

Geo-climatic Characterisation of Macedon Ranges Vineyards Year 9: Season 2021/22

Summary

The Macedon Ranges wineries are in a very diverse mountainous landscape. All vineyards are at high altitude (500-800 m) and high latitude (37°).

Not only the vineyard's altitude, but also their position on the Great Dividing Range has a tremendous influence on grape growing conditions. A 3D map was generated and 26 vineyards were marked in the landscape according to GPS based positioning. Their altitude, aspect, slope and row orientation was recorded.

The aim of the study was to provide grape growers and winemakers of these vineyards with data from hourly temperature measurements fruitset to harvest in a representative block generated by inexpensive durable equipment. Temperature data loggers (*Tinytag Gemini*, *Hastings Data Loggers*, *Port Macquarie, NSW*) were inserted into wooden boxes open to the bottom and South and fixed to vineyard posts at 1.20 m aboveground in 26 vineyards. Phenological dates were collected from the participants. Photos were taken at fruitset and harvest for information about canopy and undervine characteristics which may have influenced in-vineyard temperatures.

Diurnal temperature curves for each vineyard were delivered to participants after harvest and allowed a comparison to previous seasons. In the graphs, a line at 35°C informed when and how long vineyards were suffering from aroma destroying heat and a line showed at a glance when nights were warmer than 15°C above which acid loss occurs in the grapes after veraison. This image alone often initiated management decisions to optimise grapegrowing temperatures for highest quality outcomes.

The Macedon Ranges climate is very variable. In 9 years there were 2 warm and 3 very cold ripening seasons. Even in the warm year of 2016 most of the spikes above 35°C occurred before veraison. In all years during ripening there were very few heatloads and warm nights were rare, even in the northernmost vineyards.

The temperature data were also presented as cumulative and daily degree hours. The latter allowed a comparison between the vineyards in the region despite different veraison and harvest dates. The ripening period degree hours were more suited to group the vineyards into five geo-climatic zones than altitude alone. Particularly discriminating were their Ripening Period Cold Degree Hours, which strongly discriminated the High altitude vineyards from all others (except in the warm year 2016), less cold where the Central valley vineyards, followed by the vineyards on the Eastern slopes of the Western Range. The vineyards South of the Dividing Range were again less cold and the vineyards North of the Divide had the fewest daily cold degree hours during ripening. In cooler years these indices were very different on the 5 zones and in the warm 2016 they were more similar due to early harvest even at high altitudes.

A cool night index for the ripening month (according to *Tonietto and Carbonneau, 2004*) was calculated using the in-vineyard dataloggers March Minimum Temperature readings. For the Macedon Ranges vineyards average MMinTs were not as suitable to discriminate geo-climatic zones as were the whole ripening period cold degree hours, but interesting for a worldwide MMT comparison of March 2022 (August 2021 NH). The Macedon Ranges with an average of 11.3°C was cooler than Rheims with 12°C and Burgundy with 14°C.



The mean temperature of the ripening month is another measure of the meso-climate of vineyards. It includes additionally the daytime highs but does not calculate how long high temperatures persisted; however the duration of heatloads has a substantial effect on vines and grapes. Mean March Temperatures from the Tinytag dataloggers, averaged over the last 3 years, distinguished the previously devised geo-climatic zones very well. The High altitude vineyards had an average MMT of 15.9°C, Central Valley vineyards 16.6°C, those on the eastern flank of the Western ranges 16.8°C, Southern vineyards 17.1°C and North of the divide the MMT was 17.9°C.

The average 2022 MMT of all vineyards of the study was 17.8°C, which was lower than that of the Yarra Valley (18.8°C) and much lower than the 2021 Mean August Temperature in the Rheingau of 18.1°C and in Burgundy of 19.5°C.

Comparing “ripening month” temperatures of various regions can be problematic as in the Macedon Ranges harvest can be mid February to mid March (2016) or late March to late April (2022) and has a strong zonal variation. In the 9 years of the study harvest dates have not come continuously forward, but were early in the El Niño season 2016 or late with La Niña (2017, 2021, 2022) weather patterns.

