Managing the impact of smoke taint in the Australian wine industry

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A collaborative project is under way aimed at developing cost-effective risk assessment, remediation and diagnostic tools for smoke-affected grapes and wine and enabling industry to access tools and other information to make informed decisions when there is a fire or smoke threat.

INTRODUCTION

When grapes are exposed to smoke from bushfires and planned burns during the growing season, it can result in a negative impact on grape and wine quality, commonly known as 'smoke taint' (Whiting and Krstic 2007). In Australia, it has been estimated that since 2003, approximately $400 million worth of grapes has been lost or downgraded due to smoke taint (Krstic *et al.* 2015). Previous research has demonstrated that grapes primarily become smoke tainted via passive diffusion of smoke compounds through the berry cuticle and epidermis (Krstic *et al.* 2015). The Australian Wine Research Institute (AWRI), Agriculture Victoria, La Trobe University and Wine Victoria are collaborating on a project funded by Wine Australia, the AWRI and the Australian Government Department of Agriculture and Water Resources (DAWR) as part of its Rural R&D for Profit program. The primary goal of the project is to develop cost-effective risk assessment, remediation and diagnostic tools for smoke-affected grapes and wine, and to ensure that industry has access to tools and other information to make informed decisions when there is a fire or smoke threat. This article provides an update on progress in this project.

BACKGROUND

Smoke contains thousands of different compounds; however, the key compounds that influence taint in grapes and wine have been shown to be volatile phenols such as guaiacol, 4 methyl-guaiacol, cresols, syringol and methyl-syringol (Krstic *et al.* 2015). Once these volatile phenols enter the grapes, they can be bound to different sugar molecules to form non-volatile glycosides. The glycosides represent 'stored' smoky flavours that can be released into the wine over time. To date, it has been these glycoside compounds that have been most difficult to remove from smoke-affected juice or wine. While volatile phenols in smoke-affected wine contribute negative sensory characteristics, the in-mouth release of phenols from their associated glycosides has been shown to contribute to 'an excessively drying back-palate and retro-nasal ash character' making the wine unpleasant to consume (Krstic *et al.* 2015). The intensity of the smoke taint sensory characteristics in wine appears to be related to the timing and the duration of the grapes being exposed to smoke (Kennison *et al.* 2009). It is important that the Australian wine industry manages the risks associated with fire and smoke to maintain fruit and wine quality and protect its reputation.

DEVELOPING AN EARLY WARNING SYSTEM FOR SMOKE EXPOSURE IN VINEYARDS

Agriculture Victoria and La Trobe University are evaluating a range of atmospheric monitoring tools designed to monitor both particulate matter in

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and chemical composition of smoke and relate this to levels of compounds in grapes and wine. The project aims to determine when smoke taint compounds (volatile phenols) are present in smoke and the levels and duration of exposure that would be of concern to wine producers. The team has set up a network of smoke detectors across Victoria that monitor smoke levels continuously all year round. The data collected will be used to develop models to assess the risk of smoke taint in wine. Smoke detector data is being compared with actual levels of smoke taint compounds measured by other methods to assess whether levels of particulate matter in smoke can be used as a predictor of smoke taint, or if there are other better predictive measurements. It is hoped that this work will lead to a practical tool where growers will be notified of potential smoke taint risk in their vineyard via a remote early warning network.

UNDERSTANDING BACKGROUND LEVELS OF SMOKE TAINT COMPOUNDS IN NON-SMOKE EXPOSED GRAPES

Volatile phenols and their glycosides are present in grapes, even when they have not been exposed to smoke during the growing season. Therefore, to successfully diagnose smoke-affected grapes or wine it is important to understand these natural background levels and how they vary across popular Australian grape varieties. Since 2010 the AWRI has been developing a database of baseline levels of volatile phenols and their associated glycosides in non-smoke exposed grapes of major Australian varieties, which is used when assessing analytical results from potentially affected grape and wine samples. During the 2017 vintage additional grape varieties were added to the database including: Sauvignon Blanc, Pinot Gris, Semillon, Merlot, Grenache, Mataro and Sangiovese.

