have on wine composition and sensory character. Both fruit maturity and ethanol concentration had significant effects on the chemical and sensory profiles of the wines. Wine physical viscosity increased with increasing ethanol concentrations, and wine color was positively impacted, with higher ethanol concentrations favoring the formation of polymeric pigments, leading to darker wines. Wines made from unripe fruit (20 Brix) were characterized by green flavors and sour taste, while wines made from overripe fruit (28 Brix) were described by fruity flavors and sweet taste. Manipulations targeting the adjustment of ethanol had a greater effect on wine sensory properties than fruit maturity: wines made from ripe (24 Brix) and overripe fruit adjusted to low ethanol concentrations were described similarly to wines made from unripe fruit, and wines made from unripe and ripe fruit adjusted to high ethanol concentrations were described similarly to wines made from overripe fruit. The results of this study demonstrate that both ethanol concentration and manipulations to achieve desired ethanol concentrations have a large influence on wine chemistry and sensory properties, suggesting that wine ethanol concentration is more important for the sensory profiles of wines than is fruit maturity at harvest.

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Linking Sensory Properties and Chemical Composition of Vitis vinifera cv. Cabernet Sauvignon Grape Berries to Wine

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Winemakers and grapegrowers usually taste winegrapes to determine if they are suitable for producing various wine styles of different quality. However, the ability to predict wine style from tasting grapes is unproven, and the relationship between the flavor characters of grapes and wine is poorly understood. The objective of this study was to investigate the sensory properties of Cabernet Sauvignon grapes and the corresponding wines and to determine the relationships between the two. Grapes were harvested between 23 to 25 Brix from eight locations across the state of South Australia over two vintages and made into wine. A total of 25 samples from across the eight locations were harvested for each vintage. The grapes and wines were evaluated by a trained sensory tasting panel. Grapes were evaluated using the berry sensory assessment (BSA) methodology previously published, and grapes and wines were measured for their basic chemical makeup. Samples were consistently different by chemical and sensory properties within the grapes and wines across vintages. Five sensory attributes of wine were consistently predicted using BSA attributes and berry chemical measures. Finding berry sensory attributes that consistently relate to wine style and profile remains challenging. The contribution of basic chemical measures, including sugar levels and color of grape samples, were reliable predictors of wine sensory attributes for both vintages.

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Spatial Variation of Winegrape Yield and Berry Composition and their Relationships to Spatiotemporal Distribution of Soil Water Content

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Spatiotemporal variability in vineyard soil water content (SWC) can affect yield and berry composition. The objectives of this study were to examine spatial variability in yield and berry composition over time and to quantify the contribution of spatial variability in SWC to these parameters. Yield, Brix, tannins, and total phenols were collected at the end of the berry ripening stage for 135 georeferenced points in 2012 and for 147 points in 2013 and 2014 in a Merlot vineyard in Gansu province, China. Volumetric SWC was measured multiple times at those points at different growth stages in each year. Spatial variation in yield showed moderate and similar spatial heterogeneity for different years, but the variation in berry composition was not consistent among years. Spatial variation in yield in 2012 and 2013 was best described by an exponential variogram model, but there was no spatial structure of yield in 2014. Low SWC at 0 to 20 cm depth corresponded to higher yield than did high SWC, and the opposite results were found for 40 to 60 cm. Spatiotemporal distribution of SWC explained more than 35% of total variation in yield and berry composition in the relatively dry year of 2012, but less than 10% in the relatively wet year of 2014. The contribution of spatiotemporal distributions of SWC to spatial variability in yield and berry composition varied according to field and weather conditions. This study provides a basis for developing site-specific management measures for better economic return.

