

Cool Climate, Hot Topic

**By Ruby Andrew (Director, Vino Vitis Communications) and
Randy Weaver (Director of Wine Science, University of Auckland)**

The seventh International Cool Climate Symposium (held in mid-June 2010 in Seattle, Washington) provided a glimpse of warmer times to come, with an opening session that focused on climate change and the demand for adaptation. Keynote speaker Snow Barlow (University of Melbourne) sketched a scenario of increasing temperatures and carbon dioxide (CO₂) levels, noting that with no meaningful global agreements reached at the Copenhagen Climate Summit – nor any expected at Cancun this year – the earth will continue to warm by an average of 4°C to 5°C this century.

That presents uncharted territory for viticulture in both warm and cool climate zones, said Barlow, as increases in the mean temperature will coincide with more temperature variance and extreme weather events.

How to adapt? Are grapevines able to cope with continued, elevated levels of CO₂ and the accelerated phenology that goes hand in hand with extreme heat? Barlow emphasised that warmer wine-growing regions, including many areas of Australia, are already grappling with the issues resulting from higher temperatures – including access to water, pest and disease pressure, and, ultimately, wine quality.

Such effects were described by subsequent speakers from Australia. Leanne Webb (CSIRO) summarised the extreme heat experienced in Australian grape-growing regions in early 2009, outlining the variable success of different management techniques. Areas worst affected by the events surrounding “Black Saturday” bore little correlation to areas that experienced the highest heat, indicating that it was not solely a temperature impact causing damage in vineyards. In some instances, irrigation well in advance of the heat event helped reduce damage, as did the selection of drought-resistant rootstocks. Perhaps most important, row orientation within vineyards played a critical role,

with the greatest damage occurring on the west side of north-south rows, while east-west rows suffered significantly less damage. Also in this session, Bruno Holzapfel (Charles Sturt University) discussed the production and storage of carbohydrates in grapevines in the face of hotter, shorter growing seasons followed by a later leaf fall. Holzapfel noted that cool climate regions are likely to require new techniques to manage vines that accumulate reserves at greater levels than they do at present.

Winegrower responses to environmental stresses, presented by Kimberly Nicholas Cahill (University of California, Davis (UCD)), profiled a tendency on the part of growers to respond individually, rather than collectively, to all but the most severe pressures, such as the onslaught of a new, virulent pest and/or disease. Innovative growers are already trying new strategies to cope with climate-related issues in the vineyard, noted Cahill, but there is still a need for more (1) networking, (2) science collaboration with industry, and (3) a combined approach to match problems experienced across political boundaries.

Climate change may not yet represent a “clear and present danger,” but Alan Lakso (Cornell University) provided an easily understood snapshot of what has already occurred in New York State. There, climate change has actually played a transformative role, said Lakso, who observed that “Boston winters are now more like Philadelphia winters used to be.” One result has been a number of new wineries opening in Geneva, New York. In 80 years, he predicted, upstate New York will share a climate similar to that currently experienced in South Carolina or Georgia.

Likewise, climate change has spurred winegrowing in England, as reported by Christopher Foss (Plumpton College, UK). Grape acreage in the south of England has grown recently at an annual rate of more than 20% and now comprises more than 1,200 hectares, predominantly planted to Chardonnay and Pinot noir for production of premium sparkling wine.

The question of what defines cool climate viticulture and oenology will, in all likelihood, undergo scrutiny and revision in the years ahead, as winegrowing regions make a transition from cold climate to cool climate or from cool climate to cool/warm climate. The differentiation between which varieties can or should be grown in each climate zone is also likely to change, as regions adapt to rising temperatures first with management practices, then with different varieties, and, eventually, with the development of new regions and/or new wine styles.

Perhaps not surprisingly, given this theme, the programme for the 7th International Cool Climate Symposium showed a slight blurring of the boundaries between cold, cool and warm – indeed, Washington State’s largest winegrowing region actually falls under the “very warm” climate label in terms of viticulture and wine styles.