To characterise the physiological capability of a vineyard to produce high quality cool climate grapes in response to its meso-climate, a method was developed by *Winter and Lowe 2007* to calculate the degree hours of the pre-veraison and ripening period within the temperature bracket between 15°C and 35°C from the data logger readings and to assess the percentage of degree hours the vines had spent in those beneficial conditions.

The geo-climatic zoning of the subregions within the GI was confirmed by the average degree hours in the beneficial temperature bracket for the ripening period more than for the fruitset to veraison period and in cooler years more so than in warmer years. Most importantly, this calculation gave grape growers a tool to select management practices that can increase the percentage of Hangtime in beneficial temperatures, particularly in the High altitude vineyards.

In the nine years of the study a distinct seasonal variability of beneficial bracket time existed already in the fruitset to veraison period. Surprisingly, a very high percentage (93-95%) of degree hours were spent in the beneficial bracket in the years 2016, 2018, 2019 and 2022, and for most vineyards above 90% was spent in the cooler early summers of 2014, 2017 and 2020. Only in the very cold year of 2021 90% was hard to achieve, in particular for the Highlying vineyards.

During the ripening period, Northern, Southern and Western vineyards had, in 7 out of 9 years, 90-95% of ripening degree hours in the beneficial temperature bracket. For many Central and Highlying vineyards this was possible in 2 out of 9 years but not at all in 2022. These values, which include the duration of cold degree hours into the autumn mornings may help to initiate management changes that allow more morning sun on bunches and better airflow undervine.

In the Macedon Ranges there is also a distinct danger of spring frosts and adverse weather before fruit set. Growing season temperatures capture these events. In the current study only selected dataloggers were inserted before budburst and removed late April so that October to April in-vineyard growing season temperatures could be monitored. GST values generated from the *Tinytag* loggers were compared to those of the Bureau of Meteorology (BOM) at Kilmore Gap, the weather station of a centrally located vineyard 2 and data from the Rheingau and Burgundy.



Since 2010 there were 3 exceptionally warm years for Europe in 2018, 2019 and 2020 with GSTs of 20.9, 18.7 and 18.3°C for the Rheingau and 19.4, 17.9 and 17.4°C in Burgundy. From the weather station data in the Central Macedon Ranges vineyard 2 the GST values varied between 16 and 17°C since 2014, with the exception of 2016, and dropped to 15.2°C in the last 2 seasons.

The in-vineyard GST values were slightly higher than those of the weather stations of vineyard 2 and BOM, but in normal years (exception 2016) did not exceed 17°C. In the last 3 years their GST was on average at 16°C, whereas in the last 3 seasons in the Rheingau and Bourgogne GST was around 18°C, to only come back to between 16 and 17°C in 2021 due to a very cold spring.

In all Macedon Ranges vineyards, GSTs will be assessed in 2022/23 to provide this important dataset to all grape growers and to be able judge the current GST classifications and the projected changes in GST described in the *Australia's Wine Future Climate Atlas* (Remenyi et al., 2019).

Finally, from these data, Winkler's GDD can be calculated and compared to historic data and to those of recent observations of weather stations in the region and other cool climate vineyards of the world. In the period between 2014 and 2022 the GDD from the weather station of vineyard 2 was 1320 (compare with the *Hall and Jones, 2010* classification for 1971-2000 of 1217), whereas in these last 9 years the GDD of Burgundy (Dijon) was on average 1371 (compare with the historic 1971-2000 value of 1164).

The position of the Macedon Ranges vineyards at high altitudes and latitudes has so far protected them from severe effects of a globally warming climate. Assessing in-vineyard temperatures with small durable devices will give the grape growers and winemakers a versatile monitoring tool to compare sites, regions and seasons and most importantly to modify ripening conditions to give grapes the optimum percentage of time in the beneficial temperature bracket.