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Modeling of the Fermentation Behavior of *Starmerella bacillaris*

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Saccharomyces cerevisiae is considered the yeast species of choice for alcoholic fermentation in the production of wine. Despite this, yeasts belonging to other species, commonly referred to as non-*Saccharomyces*, have always attracted the attention of enologists. Often, increased aroma complexity of wine has been attributed to their presence in the must. Recently, studies concerning the ecology of musts and wines have highlighted the fact that non-*Saccharomyces* species are present during alcoholic fermentation and that they may possess interesting enological features. These findings have prompted investigations aimed at understanding the potential use of non-*Saccharomyces* in controlled, inoculated alcoholic fermentations together with *S. cerevisiae* (mixed fermentations). *Starmerella bacillaris* is a non-*Saccharomyces* species being studied for such use in mixed fermentations. Among other potential applications, it has been proposed that, in combination with *S. cerevisiae*, the use of *S. bacillaris* may lead to reduction of ethanol content in wine. This application is of great interest to winemakers since climate change has led to wines with high ethanol content. The goal of this study was to model the behavior of strains of *S. bacillaris* during alcoholic fermentation. Sterile grape must was inoculated with *S. bacillaris*, and the fermentation was monitored over time. Viable counts as well as chemical analyses were performed at specific time intervals. The data of the chemical analyses were used to produce polynomial equations describing the evolution of important chemical parameters as a function of the initial sugar concentration (range 220 to 300 g/L) and time of fermentation. This study confirmed that *S. bacillaris* can be considered for use in mixed fermentations, while the models can be used to predict the fermentation behavior in grape must.

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Technical Feasibility of Glucose Oxidase as a Prefermentation Treatment for Lowering the Alcoholic Degree of Red Wine

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In this work, the use of the glucose oxidase/catalase enzymatic system was evaluated as an alternative to decrease the glucose concentration and eventually produce a reduced alcohol wine. The effects of glucose oxidase, catalase, and aeration on the glucose concentration were evaluated after 24 and 48 hr of treatment of 27 Brix Carmenere must. The results showed that the effect of aeration and glucose oxidase was not significant compared to the effect produced by glucose oxidase itself. In addition, the use of catalase combined with glucose oxidase provided the best result, decreasing the glucose concentration by 51 and 78% after 24 and 48 hr, respectively, when 200 U/mL of both enzymes was used. The alcoholic degree obtained after three and five days under this treatment and subsequent fermentations were 15% (v/v) ± 0.8 and 14% (v/v) ± 0.8, respectively. A major drawback of this treatment was the color change of Carmenere must because of the H_2O_2 that was produced during the glucose oxidase treatment, despite the presence of catalase. The technical feasibility of using this prefermentative process led to a divided conclusion. It was possible to obtain a lower alcoholic degree using the glucose oxidase/catalase system, but if the goal is the industrial application of this technique, the color change must be investigated further. An evaluation of the glucose oxidase/catalase ratio was projected to show an improvement of the H_2O_2 elimination and, subsequently, decrease the effect on color change.

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Location Effects on the Aromatic Composition of Monovarietal cv. Carignan Wines

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Aroma is one of the main factors defining the character and quality of wine; therefore, it is important to study the volatile composition of wine to clearly understand which compounds are responsible for the typicality of the product. To our knowledge, there are few studies of the volatile composition of wines made from Carignan grapes, and in this work, 28 Carignan wines were analyzed. This is the first time that Chilean wines made from this cultivar have been chemically characterized. In addition, the location where grapes are cultivated can affect the volatile profile of wines due to differences in soils, climatic conditions, and other variables. Therefore, the wines used in our research came from six different zones of Chile and from two different seasons. Headspace solid-phase microextraction (HS SPME) coupled with gas chromatography-mass spectrometry was used for the analysis of the volatile compounds. The HS SPME method was optimized to provide better results. An extraction temperature of 45°C, 40 min of incubation, 1.5 g of salt, and 180 sec of fiber desorption were employed for the analysis of the 28 wine samples. Sixty-three volatile compounds were determined in cv. Carignan wines, and they were characterized as substantial amounts of ethyl esters and small amounts of volatile acid compounds, among others. Statistical analysis showed that the geographical origin affected the volatile composition of the wines studied, and production areas that were closer to the Andes Mountains showed lower concentrations of esters and acids than those wines produced in regions that were closer to the ocean.