Water management, is, of course, of interest to winegrowers in any climate zone, as there often appears to be either too little or too much. Quantity *and* quality were the topics explored in the concurrent session on this topic, which opened with a thought-provoking lecture by Claudio Lovisolo (University of Turin, Italy) entitled, “A Hydraulic World: From Plant Water Transport to Vineyard Irrigation Requirements.” Rootstock manipulation, either traditional or genetic – may be the key to enhancing premium wine varieties, he concluded, noting that the relationship between rootstocks and water availability was variable and complex. Indeed, the grapevine is genetically well equipped to battle drought, he explained, having 192 genes designed for water-stress recovery.

Nonetheless, too much stress – whether caused by a water deficit or not – is seldom a good thing, and other speakers in the session outlined new methods of evaluating when and how much to irrigate. Thibaut Scholasch (Fruition Sciences Inc., France) introduced a new database system for monitoring vine transpiration declines as a means for triggering irrigation; while Mark Battany (University of California Cooperative Extension, San Luis Obispo), provided a summary of the long-term effects of different deficit irrigation levels on the

productivity and quality of winegrapes on the Central Coast of California. Drier irrigation treatments (of 75% and 125% of estimated crop evapotranspiration) resulted in lower yields and berry size with higher juice soluble solids, with no discernible differences in juice pH or titratable acidity.

One subject all the presenters agreed upon was that if irrigation frequency is increased, then so too are periods of “recovery” for the vines. A better route is to decrease frequency but increase the amount of water to enable vines’ entire root masses to access water throughout the vineyard block.

Enhancing winegrape parameters encompassed several sessions at the symposium, including “Grape Ripening – Dealing with Variation,” “Canopy Management – Beyond Fruit Exposure,” “Fruit and Wine Aroma – Focusing on Objectivity,” and “Sensory Evaluation – From Grape to Glass.”

In a keynote presentation entitled, “Causes and Consequences of Variation in Fruit Composition,” Serge Delrot (University of Bordeaux, France) outlined the tools and strategies available for adaptation to climate change, including grape variety and rootstock selection, deficit irrigation, new application rates for nitrogen, and canopy management.

Richard Smart (Smart Viticulture, Tasmania) explored variability in Pinot noir from cool climate Tasmanian vineyards, reporting on two years of “ultra-microvinification” trials, in which single-bunch ferments were used on 76 clusters. Necessity required an ingenious approach to the technical requirements of how to press and ferment such small quantities (small Bodum coffee presses were enlisted), but Smart’s observations on vine to vine variation have implications for commercial vineyards of every size. Sunlight protects grapes from Botrytis, he noted, which means that certain assumptions concerning what constitutes the “correct” level of UV radiation may need to be revisited. Similarly, high vigour, which can affect wine quality on many parameters, is also one of the easiest factors to manage in the vineyard.

Dr Smart, who has attended every cool climate symposium since the inaugural session held in 1984 in Eugene, Oregon, will find himself wearing the mantle of “host” at the next event, which will be held in Hobart, Tasmania, in early February 2012 – with Jancis Robinson confirmed as the opening speaker. With a scant year and a half to go, can a call for symposium papers be far away?

Of course, cool climate zones are, by definition, highly variable. As Andrew Reynolds (Brock University, Canada) noted in his keynote presentation, “Back to the Future for Grapevine Canopies,” the new focus is reducing undesirable characteristics in grapes and/or customising canopy management on a varietal basis. Nonetheless, much of the research on ripening and flavour development presented at the ICCS – whether it be through canopy management, yield controls, winter pruning, shoot thinning or other vineyard inputs – acknowledged that climate or seasonal variation and cultivar play greater roles in fruit development than any or all management practices. This was noted in a series of presentations and posters, including “Estimating Grape Yield,” by Paolo Sabbatini (Michigan State University), and “Canopy Management – Beyond Fruit Exposure,” by Fiona Kerlake (Tasmanian Institute of Agricultural Research), and “Comparison of Pruning Method and Severity on Vine Growth and Productivity of Chardonnay Grapevines,” by Larry Bettiga (University of California Cooperative Extension, Monterey County).

