The Australian Wine Research Institute

Fact Sheet
VITICULTURE

Effects of climate change in the vineyard

Background

The earth's surface is warming and this is directly linked to greenhouse gas (GHG) emissions. Mitigating GHG emissions is essential if this warming is to be slowed or reversed. All industries need to consider how they are going to go about mitigating emissions, and this includes the Australian wine industry.

Increased temperatures and lower rainfall – hotter and drier

Increased temperatures and reduced soil moisture content are both contributors to the current trend for wine-grapes in Australia to ripen earlier. Warming has been found to advance crop development through the earlier onset of budburst and flowering. The times from flowering to veraison and veraison to harvest have been found to remain largely constant. Harvest records from a number of regions have shown that maturity advanced by between 0.5 and 3.1 days per year between 1993 and 2006 (Petrie and Sadras 2008).

A decline in soil moisture content can affect ripening through at least two different mechanisms. Firstly, drier soils are associated with the production of the plant hormone abscisic acid (ABA) in vine roots. The movement of ABA from roots to shoots signals shoots to stop growing and the ripening processes to begin. Increasing concentrations of ABA have been correlated with earlier maturity in wine-grapes. Secondly, dry soils are likely to warm more rapidly,

advancing budburst in spring and subsequent growth stages.

Elevated atmospheric CO_2

An increase in atmospheric CO_2 concentration above typical levels is expected to increase the photosynthetic rate of those plants that open their stomata during the day to take in CO_2, including grapevines. A rise in the photosynthetic rate is likely to lead to higher carbohydrate production within the grapevine canopy. This increase in carbohydrates will be available for processes such as growth, fruit development and ripening and higher storage of reserves over winter with impacts on budburst and early season growth. It should be noted that other factors such as water and nutrient availability can limit the amount of photosynthesis that is able to take place, even if CO_2 is readily available.

Other effects on grapevines

Shrivel

For varieties susceptible to shrivel, such as Shiraz, elevated temperatures are likely to result in increased levels of shrivel. Warmer conditions during the latter stages of ripening advance the onset of cell death in the berry pulp and increase the rate of shrivel. While cell death was advanced in both cultivars tested during research in this area (Chardonnay and Shiraz), only the Shiraz showed signs of shrivel (Bonada et al. 2013).

Leaf effects

Shiraz grapevines have been found to respond to warmer conditions with larger stomata, which provides a mechanism to protect the plant from heat damage. The maintenance of high stomatal conductance and evaporative cooling are important mechanisms that protect, within limits, Shiraz canopies from heat damage. This cooling mechanism will, however, only work if water is available to the vine (Sadras et al. 2012a), suggesting that in some cases, ability to adapt to hotter conditions will be strongly dependent on water availability.

Fruit composition

Higher temperatures were found to delay the onset of anthocyanin accumulation in Shiraz and Cabernet Franc cultivars. The rate of accumulation of total soluble solids and colour components was not changed but a delay in onset of anthocyanin production could have consequences for colour/alcohol balance. Adaptation strategies to promote the onset or rate of colour accumulation such as water deficit established shortly before veraison could partially restore the balance (Sadras et al. 2012b).

Project aims

This AWRI project *Building resilience and sustainability in the grape and wine sector* aims to collate and deliver up-to-date technical information about greenhouse gas emissions, carbon sequestration and opportunities that the Emissions Reduction Fund can provide. Project extension officers will offer grapegrowers and winemakers support to reduce their emissions and consider the opportunities to benefit financially from participation in the Emissions Reduction Fund.

Acknowledgement

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Reference and further reading

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