Managing Climate Risk for Viticulture in the Murray Valley

Compiled for Murray Valley Winegrowers Inc. December 2014.

In August 2014, the South Australian Research and Development Institute (SARDI) released a report outlining the expected future changes to the climate in the Murray Darling/Swan Hill wine regions with an expected warmer and drier future. The report's authors, Dane Thomas and Peter Hayman, identify weather and climate risks likely to occur in the future, and evaluate potential risks and consider possible actions related to climate change.

This fact sheet provides the summary of findings found in the report 'Managing Climate Risk for Viticulture in the Murray Valley' (2014) and promotes discussion on how to secure the future production of winegrapes in a warmer and drier climate.

The expected warming of the climate

The warming climate within the Murray Valley means that each vintage will be expected to be warmer than the previous. Seasonal variation will still continue to occur, however it is expected that every decade will be warmer than that of the previous decade.

The climate change modelling for moderate and high impact climate change scenarios suggests that the Murray Valley will be about 1° C to 1.5° C warmer by 2030. Accompanying this temperature increase is a total annual reduction in rainfall of between 5% to 15%, and reduction of rainfall of 5% to 25% over winter and spring by 2030.

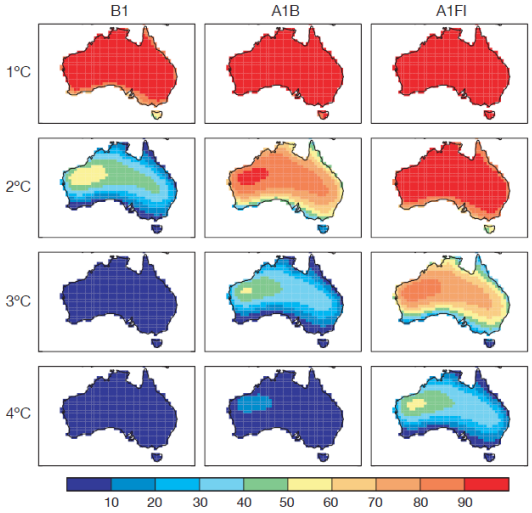

Figure 1. Risk (probability per cent) of exceeding each of the four threshold (1° C, 2°C , 3° C and 4° C) in annual mean temperature at 2070 under the B1 (low), A1B (medium) and A1Fl (high) warming scenarios. Image and more information available at www.climatechangeinaustralia.gov.au

Figure 1. Demonstrates that by 2070 in the southern grape growing regions of Australia there is a very high probability of temperatures increasing by 1° C under all warming scenarios. There is about a 50% chance of a 2° C increase under the medium warming scenario but a high chance under the high emission warming scenario. There is a much less (20%) chance of a 3° C increase in temperature under a medium warming scenario, but about a 50% chance with a high emission warming scenario.

The difference between a cool vintage and a warm vintage in the same location is typically in the range of 1° C to 2° C in growing-season mean temperature. The resulting scenario of a warmer future will increase the number of warmer vintages.

Vineyard Vulnerability to climate change within the Murray Valley

Vulnerability of varieties: a warmer future is a very important consideration to grower`s of wine grapes within the Murray Valley. Winegrape types vary in their suitability to climate. If temperatures are too high for the particular variety, the result can be overripe flavours, less retention of acids within berries and higher alcohol levels.

A very effective tool to access grape vine varietal vulnerability to heat extremes is to evaluate how certain varieties coped in recent warm years and heat-wave events.

With a warmer / drier climate, the level of water available from these water sources for irrigation may reduce for use in vineyards.

An important consideration in determining vineyard vulnerability to drought is the ability to supply irrigation water and soil water holding characteristics. An indicator of the risk is to assess the water-holding capacity of the soil. For example, a deep soil with a high Readily Available Water content (RAW) will be more resilient to the effects of drought than a shallow soil with a lower RAW count. On the other hand, a shallow soil with a well maintained irrigation system and reliable supply of water will also be well placed to handle the effects of drought and heat waves in a warming climate.

The seven changes resulting from a drier climate and their impact on viticulture within the Murray Valley

- Thomas D & Hayman P (2014) in the paper *Managing Climate Risk for Viticulture in the Murray Valley* identified seven main changes on viticulture in the Murray Valley.