While many of the viticulture sessions looked closely at the implications of climate change, the oenology researchers examined topics of more general winemaking interest. Winemakers, it would appear, have more tools at their disposal to manage the finished product. More than 200 commercial yeast strains, to name just one example, are currently available to industry, and more are being developed and marketed every year. The role of microbiology in winemaking reflects the title of the concurrent session on the topic, “Good, Bad, or Ugly.” In a review of the control of wine fermentations, Jean-Marie Sablayrolles (INRA, France) considered the effects of the timing of ammonia and oxygen additions on fermentation rate and efficiency. He then looked

ahead to on-line monitoring of metabolic products to optimise both fermentation rate and wine quality. Sablayrolles believes that the use of mixed species fermentations and GMO microbes are possible tools for winemakers in the near future.

Taking another approach to improving wine quality, Erhu Li (Cornell) discussed possible means of lowering yeast acetaldehyde production and thereby decreasing the amount of SO₂ required for winemaking. His trials showed that there are differences in the abilities of the 26 yeast strains he studied (*Saccharomyces* and non-*Saccharomyces*) to both form and degrade acetaldehyde. And Debra Inglis (Brock) examined several possible post-harvest methods for managing methoxypyrazines responsible for green aromas in such varieties as Cabernet Sauvignon. While yeast strain showed little effect, bentonite and activated carbon did give some positive results in making these wines less herbaceous.

In a thought-provoking session on wine and health, John Pezzuto (University of Hawaii, Hilo) reviewed his discoveries regarding the health effects of moderate wine consumption. He pointed out that grapes contain more than 1,200 chemicals, many of which could be beneficial to human health. Pezzuto's earlier ground-breaking studies demonstrated that resveratrol has been shown to actually prevent cancer growth in laboratory animals – although the amount a human would have to ingest to see any benefits would be on the order of 5 grams per day. Washington health consultant Gregory Gasic cautioned that resveratrol research is still ongoing: it would be premature to recommend using it as a dietary supplement.

Cool climate juices and wines tend to have high acidity and high pH, which may work to the advantage in white wines such as Sauvignon blanc, but are detrimental to the production of quality red wines. Roger Boulton (UCD) focused on this topic in his presentation, "Understanding and Adjusting Acidity Measures in Cool Climate Juices and Wines." Boulton characterised the process as "potassium ion swapping" – the percentage of the exchange determining pH and acid levels. Although potassium uptake may be

independent of potassium available in the soil, he noted, it does depend on enzyme and soil moisture. Other factors include late irrigation and later hang times, which also lead to high potassium. How to lower pH to a target of 3.6 or less? Boulton suggested a two-pronged approach, using double salt (CaCO_3) to de-acidify a small portion of the juice, followed by an addition of tartaric acid.

New products were also outlined in this session, including encapsulated *Schizosaccharomyces pompe* for reducing malic acid, presented by Sebastian Donner (Iowa State University) and a new strain of *Oenococcus oeni* for improving malolactic fermentation, presented by Charlotte Gourraud (Laffort USA Inc.).

One area that has made giant strides in recent years is mechanisation, the subject of its own concurrent session, “From Mechanisation to Automation.” As Jim McFerson (Washington Tree Fruit Research Commission) outlined in his keynote presentation, it is indeed a robotic world. From vineyard design, to robotic tractors, to water management, to harvesting and satellite mapping, precision viticulture represents the marriage of good management with automation and information systems. The new generation of multi-use mechanical equipment for vineyards is already having a tremendous impact in terms of cost and labour reductions, particularly in large-scale commercial applications. McFerson argued that researchers need to place themselves at the forefront of such developments to help automate tasks that are surging in labour costs. The next generation of automation promises even more applications – not only in terms of mechanisation, but also new information systems for monitoring in both the vineyard and the winery.

