Technical notes

Analysing spray diaries to understand powdery mildew control in Australian viticulture

Powdery mildew (*Erysiphe necator*) is one of the most economically important diseases of viticulture both in Australia (Scholefield and Morison 2010) and world-wide (Pearson and Gadoury 1992). Susceptibility varies across grape varieties; however, the fungus is able to infect all green tissues and can cause severe damage to leaves and berries (Doster and Schnathorst 1985). Powdery mildew is favoured by humid weather, but rainfall is not needed for its development. The optimum conditions are temperatures between 20 and 30°C and relative humidity above 45% (Delp 1954). In seasons with favourable weather conditions or when limited control measures are implemented, the disease can be severe on susceptible varieties and result in yield reduction and loss of fruit quality (Halleen and Holz 2001). Less than 5% disease coverage can result in off flavours in wine (Stummer et al. 2005). In Australia, since the 1980s, growers have been advised to manage powdery mildew using a fixed-interval foliar fungicide program, with a focus on early season management to control inoculum loads while they are small (Emmett et al. 1997a,b). A typical recommended program calls for fungicide applications to be made at two, four and six weeks after bud burst, followed by further applications if monitoring picks up powdery mildew on vines or weather conditions are conducive for disease development.

A wide range of active ingredients is available for the control of powdery mildew in Australia (Essling and Lord 2018). Considerable information has been derived from efficacy trials, both as part of the fungicide registration process and with an aim of refining fungicide programs. Besides the expectations of efficacy, growers also choose fungicides based on their cost, availability, ability to treat additional pests or diseases, compatibility for tank mixing with other active ingredients and concerns about phytotoxic effects. While optimum control strategies have been developed and the suitability of a range of active ingredients assessed, very little information has been available about which products are applied and how they are used by grapegrowers in real world situations. This gap has been addressed by an AWRI study that has sourced anonymised Australian spray diary data for analysis and interpretation, as part of its broader project on agrochemicals in Australian viticulture.

Analysing spray diaries

Spray diaries are used to record on a block level the plant protection products applied in viticulture, as well as the weather conditions, date and growth stage of the vines when the sprays are applied. This information is typically recorded electronically, with growers using online software to enter data. Grape buyers review the collated spray records for each block prior to harvest to confirm that the label requirements for the chemicals used and any other company-specific conditions have been met.

This article presents spray diary data sourced from AgSmart, provider of the spray diary software (GrapeWeb) most commonly used by Australian wine-grape growers and covering more than 50% of Australian wine-grape plantings (AgSmart 2018). The data sourced covers most Australian regions for the 2012 to 2018 seasons and was assessed on the basis of the number of applications made per block. The data set was analysed to investigate the fungicide programs applied to the seven most commonly planted grape varieties in Australia: Cabernet Sauvignon, Chardonnay, Merlot, Sauvignon Blanc, Shiraz, Pinot Noir and Semillon. The average number of fungicide applications varied significantly among the varieties (Figure 1).

Chardonnay, Pinot Noir and Sauvignon Blanc received more fungicide applications compared to the other varieties, while Semillon, Shiraz and Cabernet Sauvignon received fewer applications (Figure 1). Differences in susceptibility to powdery mildew between varieties were described by Wicks et al. (1993) following the very challenging 1992 vintage. That study found that powdery mildew infection was not seen on Cabernet Sauvignon and Merlot, was very light on Pinot Gris, light on Semillon and one Shiraz plot, moderate on the second Shiraz plot and Sauvignon Blanc, severe on Pinot Noir and very severe on Chardonnay. These observations align quite well with the average number of fungicide applications per season in the data set reported here for 2012–2018; however, the difference in the fungicide

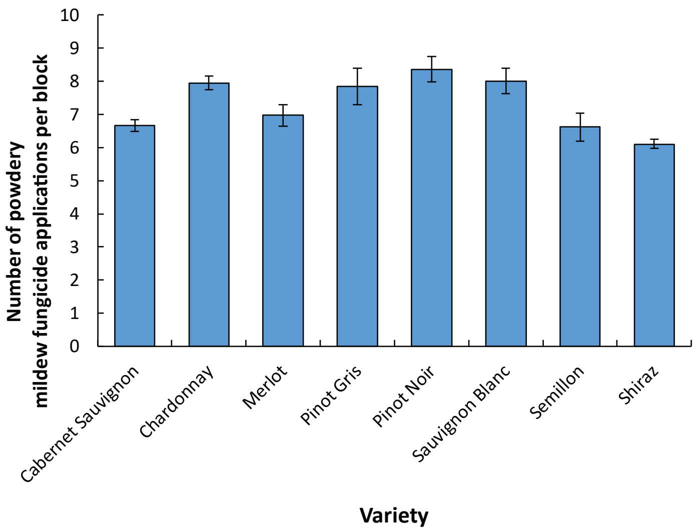

Figure 1. The average number of fungicides targeting powdery mildew applied per vineyard block across Australia for the seven seasons 2012-2018, broken down by grape variety. Error bars are 5% Fischer's LSDs.

programs between varieties was relatively small (approximately 1.5 applications per season). Given that powdery mildew infections in Cabernet Sauvignon and Shiraz are rare, there may further opportunities to tailor fungicide programs to specific varieties.

