Quantifying the advancement and compression of vintage

Shifting phenological development is the most conspicuous biological effect of recent warming, with advanced maturity of grapevines being reported for Europe, North America and Australia (Duchêne and Schneider 2005, Petrie and Sadras 2008, Wolfe et al. 2005). Between 1993 and 2006, maturity of grapevines in Australia advanced between 0.5 and 3.0 days per year across a range of regions (Petrie and Sadras 2008).

Warmer temperatures and an advancement in maturity can affect fruit quality and wine style, often causing 'unbalanced fruit' where high sugar levels are reached before optimum colour (and potentially flavour) development has been achieved (Sadras and Moran 2012). Associated with the advancement in maturity have been anecdotal reports of compression of the harvest period, with different varieties grown in the same region now reaching optimal maturity at similar dates and a narrower period during which a single variety matures (Coulter et al. 2015). Given the capital-intensive nature of the wine industry (processing capacity is used at most for 8–12 weeks per year), climatic trends that compress harvests have the potential to affect financial viability. Considerable investment would be required to increase processing capacity (for example red fermenter space) to allow production to be completed over a shorter time period.

To date the anecdotal reports of more compressed vintages have been difficult to validate and quantify. However, the analysis of commercial maturity data, dating from 1995 to 2014, from a major Australian wine company offered the opportunity to investigate these reports further. The sugar accumulation of individual blocks (based either on grower-reported values or samples delivered to the winery laboratory for maturity analysis) across a region was tracked and the day of the year when each block reached 12 Baume was interpolated from the maturity samples collected immediately below and above this level. Basing maturity assessment on Baume rather than harvest date gives a more accurate assessment of the impact of climate on fruit maturity, as it is independent of human decisions that can be influenced by other factors such as target wine style or winery capacity.

The analysis showed a continuation of a trend first reported by Petrie and Sadras (2008). For example, the average date that Chardonnay in McLaren Vale reached 12 Baume has advanced at 1.3 days per year and McLaren Vale Cabernet Sauvignon has advanced at 1.9 days per year (Figure 1). Analysis of a longer data sequence highlighted not only the advancement in maturity, but also that in many regions the later ripening varieties (i.e. Shiraz and Cabernet Sauvignon) were advancing in maturity at a faster rate than the earlier ripening varieties such as Chardonnay. This means that the time window between the maturity of Chardonnay and

Cabernet Sauvignon has narrowed. In the early 1990s the range in dates between when the average maturity of these two varieties reached 12 Baume in McLaren Vale was just over 20 days; it is now averaging closer to five days and Shiraz also needs to be processed during this period (Figure 1). Note that while McLaren Vale was used in this example, a similar trend was observed across many Australian regions.

Individual varieties are also reaching maturity over a shorter period within one region. The technique described above to determine the date when a block reaches 12 Baume was also used to calculate the proportion of blocks for a specific variety within a region that had reached

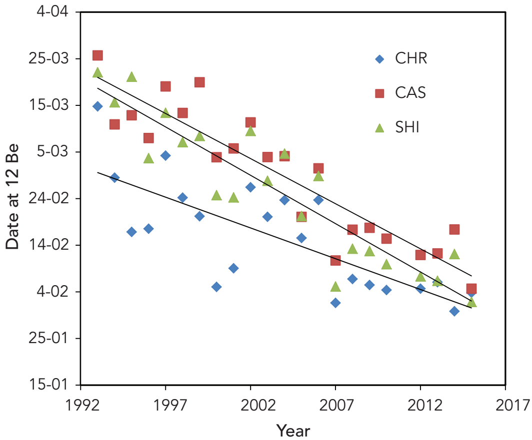

Figure 1. The advancement in the date at which 12 Baume was reached for vineyards in McLaren Vale. Chardonnay – blue diamonds (r^2=0.58); Cabernet Sauvignon – red squares (r^2=0.83); Shiraz – green triangles (r^2=0.84).

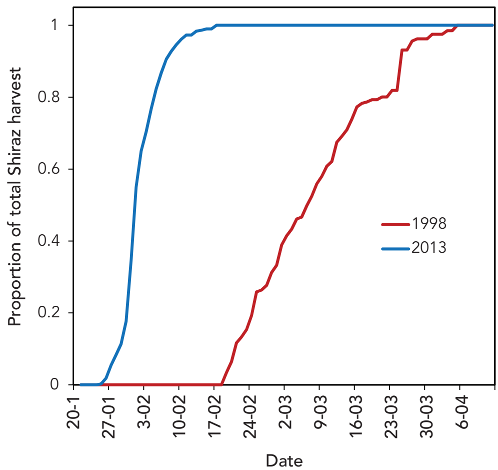

Figure 2. The proportion of the Shiraz blocks in the Barossa and Eden Valleys that reached 12 Baume on a given date in 1998 (red - right line) and 2013 (blue - left line).

12 Baume. For example, the Shiraz blocks across the Barossa region (both Barossa and Eden Valley) reached maturity over a 30-day period in the late 1990s and this reduced to a 15-day window by the mid 2010s (Figure 2). Once again this increases pressure on vineyard and winery infrastructure. While Figure 2 shows the extremes of the time series (1998–2013), the shortening of the vintage period has occurred gradually over time.

This analysis does not allow separation of the effects of warming, other environmental factors and changes in management practices. However there have not been step changes in management during the study period. While reduced yield is often suggested as a driver of earlier fruit maturity (e.g. Pearce and Coombe 2004), no consistent yield trends were observed across the regions included in this study. Regardless of the causes, the advancement in maturity and compression of the window of peak maturity illustrate the challenges faced by wineries to process fruit over a shorter and more intense period.

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References

Coulter, A., Cowey G., Petrie P., Essling M., Holdstock M., Stockley C., Simos C., Johnson D. (2015) Vintage 2015 – observations from the AWRI helpdesk. Wine Vitic. J. 30, 38–40.

Duchêne, E., Schneider C. (2005) Grapevine and climate changes: a glance at the situation in Alsace. Agron. Sustain. Dev. 25, 93–99.

Pearce, I., Coombe B. (2004) Grapevine phenology. Viticulture: Volume 1 – Resources, Eds. P.R. Dry and B.G. Coombe (Winetitles: Adelaide, South Australia) pp. 150–166.

Petrie, P.R., Sadras V.O. (2008) Advancement of grapevine maturity in Australia between 1993 and 2006: Putative causes, magnitude of trends and viticultural consequences. Aust. J. Grape Wine Res. 14, 33–45.

Sadras, V., Moran M. (2012) Elevated temperature decouples anthocyanins and sugars in berries of Shiraz and Cabernet Franc. Aust. J. Grape Wine Res. 18, 115–122.

Wolfe, D.W., Schartz M.D., Lakso A.N., Otsuki Y., Pool R.M., Shaulis N.J. (2005) Climate change and shifts in spring phenology of three horticultural woody perennials in northeastern USA. Int. J. Biometerol. 49, 303–309.

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