A self-propelled multifunctional transport and propulsion device, as presented by Rainier Keicher (Geisenheim, Germany), may be limited in use to the steep slope vineyards in Mosel (where gradients of up to 70% are not uncommon), but other developments are likely to have broader application. Spatial variability monitoring and NDVI imaging, as outlined in presentations by Javad Hakimi Resaei (Brock), and Martin P. Mendez-Costabel (Gallo Winery,

California), are currently being explored for a variety of uses, including crop/yield forecasting.

Many of the researchers attending the Soil Management concurrent session could only envy the timeframe of a French trial focused on amending vineyard soils. As discussed in “Patience Please,” keynote speaker René Morlat (INRA, France) outlined a trial that lasted 28 years to determine the correspondence between higher total organic carbon (TOC) and higher wine classifications (grand cru). Higher organic amendments, such as cattle manure, led to an oversupply of nitrogen, he reported, which in turn led to decreased berry quality, higher alcohol concentrations and a reduced capacity for ageing of finished wines. One finding shows promise: mulches incorporating crushed vine wood appear to be a good means of maintaining and/or improving TOC content.

Paul Schreiner (USDA Agricultural Research Service, Oregon) explored the role that nitrogen plays on fruit quality, noting that it remains uncertain how vine nutrients affect vine performance and fruit quality. Michael Wolff (UCD) described a Napa vineyard trial designed to determine vineyard floor treatments with an eye to reducing CO₂ emissions, reporting that a conventional no-till barley cover crop actually seemed to sequester more carbon than either no-till no-cover or a twice-tilled cover crop.

Cool climate viticulture frequently has to battle disease on a variety of fronts, including Grapevine Leafroll-associated Virus 3, Powdery Mildew and Botrytis. Disease management, from the perspectives of sustainability and innovation, was covered in a concurrent session led by a presentation by Olivier Viret (Swiss Federal Research Station Agroscope) on “Linking Plant Resistance and Disease Forecasting Models.” To date, no organic and/or alternative compounds, among the 40 products tested in Viret’s trials, have shown efficacy to equal classic fungicides. Genetic modification experiments in this area are under way in a number of countries, and Viret noted that metabolites as resistance markers show a promising avenue for genetic research. Similarly, breeding for resistance in the vines themselves has led to the

creation of new varieties/hybrids. Since 1996, experimental crosses created by Viret and his colleagues have resulted in 33 new cultivars (30 red and 3 white varieties), of which 13 have been selected for further monitoring and analysis. With distinctive names such as Garinoir, Carminoir, and Gamaret, the new cultivars are now planted over extended areas – in France, 8,000 hectares are currently planted to Gamaret alone.

With as many as 70 different viruses or virus-like diseases now documented in grapevines, the potential for multiple infections in vines is staggering. One virus, however, still dominates in terms of economic impact, and that is Grapevine Leafroll-associated Virus 3 (GLRaV-3), which accounts for nearly 60% of losses in grape production. Naidu Rayapati (Washington State University) outlined the impact of GLRaV-3 in Washington vineyards, noting that 50% of samples submitted for laboratory testing show the presence of GLRaV-3. Mixed or compound infections, which often include GLRaV-3, are also frequently found in Washington vineyards, and may comprise Grapevine Fleck Virus, Grapevine Vitiviruses A and B, and Rupestris Stem Pitting as well as other leafroll viruses.