Timing of fungicide applications

The timing of fungicide applications is critical for the effective control of powdery mildew. The data set was grouped into eight development stages based on Coombe (1995) so that the average number of fungicide applications made at each stage could be calculated. The developmental stages were pre-budburst (< EL4); leaf separation (EL7-EL12); shoot growth (EL13-EL18); flowering (EL19-EL27); early berry growth (EL29-EL32); late berry growth (EL33-EL34); ripening (EL35-EL39) and post-harvest (> EL41). Most fungicide applications were made during the flowering period (23%), with approximately equal numbers of fungicides applied in the periods before and after flowering (Figure 2).

The Australian recommendations for powdery mildew management focus on three fungicide applications prior to flowering (nominally at 2, 4, and 6 weeks post-budburst) to reduce inoculum and prevent the development of an epidemic (Emmett et al. 1997a,b). Analysis of spray diaries suggests that, on average, this recommendation is not being followed by growers (Figure 2) as the number of fungicides applied was evenly split either side of flowering. This presents an opportunity to improve powdery mildew management if growers can be encouraged to follow the recommended spray timings.

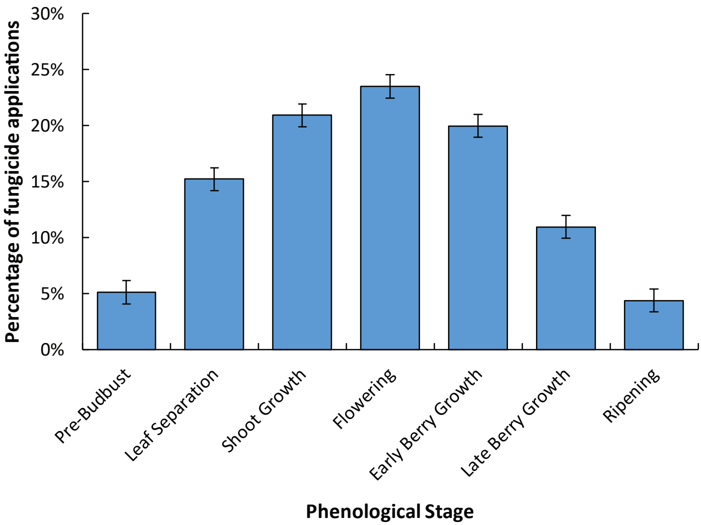

Figure 2. The phenological stage when fungicides targeting powdery mildew were applied across Australia for the seven seasons 2012-2018. Error bars are 5% Fischer's LSDs.

Evapotranspiration as a possible warning measure?

Powdery mildew 'pressure' can vary with weather conditions, between growing regions and between seasons. Evapotranspiration is a measure of the water transferred from the land to the atmosphere, and is calculated based on solar radiation, wind, humidity and temperature. It is commonly used as an aid to irrigation scheduling. Moyer et al. (2016) has suggested that powdery mildew epidemics may also be predicted from evapotranspiration, as the same environmental parameters also influence its growth. The sum of the evapotranspiration for October and November calculated from weather stations located in three regions (Barossa Valley, Langhorne Creek and Coonawarra) and across seven seasons was compared to the number of fungicide applications made (Figure 3).

A very strong inverse relationship ($r^2 = 0.81$) can be seen between the evapotranspiration and the number of fungicide applications made during this period. Calls to the AWRI helpdesk suggest that growers often do not become aware of powdery mildew epidemics until January, when control is very difficult, even when conditions have been conducive to disease development earlier in the growing season. The strong relationship between evapotranspiration and the number of sprays applied suggests that evapotranspiration could be used as a warning measure to alert growers when disease pressure is higher than usual, allowing their disease scouting or spray programs to be modified accordingly. Further analysis is needed to determine if this relationship is consistent across other regions.

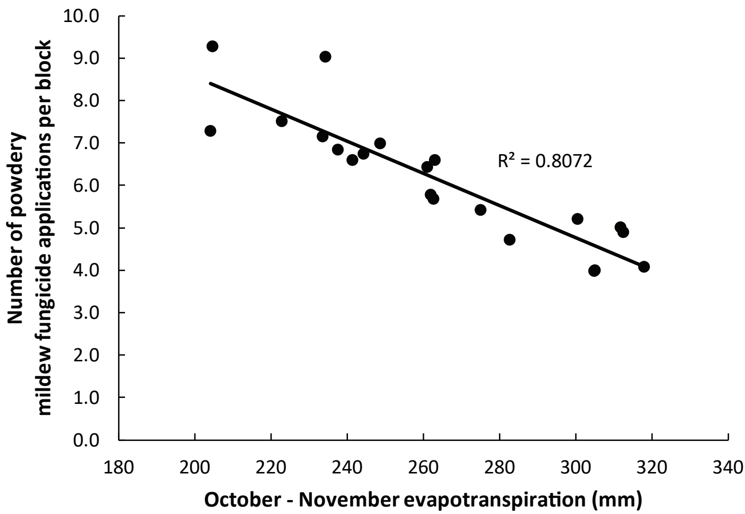

Figure 3. The relationship between the cumulative evapotranspiration during October and November and the number of fungicides applied targeting powdery mildew in the Barossa Valley, Langhorne Creek and Coonawarra for the seven seasons 2012-2018.

A useful resource

The spray diary data sourced by the AWRI as part of its agrochemicals project has proved to be a useful resource in understanding how agrochemicals are used in practice in Australian viticulture. Region-specific information sourced from this data set has been presented at roadshow workshops and seminars across Australian wine regions, to help growers and winemakers understand agrochemical use in their regions. There is also potential for the data set to be used in the design of future research and extension activities.

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