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Chemical Gradients in Pilot-Scale Cabernet Sauvignon Fermentations and Their Effect on Phenolic Extraction

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The color and tannin content of red wine is due to specific compounds, referred to as phenolics, which mostly originate from grape skins and seeds. During red wine production, phenolics are extracted from crushed grapes through contact with fermenting juice. During fermentation, grape skins and seeds rise to the top of the fermentor and form a cap, which reduces skin and seed contact with fermenting juice. The reduced contact between skins, seeds, and juice limits the amount of phenolics which may be extracted into the fermenting must. Cap management techniques such as pump-overs are performed to maintain contact between the skins, seeds, and juice. While cap management is clearly needed, the chemistry of phenolic extraction before and after cap management is not well understood. A better understanding of this chemistry would allow winemakers to better plan and implement cap management. The chemistry of phenolic extraction was studied during two Cabernet Sauvignon fermentations performed at the pilot scale (2000 L). The phenolic content was measured immediately before and after pump-overs using a sampling array that allowed the fermentations to be monitored at four depths (two in the cap and two in the liquid) and at three distinct points at each depth. The results of these analyses showed the formation of concentration gradients between cap and liquid for several phenolics between pump-overs. The results also show that concentration gradients for skin-derived phenolics form early during fermentation and decrease as the fermentation progresses, and concentration gradients for seed-derived phenolics are maintained throughout the fermentation.

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Double-Pruning Grapevines as a Management Tool to Delay Berry Ripening and Control Yield

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Under a global warming scenario, growing grapes in temperate climates poses the challenge of avoiding too-fast ripening, which can favor sugar accumulation at the expense of desired phenolic and aromatic maturity. Therefore, modified cultural practices are needed to be able to selectively delay the sugaring process. In a three-year study, Sangiovese vines mechanically spur-pruned during dormancy in February were subjected to immediate or delayed (post-budbreak) manual finishing to test the potential of a double-pruning approach to delay fruit sugar accumulation and limit yield. The treatments were applied in 2014, 2015, and 2016 at BBCH-0 as standard hand-finishing on dormant buds (SHF), and as late (LHF) and very late (VLHF) hand-finishing at BBCH-14 and BBCH-19, i.e., when the two apical shoots on the mechanically-shortened canes were ~10 and 20 cm long, respectively. Yield per vine was severely reduced in the VLHF treatment (-43% versus SHF) due to high incidence of unsprouted (blind) nodes, lower shoot fruitfulness, and berries per cluster; yield reduction in LHF was -22% versus SHF, due only to the incidence of unsprouted nodes. While the fruit ripening profile was not significantly modified in VLHF compared to SHF, in data pooled over three seasons, LHF delayed basic fruit composition at harvest, producing fruit with less total soluble solids, lower pH, and greater acidity, but more phenolics than SHF. LHF has the potential to decouple sugar versus anthocyanins accumulation as well as to delay harvest date or increase crop hanging time under specific vineyard conditions.

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Dry Matter Accumulation and Nitrogen and Potassium Partitioning in the Roots and Trunk of Field-Grown Thompson Seedless Grapevines

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Dry matter and nitrogen (N) and potassium (K) partitioning were determined in the roots and trunks of five- and six-year-old field-grown Thompson Seedless grapevines over the course of two growing seasons using destructive harvests. Trunk and root dry biomass decreased slightly from leaf fall the previous season until midway between budbreak and anthesis during the current season, at which time dry matter accumulation began and continued to increase until leaf fall. The concentration of N increased from the first of the calendar year in the roots, peaked midway between budbreak and anthesis, then decreased throughout the remainder of the growing season the first year, but remained constant after anthesis the second year. The concentration of N in the roots increased after fruit harvest both years. Total N in the root system somewhat followed a pattern similar to that of N concentration. The concentration of K and total K in the root system varied only slightly throughout the growing season. The loss of N in the trunk and roots accounted for ~11% of the N accumulated in the current season's shoot growth (leaves, stems, and clusters) from budbreak to fruit harvest in the first year of the study and 4% in the second year during the same time frame. Approximately 85% of the increase in total N in the roots and trunk (16.9 g N/vine) after fruit harvest the second year was due to N translocation (14.4 g N/vine) from the leaves as they senesced. Under the conditions of this study, N reserves in the permanent structures of the vine contributed only slightly to the N demand of the current season's new growth between budbreak and fruit harvest. It was also demonstrated that N in the leaves is efficiently redistributed to the roots and trunk during leaf fall.

