The Australian Wine Research Institute

Fact Sheet

VITICULTURE

Managing greenhouse gas emissions in viticulture

Background

The world's grapegrowing regions are getting warmer, increasing by 1.26°C in the past 250 years (Jones et al. 2005). This warming trend is associated with increases in the concentrations of GHGs in the earth's atmosphere. The impacts of a warmer and drier climate on viticulture have been the subject of much recent research and include earlier budburst, shorter winters, compressed vintages and more frequent extreme weather events such as frosts, heatwaves and bushfires. Strategies are being investigated to help grapegrowers adjust to a changing environment (Webb et al. 2012, Bonada et al. 2013, Sadras et al. 2012). 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.

How can viticulture contribute to reducing greenhouse gas emissions?

Agricultural and forestry producers, which include viticulture, account for approximately 21% of the GHG emissions generated in Australia (National Inventory Report 2012, Volume 1). While the biggest contribution to these emissions comes from livestock production, the wine-grape sector can still play a part in emissions reduction.

The Australian Government, through the Emissions Reduction Fund (ERF) provides incentives for farmers and land managers to earn carbon credits by sequestering carbon or reducing greenhouse gas emissions on the land. Under the ERF, emissions reductions will be purchased by the Government in a reverse auction (at the lowest accepted cost) to ensure that the best value is obtained. The Australian Government is working with businesses to develop appropriate methods to calculate genuine reductions. Eligible activities will have to be approved by the government and must be new projects, implementing activities that are not business as usual or enforced by law, nor have been paid for under another program.

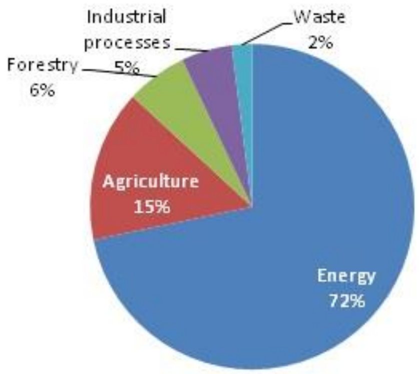

Figure 1. Australia's net greenhouse gas emissions (carbon dioxide equivalents, CO2-e) by sector in 2012 (National Inventory Report 2012, Volume 1)

Under the ERF, farmers and landholders are able to earn carbon credits (as Australian Carbon Credit Units or ACCUs) provided that they are using an approved emission reduction or carbon sequestration method. The only currently approved methods that the grape sector can use to earn ACCUs are through activities that sequester carbon. These include projects that protect native forests or regenerate native forest land by permanent environmental plantings of native tree species. Landholders may benefit from planting trees to minimise erosion, reduce salinity or establish a windbreak and at the same time potentially boost their income by generating and selling ACCUs under the ERF. Sequestration methods have a 25-year permanence requirement so must be considered in this time frame. Potential ERF participants should consider the financial benefit of generating ACCUs alongside the costs of participation and the potential for co-benefits such as natural resource management or agricultural productivity gains.

Audits of vineyard businesses have shown that the greatest proportion of emissions comes from fuel and electricity use. Opportunities for both reducing emissions and saving money in those areas should be explored. Reduced fuel consumption has been reported through eliminating one or two tractor passes per year by grazing sheep in the vineyard during winter (McGourty 2012). The use of precision viticulture technologies and pest and disease monitoring can also reduce tractor passes and, in some vineyards, fuel savings have been achieved using multi-row spray equipment. Managers can audit their vineyard's fuel and electricity use and greenhouse gas emissions using the Australian Wine Carbon Calculator (available from the AWRI website at http://www.awri.com.au/industry_support/entwine/carbon-calculator/).