Turning to wine chemistry, Andrew Waterhouse (UCD) presented a technically challenging discussion of his latest work regarding the chemistry of oxidation of juice and wine. While his talk was fascinating, most attendees found it somewhat beyond their understanding of chemical and biochemical processes. In a talk entitled “The Myth of Fingerprints,” Mark Downey (Department of Primary Industries, Mildura, Australia) recounted his futile attempts to identify grape varieties by their differences in anthocyanin ratios. While such a technique, if developed, would be an enormously valuable tool for winemakers, Downey found that variations between these proportions are too great for use as an identifying tool.

Dominick Durner (DLR Rheinpfalz, Germany) reviewed the effects of micro-oxidation (MOX) of Pinot noir wines on sensory qualities, especially green character and colour. Results varied between vintages, but Durner was able

to establish that the flavan-3-ol to anthocyanin ratio of Pinot noir wines can be regarded as a potential indicator for the dosage and timing of MOX.

In another study of both Pinot noir and Merlot, James Osborne (Oregon State University, Corvallis) looked at the ability malolactic bacteria have to degrade compounds important to the development of stable colour. He reported that *Oenococcus oeni* can indeed reduce both phenolic and non-phenolic compounds affecting colour and colour stability.

The increasing role that sensory evaluations play in research was highlighted in several presentations, as well as the concurrent session devoted to this topic. Sensory analysis can help to verify qualitative differences that may be difficult or impossible to quantify – as noted in the presentation by Glen Creasy (Lincoln University) on “Waste Stream Sourced Reflective Mulch Affects the Aroma Profile of Pinot Noir Juice.” The use of crushed glass and other substances such as crushed mussel shells as reflective mulch created differing aroma profiles that sensory panelists were able to detect.

Similarly, Kisten Creasy’s presentation, “Aroma Differences between Wild and Inoculated Ferments in Sauvignon Blanc Wines,” presented sensory evaluations conducted at Lincoln showing more olfactory “hits” for wines made with wild yeast ferments, while Debra Inglis (Brock) outlined the ease with which Ladybug taint (caused by methoxypyrazines present in the ladybug) can be detected by sensory panelists even at parts per billion.

Isabelle Lesschaeve (Vineland Research and Innovation Centre, Canada) discussed the complicated interaction of factors affecting consumer wine preferences. Confirming that consumers tend to prefer sweet and fruity wines, Lesschaeve noted that what is less understood are the many other influences such as price, origin, brand, packaging, ambience and social environment that drive consumer choice. Also, involvement, fear of mistakes, knowledge and attention all play a role.

As another approach to sensory evaluation but for research purposes, Elisabeth Tomasino (Lincoln) introduced the idea of using experienced

(professional) but “untrained” tasters to study the variance of random effects. Tomasino showed that using experienced tasters is effective and at a lower cost than custom training “amateur” tasting panels.

Fruit and wine aroma were also examined from the quantitative perspective, with an emphasis on the chemical analysis of the specific compounds that distinguish a particular variety. Erich Leitner (Graz University of Technology, Austria) outlined the influence of grape ripeness on the analytical and sensory properties of Styrian Sauvignon blanc in Austria; Gerard Logan (University of Auckland) profiled the recently identified compound of Rotundone (responsible for the peppery aroma of Syrah) in a trial block at Hawkes Bay, and Gavin Sacks (Cornell) asked the question “What makes Riesling Riesling?” Sacks believes it may be TDN and several other peri-threshold compounds rather than the conventional belief that it is monoterpene alcohols. Logan’s findings – that Rotundone production in Syrah increases rapidly shortly after veraison – were somewhat trumped by his discovery that the compound is present in Cabernet franc at more the double the level found to be present in Syrah.

In the keynote presentation for this session, Pascal Schlich (INRA, France) presented a new technique for sensory analysis based on the temporal dominance of sensations (TDS). TDS is already used in other industries, and Schlich believes that it shows great promise for use in wine, as it enables panelists to score immediately as different flavour attributes rise to dominance within the timeframe of a wine tasting. Software is currently in development to incorporate TDS into sensory evaluations.

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