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Crop Level and Harvest Date Impact Composition of Four Ontario Winegrape Cultivars. I. Yield, Fruit, and Wine Composition

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It is a widely-held notion that cluster thinning will lead to improvements in berry, must, and wine composition, and consequently, enhancements in wine sensory quality. It was our hypothesis that crop reduction merely reduced yield, and that a more practical process would be to retain a full crop and delay harvest for a significant period of time. Pinot gris, Riesling, Cabernet franc, and Cabernet Sauvignon vines from a single vineyard in Virgil, Ontario (Canada), were subjected to two crop levels (full crop [FC] and half crop [HC]), whereby crop was reduced in HC to one basal cluster per shoot at veraison. Crop level treatments were combined with three harvest dates: T0 (commercial harvest), T1 (three weeks after T0), and T2 (six weeks after T0), all with subsequent wine production. Analyses of berries, musts, and wines were carried out. Reductions in crop led to an increase in Brix, reduced yield and cluster number in all cultivars, and an increase in cluster weight in Cabernet franc. Delayed harvest date also led to an increase in Brix and pH and reductions in titratable acidity (TA) and berry weight. Effect of harvest date in berries carried through to musts and consecutively to wines; increases in pH and TA in T2 treatments were associated with reductions in anthocyanins, phenols, and color intensity in red cultivars. It was concluded that delayed harvest date had a greater magnitude of effect than crop reduction; therefore, maintaining a full crop with a later harvest date might have a greater beneficial impact on potential wine quality than reducing crop level.

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Impact of Fruit-Zone Leaf Removal on Rotundone Concentration in Noiret

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Rotundone was recently identified as the compound that imparts the black pepper aroma in several winegrape cultivars. This two-year study aimed to identify the presence of rotundone in Noiret (interspecific hybrid of *Vitis*) and to determine the impact of fruit-zone leaf removal on rotundone concentrations in fruit and wine. The relationship between the intensity of black pepper aroma and rotundone concentration in Noiret wine was also explored. An undefoliated control (CON) was compared to a maintained fruit-zone sunlight exposure (MSE) treatment, where leaves were periodically removed from the fruit-zone. The influence of timing of fruit-zone leaf removal was assessed in a separate experiment by comparing preveraison leaf removal (LR) and postveraison leaf removal (PVLR) treatments. MSE vines had greater fruit-zone sunlight exposure compared to the CON throughout the season in 2015, both at the pre- and postveraison stages, but in 2014, only after veraison. PVLR increased fruit-zone sunlight exposure during ripening compared to LR in 2015 only. Rotundone could not be quantified in Noiret berries sampled before or at veraison (limit of quantitation = 0.16 µg/kg). Rotundone concentrations in harvested fruit and wines did not differ between treatments in 2014, but were significantly higher in MSE than in CON in 2015 (1.98 versus 1.28 µg/kg). PVLR temporarily increased rotundone concentration compared to LR, but differences disappeared by harvest. Black pepper aroma intensity, as determined by a sensory panel, was positively correlated ($p = 0.023$, $r = 0.791$) with rotundone concentration in wines made from imposed viticulture treatments, providing evidence that black pepper notes in Noiret are positively related to concentration of rotundone in the wine.