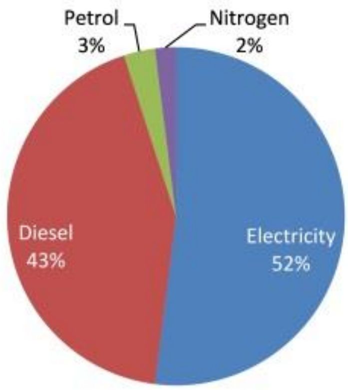

Figure 2. Greenhouse gas emissions from viticulture (CO2-e) in Australia (personal communication, Winemakers' Federation of Australia 2013)

Even without the possible carbon credits to be earned, there are benefits to landholders who are able to add carbon to soil and/or carefully manage fertiliser inputs. The potential for reducing GHGs in these areas is explored below, with some of the material presented adapted from factsheets produced by Dr Jeff Baldock, CSIRO Land and Water.

Managing soil carbon in a vineyard

Soil organic carbon is the carbon stored within soil. It is part of soil organic matter which includes other important elements essential for plant growth and soil health. Soil organic matter plays a role in the biological, chemical and physical properties of soil and importantly provides the soil with resilience. The amount of carbon in a soil depends on many factors such as rainfall, temperature, vegetation and soil type. While some of these factors are fixed characteristics or are determined by climate, others can be influenced by management practices. Practices that result in carbon losses from soil are those that reduce carbon inputs or increase the decomposition of soil organic matter. In viticulture these include leaving the ground bare (fallowing), cultivation or overgrazing. Practices that return plant residues to the soil include fertiliser application, irrigation and the planting of cover crops. The application of organic materials such as manure, plant debris and composts is a direct way to improve soil carbon levels in vineyards but it is important to note that often decades of constant management are required to make a significant difference.

Fertiliser management

Nitrous oxide (N_2O) is a greenhouse gas that has a global warming potential about 300 times greater than carbon dioxide. It is formed in soils via biochemical reactions, in a process known as nitrification.

The greatest emissions of N_2O result from:

- Nitrates applied to the soil from nitrogen fertilisers that are excess to the plants requirements, this includes application that is at the wrong time, in the wrong place or in an inefficient manner. For example, applying nitrogen in excessively wet periods significantly increases the release of N_2O into the atmosphere.
- Anaerobic soil conditions such as waterlogged or compacted soils. When soil is in this condition nitrogen is lost to the atmosphere as N_2O and is not available to the vine.

N_2O emissions are an indication of wasted nitrogen fertiliser and reducing these emissions can improve economic and production efficiency. The viticulture sector can influence N_2O emissions by managing moisture levels and nitrogen supply in soil. A visual examination of vine growth is a useful way to evaluate a vine's nitrogen status, and analysis of yeast assimilable nitrogen in fruit at harvest can also indicate whether or not the nitrogen needs of the vine are being met. If nitrogen is required, the times of peak nitrogen uptake in a vineyard are at flowering and before veraison so just before these times is most effective for applying nitrogen. Nitrogen fertiliser should not be applied too far ahead of when it is needed and not before a forecast heavy rainfall event. Nitrogen should be applied to the rootzone and, where runoff occurs, it is better that a cover crop is present to recover lost nutrient. Vegetation or yield mapping of the vineyard can be used to identify areas of low and high nitrogen demand and fertiliser application rate should be adjusted accordingly.

Products that can inhibit the reactions that form N_2O in soils and therefore reduce emissions have been developed. Research is currently underway in horticultural crops to investigate how effective these products are in reducing N_2O emissions and increasing nitrogen use efficiency.

Conclusion

The wine-grape sector in Australia is significantly affected by changes in climate brought about by GHGs in the atmosphere and therefore has a role to play in implementing actions that reduce GHG emissions. These actions may be rewarded through government incentives, but even without them, there is a responsibility to seek out and implement practices that reduce greenhouse gas emissions to contribute to long-term industry sustainability. Other than the planting of trees on otherwise unproductive land, the biggest opportunities for grapegrowers are in improvements in fuel and electricity use as well as soil and fertiliser management. For more information about greenhouse gas emissions in the grape and wine industry, visit http://www.awri.com.au/industry_support/climate-environment/new_climate/.

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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References and further reading

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