LATE LEAF REMOVAL DOES NOT CONSISTENTLY DELAY RIPENINGIN SEMILLON IN AUSTRALIA

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Abstract:

Context and purpose of the study - An advancement of grapevine phenological development has been observed worldwide in the last two decades. In South Australia this phenomenon is even more accentuated since grapevine is often grown in a hot climate. The main consequences are earlier harvests at higher sugar levels which also result in more alcoholic wines. These are deemed undesirable for the Australian wine industry with consumer preferences shifting towards lower alcohol wines. Vineyard practices can be implemented to control and delay ripening. Amongst them, apical late leaf removal has been successfully applied in Europe to delay ripening by up to two weeks in Sangiovese, Aglianico and Riesling. In those studies, no negative effects were observed on grape colour, phenolics and on the carbohydrate storage capacity of the vines. To date, this technique has not been studied in Australia. In this study late leaf removal, apical to the bunch zone was applied to the variety Semillon for four seasons and compared to an untreated control.

Material and methods - The study was carried out for four consecutive seasons starting in 2015 in the variety Semillon at the Waite Campus, University of Adelaide, Australia. Yield, yield components and berry chemistry (total soluble solids, titratable acidity, pH and total phenolics) were all assessed during the study.

Results - Results showed that despite the removal of up to 30% of the vine's canopy, the technique was effective in delaying ripening only in one of the four seasons. No differences were observed in yield components and berry and wine chemistry between the treated and untreated vines. These results suggest that the technique might not be a feasible strategy to delay ripening in Semillon grown in a hot climate in Australia.

Keywords: Leaf removal, delayed ripening, canopy management, leaf area, Semillon

1. Introduction

Decisions on harvest date for quality grape production are a based on the balance between technological ripeness (sugars and acids), phenolic maturity (quantity and quality of tannins and pigments) and aromatic ripeness (Poni et al. 2017).

Environmental challenges such as high temperature, CO_2 concentration and solar radiation have an impact on the grapevine ripening process (Duchene and Schneider 2005, Jones et al. 2005). In South

Australia, a warmer climate and a decrease in soil water availability advanced the process (Webb et al., 2012). Grapes are not only ripening earlier and quicker but also vintages are becoming more compressed with traditionally late varieties ripening at the same time as the early ones. This trend towards overly fast ripening has also been linked to a decoupling between sugar accumulation and phenolic and flavour maturity (Sadras and Moran 2012). Moreover, the compression of harvest causes winery logistical issues around crushing capacity and winery storage. Lastly, while harvest is being carried out at higher sugar levels and potential wine alcohol, consumers preferences are shifting towards lighter style wines with lower alcohol content (Saliba et al., 2013).

Due to all these reasons, recent research has focused on identifying and trialling vineyard management strategies able to delay ripening and/or mitigate the negative impacts of early harvests (Palliotti et al. 2013). Techniques such as: greater crop load, shoot trimming, late season vine growth, artificial shading, antitranspirants and growth regulators have all been trialled with mixed results (Caccavello et al., 2017). Defoliation of shoots apical to the bunches has shown promising results for delaying grape TSS accumulation without having a negative impact on colour or phenolic development (Poni et al. 2017). Moreover, according to Palliotti et al. (2013), this method did not affect the replenishment of root carbohydrates. This practice is carried out at veraison by plucking 30–35% of the leaves from the middle third of the canopy to create a 50 cm window. A few leaves at the apex of each shoot, as well as a few leaves immediately above the bunches are retained thus reducing leaf photosynthetic area while maintaining canopy shade around the fruit zone (Palliotti et al. 2013). In a 2009 study on Riesling the technique caused a ripening delay of 14 days compared to non-defoliated vines without having an effect on TA or pH (Stoll et al. 2010). Similar results were obtained in a two-year study on Sangiovese, where leaf removal delayed sugar accumulation by two weeks while having no effect on the accumulation of anthocyanins and phenolics or the replenishment of reserves in canes and roots (Palliotti et al. 2013). Lanari et al. (2013) and Poni et al. (2013) reported a delay of technological ripeness without affecting colour and phenolics on Sangiovese and Montepulciano.

In this study post veraison leaf removal was investigated as a tool for delaying ripening through a reduction of the photosynthetically active canopy. Leaf removal was applied for four consecutive seasons to the variety Semillon grown in the hot climate of Adelaide (Hall et al., 2010), Australia. Yield components and grape chemistry were assessed during the four years.

2. Materials and methods

From 2014 to 2018 Semillon vines in the vineyard of The University of Adelaide at the Waite Campus, were used for the trial. The vineyard was established in 1990, vines are own rooted, trained to a bilateral spur pruned cordon with vertically positioned shoots. The row and vine spacings are 3 m by 1.8 m and the climate at the vineyard site is classified as "hot" (Hall and Jones, 2010).

A fully randomised block design was used for the experimental trial. Three panels of three vines for both the control (C) and the late leaf removal (LLR) treatments were allocated in three rows. A total of 27 vines were assigned to each treatment.

The LLR was carried out according to Poni et al. (2013) by removing the middle third of the canopy at veraison (12 Brix). The canopy at the bunch zone and the shoot tips remained untouched.