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Water Management of Irrigated Cabernet Sauvignon Grapevines in Semiarid Areas

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The effect of four years of deficit irrigation on water savings, yield, crop load, plant growth, and juice quality was determined on Cabernet Sauvignon grapes grown on the central California Coast. The growing season was divided into three periods. Period one was from budbreak to fruit set with no irrigation. Period two was from fruit set to three weeks post-fruit set, during which 75% of calculated crop water use (ET_c) was applied for all treatments. At the end of period two, irrigation was terminated until leaf water potential reached -1.2 MPa. Period three was from the end of period two to harvest, during which irrigation resumed whenever the leaf water potential (LWP) reached -1.2 MPa in one of three sustained deficit irrigation treatments equal to 25/35% (LOW), 50% (MED), and 75/65% (HIGH) of ET_c. The sum of rainfall and irrigation applied during the growing season ranged from 91 to 196 mm, from 145 to 234 mm, and 198 to 273 mm for the LOW, MED, and HIGH treatments, respectively. Total water use including soil water during the growing season ranged from 250 to 359 mm, 288 to 418 mm, and 313 to 378 mm for the LOW, MED, and HIGH treatments, respectively. Yield was linearly related to the total applied water and was consistently lower in the LOW treatment across all years than the MED and HIGH treatments, while the MED and HIGH treatments were not significantly different. Average pruning weight and cane weight declined in all treatments during the study, as did the average berry size. Berry and wine quality were not affected by irrigation treatment within a given year but were significantly different across years due to climate, irrigation schedules, and harvest dates. Our results illustrate potential water savings with moderate deficit irrigation (i.e., MED), with minimal or no significant effect on fruit yield and quality, while severe deficits (i.e., LOW) led to significant loss of yield without increased quality and would not be considered economically sustainable.

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Cold Hardiness of *Vitis vinifera* Roots

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In viticulture regions characterized by subfreezing winter temperatures, damage to buds, cordons, and trunks is a frequent concern. In most of these climate conditions, however, the impact of freezing temperatures on roots is often not considered due to the insulating effects of soil or snowfall. But what happens when soil temperatures drop to or below freezing, which can happen during Washington's relatively dry winters and in our well-drained soils? Traditionally, Washington State grows own-rooted *Vitis vinifera*, which allows for quick vineyard recovery after a damaging (aboveground) winter event. But this practice does not take into account the potential effects that low soil temperatures have on root survival. This paper explores the root cold hardiness of two *V. vinifera* cultivars and whether roots undergo the same cold acclimation and deacclimation processes seen in aerial portions of the grapevine.

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Bioactive Gibberellins Show Differential Abundance at Key Phenological Stages for Berry Growth in Table Grapes

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Berry size, a key trait in table grape production, results from complex physiological and biochemical events occurring from anthesis to ripening. Gibberellins (GAs) play a crucial role in the regulation of this process, as widely demonstrated by exogenous applications of gibberellin acid (GA_3), but the endogenous evolution in concentration and its relation with berry size is poorly understood. Using berries from a crossing of Ruby Seedless × Sultanina with contrasting phenotypes for berry and seed size, we analyzed GA metabolites at four key phenological stages for berry size: 50% flowering (FL50), 2 to 4 mm (CU24), 2 to 4 mm plus one week (CU24+1), and 6 to 8 mm. Our results show that both bioactive metabolites GA_1 and GA_4 are produced, demonstrating that both the 13-hydroxylation and the non-13-hydroxylation GA biosynthetic routes are functional in grape berries. The variable abundance of both bioactive GAs throughout berry growth suggests complex regulation of this pathway. GA_1 had a higher concentration than GA_4 during the FL50 to CU24+1 stages, whereas GA_4 concentration increased later during the berry-setting stage and was relatively constant to the 6 to 8 mm stage. Accumulation of GA_1 was greater than with GA_4, with a three-fold higher concentration at CU24+1. In addition, our results suggest that GA synthesis occurs in smaller seedless berries, but accumulation of GA_4 occurred slightly later than in larger berries with full seeds.

