WASHINGTON STATE UNIVERSITY

Viticulture and Enology

Oenology

The science behind wine

Perfect composition

Dr James F Harbertson elucidates the growing field of oenology and explains how collaboration with industry can help to highlight and solve the problems associated with the production of wine

Your studies focus on the Washington (WA) wine industry. Why have you focused efforts on this region?

Washington State University gets a portion of its budget from the Washington State Government and as such I am mandated to work on issues in this state. The Washington Wine Industry helped to fund my position at the University and thus has directed my research and extension on wine.

What metrics do you consider when assessing the composition and quality of grapes?

We evaluate the fruit visually (berry size, damage, variation) and measure sugar and acids, and if the fruit is red we measure tannins and pigments. We also taste the fruit but the fruit very rarely tastes anything like the wine as the flavours are trapped as precursors (bound to sugar) that are only released during the wine-making and ageing process. There are some exceptions to this of course, several of the more aromatic white cultivars like Muscat or Riesling, will have some of the flavours found in the fruit. Vegetable aromas are sometimes found in red and white grapes and are usually associated with less ripe fruit.

Oenology is a growing scientific field. How is research benefiting the wider community of wine producers?

As wine is quite complex, chemical science has helped deconstruct some of that complexity to provide more tools to help winemakers make better decisions and hopefully better products. I don't think scientists seek to demystify wine but instead to better understand its elemental parts. One of the interesting aspects of this is that it encourages winemakers around the world to heed other breakthroughs in other locations and work out how to utilise them in the most unexpected, and in many cases, unintended ways.

Has climate change had an impact on the yield and quality of harvest? What have you observed?

We have not felt the impacts of climate change in WA as severely as others but the danger here is still fairly high. Most of the irrigation water is gained from snow that falls in the Cascade Mountains. In years of drought the snowpack is limited and all of the farmers (hops, cherries, apples and wine and juice grapes) in WA dependent upon its water suffer. On the other hand, many grape growers here are very keen to point out that in the past, the area was much cooler and harder-to-grow grapes that take longer to ripen and/or are less cold tolerant that are more popular amongst wine consumers (Cabernet Sauvignon, Merlot, Syrah) are now easier to grow in the region. So there are both dangers and opportunities it seems from the impacts of climate change.

What are the benefits and pitfalls of blending wines?

There are many benefits of blending different grape cultivars together, or even blending different lots of wines of the same cultivar produced by different winemaking methods. The most obvious improvements come in the form of changes in every aspect of the wine from the flavour, colour, mouthfeel, acidity, to the more esoteric terms like balance, and the dynamic nature of wine when it is tasted. Some of the most important things learned about blending almost seem the most obvious. Wine is not just the sum of its parts; the perception of it is multidimensional and complex nature would fit very easily into gestaltism philosophy. There are some pitfalls to blending as well which are the converse of every benefit just described, as well as stability issues.

Is there an ideal blend?

It is hard to say if there is an ideal blend. Some very famous winemaking areas have laws about which grapes can be blended together which have been broken elsewhere to wonderful effect. This coupled with the advent of more grape cultivars and less restrictive rules suggests we may have new blends in the future. Some may be bad and some may be good. The market will likely dictate some of this but I for one look forward to it.

The nature of wine

The effects of climate change on grape and wine production and how this can be mitigated

Wine grapes, although highly romanticised are agronomic commodities like any other and are subject to variations in climatic and environmental impacts. In grapes, the development of the future and current crop are subject to environmental variations, and vineyard practices. Thus temperature changes, or water stresses during key periods including dormancy, flowering, grape ripening can have profound impacts on the current and future crop's size, composition and quality.

In some cases it has been observed that the climatic conditions in winemaking regions have warmed over the last 50 years (France and Italy). For some regions in the United States winegrape growers have learned that they can grow grape cultivars they had not anticipated, which has opened up new opportunities. Similarly the south of England has seen an uptick in the production of sparkling wine where previously it was limited.

This general warming is not without its dangers and challenges. Overall increases in temperature may force established wine grape regions to reevaluate the appropriate cultivars to produce wine from. For example, in most of Europe the wine grape growing regions have numerous rules about which grapes can be grown and which vineyard and winery practices can be utilised. Areas like Burgundy may eventually find their climate too hot to produce world class Pinot Noir and Chardonnay as they do now. Thus, it would be prudent for even the most established areas to decide what they will do as the climate shifts. In the vineyard some potential solutions have been proposed including: changing row orientation to avoid excess heat or ultra-violet light exposure, avoiding canopy architecture that enhances fruit exposure, reduction of leaf removal during fruit maturation, use of sprinkler systems for evaporative cooling, etc.

In the winery it may force wine regions to legalise certain additions that are currently thought of as taboo, and in the process place a new financial burden on the wineries. As it gets hotter the winemakers may decide that they cannot achieve the wine flavour or colour they are looking for without having excessively ripe fruit that has accumulated more sugar than yeast can ferment to dryness. In California and Washington this has been a feature of wine production for more than 10 years. This may require legalisation of water additions to dilute the juice to a more palatable concentration of sugar for the yeast. Yeast producers have recom-

mended higher inoculum levels for high sugar ferments and greater additions of yeast nutrients to ensure the fermentations are completed. Pigment additions from juice concentrate derived from French-American hybrid grapes may also be necessary to maintain the wine colouration that consumers have come to expect. Additions of grape acids, although already currently legal in many areas of Europe will be a necessity rather than a luxury. As many consumers are not aware of all of the additions that are currently used for the production of wine, the European wine industry will need to be careful how they market their new products.

Though replanting more appropriate cultivars for hotter regions may be the best solution, it is certainly the most expensive and would require both vineyard and winery employees to re-master their craft as no cultivar behaves the same way in the vineyard or winery.

Further sustained severe weather patterns may cause droughts, soil or water salinity issues, wildfires and/or, prescribed burning of combustible vegetation. In some cases fires, either wild or prescribed, have resulted in wines that are tainted with smoke flavors that are best described as ashtray or medicinal.

In any case, the management of both human and natural resources will be key to mitigating the impacts of climate change, such as lowering the amount of water required to produce a litre of wine. Both vineyard and winery can improve water usage efficiencies. Compared to other crops grape production requires considerably less water. Between 100-1000 L of water is used in the vineyard to make 1 L of wine (40:60 rainfall: irrigation). Some estimates ignore rainfall but the water is still necessary to grow the plant (in some places irrigation is illegal). In WA irrigation is legal and totally necessary as we receive about 200 mm of rain a year. For winemaking it takes about 1-20 L of water to make 1 L of wine (primarily from cleaning). In the vineyard regulated deficit irrigation techniques can be utilised to lower inputs, and in some cases can change berry size and improve pigment and tannin concentration of wines. In the winery clean in place systems (CIP) can be used to lower the amount of water used to clean fermentation and storage vessels. CIP is very old technology but has been underutilised in the wine industry. The improvements in water efficiency would be very similar to those observed for household dishwashers compared to conventional hand washing.

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James Harbertson is Associate Professor of Enology at Washington State University. His research interests are focused on the phenolic compounds found in grapes and wine and their biochemical and chemical changes during grape ripening, winemaking and ageing. Harbertson has worked on a variety of projects including understanding the variability of tannin found in red wine cultivars and the ultimate relationship between tannin, polymeric pigments and astringency. He works with wineries to solve simple and difficult problems and is located in the wine-grape growing region at the WSU Prosser Irrigated Agriculture Research and Extension Center.

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