These vines were more than just smoke-affected.

DETERMINING SENSORY THRESHOLDS OF SMOKE TAINT IN WINE

Sensory studies are being conducted using dilution techniques to determine sensory threshold levels of volatile phenols and their glycosides in wines, and to assess the effectiveness of dilution or blending as a management technique in wineries. Sensory analysis of diluted or blended juices and wines will be conducted to assess the impact of reducing the concentrations of key volatile phenols and their associated glycosides.

ASSESSING OPTIONS TO PREVENT OR LIMIT SMOKE TAINT COMPOUNDS GETTING INTO GRAPES

The AWRI, La Trobe University and Agriculture Victoria are conducting experiments to see if commercially available horticultural sprays applied to grapes prior to smoke exposure could be used to limit the uptake of volatile phenols. More than a dozen products with different modes of action have been tested in a model system, including oil/hydrophobic sprays, pest control products, sunscreen protectants and other solid materials that may provide a physical barrier. Most treatments provided little if any protection and, in fact, often resulted in higher levels of free phenols and their glycosides in the grapes. The highest levels were seen with the more oily/hydrophobic materials. While further products will be assessed, these results suggest that at best only limited protection is likely to be achievable from applying preventative treatments to vineyards ahead of an anticipated smoke event. This highlights the need for more research into smoke taint remediation options in the winery.

REMEDIATION STRATEGIES FOR MANAGING SMOKE-AFFECTED FRUIT AND WINES IN THE WINERY

The AWRI is currently investigating a range of enzymes and fining agents as options for treating smoke-tainted fruit, juice and wine to remove or reduce the taint. It is hoped that this work will lead to treatments that offer improved selectivity in removing smoke taint volatile phenols and their glycosides, without removing

KEY WEBSITES THAT CAN HELP GROWERS ACROSS DIFFERENT STATES STAY INFORMED ABOUT FIRES:

Victoria

Victorian Government's Forest Fire Management website: https://www.ffm.vic.gov.au/

Victoria Emergency website: http://emergencyvic.info/

Country Fire Authority website: http://www.cfa.vic.gov.au/contact/

New South Wales

New South Wales Rural Fire Service website: https://www.rfs.nsw.gov.au/

South Australia

SA Government's Fire Management webpage: http://www.environment.sa.gov.au/topics/fire-management

South Australian Country Fire Service website: https://www.cfs.sa.gov.au/site/home.jsp

Tasmania

Tasmanian Government's Fire Management website: http://www.fire.tas.gov.au

Western Australia

WA Government's Parks and Wildlife Service prescribed burn webpage: https://www.dpaw.wa.gov.au/management/fire/prescribed-burning

WA Government's Fire and Emergency Services website: https://www.dfes.wa.gov.au

components that contribute to positive wine characters.

STAYING INFORMED ABOUT PLANNED BURNS

Following the Black Saturday Bushfire Royal Commission, the Victorian Government introduced a planned burn management strategy to reduce fuel load and bushfire risk on public land across Victoria. In that state, there is now a free opt-in Planned Burn Notification System that notifies users about planned burns on public land. Interested parties can register through the Department of Environment, Land, Water and Planning Forest Fire Management website https://www.ffm.vic.gov.au/ to receive notifications regarding planned burns in an area or areas of interest. At this stage the notification system does not include the Country Fire Authority's (CFA) burns; however, work is under way to develop a system that includes both departments' planned burn notifications. Other states provide a range of information about fire management and planned burns through the websites listed in this article.

LEARNING FROM INDUSTRY EXPERIENCE

The project team is interested to hear from winemakers and grapegrowers about their past experiences in dealing with smoke tainted juice and wine. The AWRI is also seeking samples of smoke-affected grapes and wines (from past vintages or 2018) for use in winery mitigation experiments. Please contact Julie Culbert (Julie.Culbert@awri.com.au or 08 8313 6600) if you are able to help.

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