1) Warmer spring and summer mean temperatures altering growth patterns

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
A greater number of warmer vintages are expected into the future as there is a high confidence from science on climate warming. There is a lower confidence in the seasonal pattern of warming. An example of this is the current observation that night-time temperatures have warmed at a higher level than day-time temperatures. It is uncertain if this trend will continue.	With warmer weather conditions, the development on grapevines through the ripening process would be expected to increase. Quicker development will lead to de-coupling of sugar and flavour ripening. These changes in vine phenology are expected to be more pronounced in the cooler viticultural zones.	If grapevine development is determined by temperature, it would be expected that the industry experiences earlier, compressed vintages. The effect of temperature may be offset by adopting particular management strategies such as pruning and crop-load management. Pest and disease management in a warming climate will need to be closely monitored and evaluated.

2) Heat waves and extreme high temperatures

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
High confidence in the frequency and intensity of heatwaves during summer. Low confidence in the timing of the individual synoptic events that lead to heatwave conditions.	Heatwave events exert different levels of damage relative to the phonological growth stage of the grapevine. The Murray Valley, a hot climatic region, could expect a higher chance of heatwave events.	Various canopy management options. Greater emphasis on gaining accurate weather data for management decisions for upcoming heatwave events. Keeping some water allocation as possible 'insurance' to help with vineyard management through heatwave events.

3) Frosts and extreme low temperatures

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
Increased night-time temperatures may reduce the risk of frost events, although increased drying may counter this possible trend. There is a lower confidence in the timing of the individual synoptic events related to frosts.	There may be earlier budburst due to the changes in vine phenology experienced as a result of warmer temperatures. Even if frequency of frost remains constant at current levels, this earlier bud burst may increase frost risk.	To date viticulture in frost-prone areas has management strategies to minimise the risks and levels of frost damage. These management strategies include: - Variety choice (later budburst and flowering). - Soil moisture management. - Cover crops and mulching. - Wind breaks, sprinklers and frost fans.

4) Drought: Less autumn, winter and spring rainfall.

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
Low to medium confidence in rainfall projections. Generally anticipating drier winters and springs. Lower confidence in projections for summer. Medium to high confidence in an increase in evaporative demand. (Approx. 2% to 3% increase in ETo for each 1° C rise in temperature).	A large amount of research has been conducted on the topic of water stress and vineyard management in Australia. Information can be found at http://research.agwa.net.au/wp-content/uploads/2013/09/SAR-1002.pdf Changes in rainfall levels will alter the distribution and incidence of pest and diseases observed in vineyards.	The use of on-farm water supplies. Ground works to direct surface run-off or increase water infiltration within vineyards. Variety and rootstock selection. Mulching to minimise evaporation. Inter row management such as the use of cover crops.

5) irrigation water restricted or of lower quality

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
Projections of water inflows to the Murray Darling Basin indicate that run-off is very sensitive to the observed levels of rainfall. 10% decline in rainfall may result in 20% to 30% declines in run-off in the inland Australian catchments.	At a per/hectare rate, the amount of irrigation water applied to vineyards in the Sunraysia area is higher than cooler or wetter viticultural regions across Australia. Quality winegrape production requires a secure supply of high quality irrigation water.	Soil moisture monitoring within soil profiles will improve understanding and management of different soil types within vineyards. Irrigation scheduling and more accurate weather forecasting will allow for better use of rainfall. Capture and storage of local stormwater or waste water for use within vineyards. Water trading where water can be transferred.

6) Summer rainfall increases

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
Low to medium confidence in rainfall projections. Lower confidence in projections for summer.	Altered pest and diseases. Possible reduction in berry quality resulting in reduction in wine quality.	Opportunities to learn from regions with wetter summers than currently observed in the Murray Valley.

7) Increased atmospheric carbon dioxide (CO_2)

Confidence from climate science	**Impact on grapevines**	**Possible management strategies**
Very high confidence	An increase in the level of CO_2 will impact canopy growth and transpiration efficiency, effecting water balance. Other interactions with heat and frost are also expected. A higher concentration of CO_2 could influence grapevine berry ripening along with lifecycles of vineyard pest and diseases.	Various canopy management techniques to control vine vigour and greater emphasis on vine balance. Crop coefficient for various vineyard growth stages could be revised for due to higher CO_2 levels, resulting in altered irrigation schedules. Greater emphasis on pest and disease management.

Resources and Further Reading:

- Thomas, D. Hayman, P (2014). *Managing Climate Risk for Viticulture in the Murray Valley*. South Australian Research and Development Institute. http://www.sardi.sa.gov.au

- The CSIRO and Bureau of Meteorology's report *Climate Change in Australia (2007)* contains a technical summary of projections for climate change in Australia within different regions. Further information on climate change for individual regions can be downloaded from http://www.climatechangeinaustralia.gov.au

Murray Valley Winegrowers' Inc

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