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Physicochemical Characterization of the Foam of White and Rosé Base Wines for Sparkling Wine Production (AOC Cava)

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The foam of two base wines was overflowed by carbon dioxide sparging, and the foam wine was recovered. The foam wine (FW), original wine (CW), and the remainder fraction (RW) were analyzed to determine foam properties, chemical composition, and some physical properties. In general, FW had better foam parameters, higher density, and lower surface tension and viscosity than CW and RW. FW wines also tended to have higher concentrations of proteins and lower concentrations of ethanol, higher alcohols, titratable acidity, and esters. The improved foam properties in the FW wines were likely due to low levels of foam-negative factors (ethanol and fatty acids) and high levels of foam-positive factors (proteins).

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An Upgraded Core Set of 11 SSR Markers for Grapevine Cultivar Identification: The Case of Berry-Color Mutants

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This research focused on the development of a molecular assay, based on the amplification of 11 simple sequence repeats, that is useful for combining varietal identification with skin color discrimination of less-colored/colorless mutants from a black wild-type cultivar (like Pinots). The proposed molecular toolkit was reliable using both purified and unpurified DNA obtained from leaves, speeding up the time required for laboratory analyses and lowering costs of the molecular outcome.

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Adapting a Photochemical Reactor to the Study of UV Ecology in Vineyard Yeast

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In the vineyard, many types of yeast can be present on grapes, but they are eventually outcompeted by *Saccharomyces* yeast as fermentation progresses. A selective pressure with the potential to affect the composition of the non-*Saccharomyces* community is UV light, particularly in places with very high levels of UV-B (280 to 315 nm) radiation, like New Zealand. Understanding how UV light affects vineyard yeast could be very important because of growing evidence that non-*Saccharomyces* yeast present on grapes in vineyards can play a role in the fermentation process and terroir. Thus, understanding how UV light can affect yeast community composition represents a step toward understanding how specific taste signatures derived from certain microbial communities are produced. To fully understand these processes, overall UV sensitivity to wavelengths encountered in the vineyard would need to be characterized for each member of the non-*Saccharomyces* vineyard yeast community. Traditional UV-sensitivity assays have used instruments that only emit at 254 nm (UV-C), a wavelength filtered out by the ozone layer in natural environments. We present a method that allows experimental determination of UV-B sensitivity in yeast (and presumably, sensitivity to several other wavelengths) that uses a Rayonet RPR-100 photochemical reactor. This method outperforms traditional methods of irradiation in both ecological relevance and tight control of wavelength and flux. With our protocol, better understanding of the ecological processes that drive community structure in vineyards and, therefore, also microbial terroir, can be achieved.

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Filter Media Comparison for the Removal of *Brettanomyces bruxellensis* from Wine

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Brettanomyces bruxellensis is a wine spoilage yeast of significant concern to wine producers, and its removal by filtration is not fully understood. The aim of this work was to compare the efficacy of filters with different compositions and micron ratings in removing *B. bruxellensis* from wine. Filters commercially available as pleated cartridge for the wine industry were evaluated. Wine inoculated with a *B. bruxellensis* strain was used and the Food and Drug Administration (USA) guidelines for filter validation on aseptic processing were followed. No cells were detected in wines filtered through polyethersulphone (PES) filters in all micron ratings tested (0.45, 0.65, and 1.0 µm), showing their high efficacy in removing *B. bruxellensis*. Similar efficacy was achieved for X grade glass microfiber (GF) filters. On the opposite, low retention was obtained with polypropylene (PP) filters (0.6 and 1.0 µm) and V grade GF filters. A major observation from this work is that different filter compositions with similar micron ratings showed different retentions of *B. bruxellensis*. The study emphasizes that filter media (composition and micron rating) play a crucial role on the mechanisms involved in the retention of microorganisms; thus, this work points toward the importance of a complete characterization of the filtration media, not just the pore size, by enologists prior to wine filtration and by researchers in scientific studies concerning *Brettanomyces* removal by filtration.

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