On the middle vine of each panel, canopy architecture was measured using the VitiCanopy App (De Bei et al., 2016) before and after the LLR was applied. At harvest, yield, bunch number, bunch weight and berry weight were measured. On a sample of 100 berries, total soluble solids (TSS), pH and titratable acidity were assessed (BRX-242 Erma Inc. Tokyo, Japan and autotitrator Crison instruments Barcelona, Spain). Total phenolics were also measured according to Iland et al. (2004).

All data was analysed using the XLSTAT software (Addinsoft SARL, Paris, France).

3. Results and discussion

Seasonal differences in canopy size were observed, with values of LAI ranging from 2.18 to 1.5 in the four years. LLR reduced these values by 23%, 20%, 21% and 29% in 2015, 2016, 2017 and 2018 respectively. Previous studies reported reductions in total leaf area per plant of about 30% (Poni et al. 2013, Palliotti at al. 2013, Caccavello et al. 2017) in response to the leaf removal treatment. Moreover, previous studies all measured the total leaf area per plant. Unlike those, this study measured LAI through cover photography and the VitiCanopy App (De Bei et al., 2016). The cover photography method does not distinguish between leaves and other plant material (cordon, shoots and bunches) and as such, the results obtained are most often refer to as Plant Area Index (PAI). In this case, thick cordons, typical of well-established vines, and shoots contributed in equal measure to both the measurements conducted before and after LLR. This is most likely the reason why the calculated reductions are lower than in previous studies, but nonetheless significant.

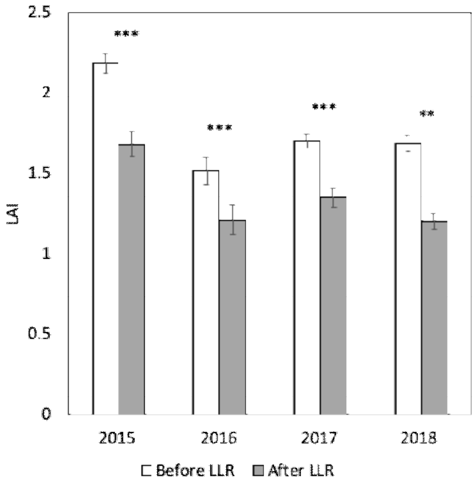

Figure 1: Effect of the leaf removal (LLR) treatment on the vines leaf area index (LAI) before (white) and after (grey) treatment. Means were separated by T-Test **, *** indicate significance at P<0.01 and 0.001 respectively.

The decision to harvest was based on TSS accumulation with a target of 21 Brix. Only in 2016, out of the four seasons, the LLR had an effect in delaying ripening; C was harvested on day of the year (DOY) 21 while LLR on DOY 29, results in agreement with previous studies (Poni et al., 2013; Palliotti et al., 2013). In the three other seasons both treatments were harvested at the same time, on DOY 42, 61 and 29 in 2015, 2017 and 2018 respectively. These results agree with those from Zhang et al. (2017) who also showed no effect of the treatment in delaying ripening.

Despite the differences in canopy size, no significant differences in yield components were observed between treatments (Figure 2A), results are consistent with previous studies (Palliotti et al., 2013; Poni et al., 2013; Filippetti et al., 2015). Caccavello et al. (2017) obtained smaller berries in defoliated vines in the variety Aglianico. Also in agreement with previous studies, no differences were observed in TA, pH and total phenolics (Figure 2B) (Palliotti et al., 2013; Caccavello et al., 2017).

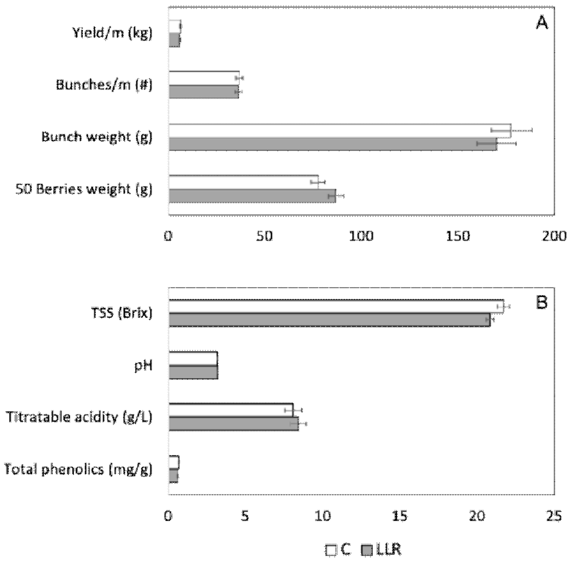

Figure 2: Effect of the leaf removal treatment on yield and yield components (A) and berry chemistry at harvest (B) of Semillon. LLR= late leaf removal, C= control. All results were not significant at $P<0.05$ as assessed by T-Test.

Conclusions

To the best of our knowledge, this study has been the first investigation on the effect of late leaf removal as a practice to delay ripening in a hot climate in Australia. Other studies have demonstrated that post veraison leaf removal slows down sugar accumulation and effectively delays ripening without affecting other berry chemistry parameters. Our results did not show a decrease in the rate of grape sugar accumulation and hence a delay in ripening as a result of the defoliation technique. This is despite the fact that the treatments had a significant impact on the canopy architecture. We hypothesise that the lack of effect may be related to the site characteristics and in particular to the non-light-limiting environment. In regard to the economics of the use of this treatment by growers, the results of this study do not support its use at this time.

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