Investigating the consequences of trimming and crop removal on soluble solids and titratable acidity for Sauvignon Blanc and Pinot Noir

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Trimming vines and removing crop can help regulate yield, vegetative growth and vigour but does it alter the development of berry components during ripening? A New Zealand study has improved our understanding of when and how to manipulate the leaf area to fruit mass ratio to influence target berry composition.

INTRODUCTION

Trimming vines and crop removal are vineyard management practices grapegrowers use to manage yield, control vegetative growth and vigour. However, these techniques may impact on berry composition at harvest. Trimming and crop removal alter the source-sink balance of the vine: trimming removes leaves, reduces the source of photosynthates needed for berry ripening, while removing crop reduces the sink demand for photosynthates and other assimilates.

Grape composition at harvest is a result of an accumulation or decrease in berry components throughout the ripening phase. It is important, therefore, to understand how trimming and crop removal alter the development of berry ripening. The time of trimming or crop removal may also influence the outcome. For example, lower total soluble solids (TSS) at harvest may be due to a slower rate of TSS accumulation, a delay in the start of ripening or both. Would trimming at veraison have the same effect and are other components such as titratable acidity also altered in the berry?

Our recent studies aimed to address these questions by investigating the influence of trimming vines to reduce the leaf area and/or removing crop to reduce the fruit weight, which altered the leaf-area-to-fruit-mass (LA:FM) ratio for Pinot Noir and Sauvignon Blanc (Parker *et al.* 2014, 2015). We modified the LA:FM ratio on four-cane vertically shoot positioned vines pruned to 12 nodes per cane by 1) trimming to either 12 or six main leaves per shoot (all laterals were removed at the time of treatment and new lateral growth was removed regularly up until harvest), and 2) in combination with the trim treatments, vines had either no, 50% or 75% crop removed. The treatments were applied either at fruitset (when berries were approximately pea-size) or at veraison and the trial was carried out over two seasons, 2009-10 and 2010-11. New vines were used each season. Total soluble solids (TSS, °Brix), titratable acidity (TA, measured as g/L tartaric acid equivalents), pH and berry weight were measured from veraison up until harvest to evaluate the impact of trimming and crop removal on the change in berry components during ripening.

Sauvignon Blanc vines trimmed to 12 leaves at fruitset with no crop removed (left). Sauvignon Blanc vines trimmed to six leaves at fruitset and with no crop removed (right). Black square indicates scale (10cmx10cm)

WHAT HAPPENS TO TOTAL SOLUBLE SOLIDS (TSS) WHEN VINES ARE TRIMMED AT FRUITSET OR AT VERAISON?

Trimming fully cropped vines to six leaves at fruitset delayed veraison by up to one week (estimated here in Figure 1 (see page 41), by 8°Brix but also confirmed by colour and softness measurements) when compared with other treatments and slowed rates of TSS accumulation. Pinot Noir vines trimmed to six main leaves per shoot and with full crop only reached 16.8 and 17.7°Brix at harvest in 2009-10 and 2010-11 seasons, respectively. Sauvignon Blanc vines reached 16.8 and 15.6°Brix at harvest in 2009-10 and 2010-11 seasons, respectively. The lower Sauvignon Blanc values can be partly explained by the later date of veraison when compared with Pinot Noir. Trimming at veraison also slowed TSS accumulation, but because veraison was not delayed, the differences generated by trimming were not as pronounced as they were when applied at fruitset. For example, trimming alone (with no crop removal) at fruitset generated differences between the six main leaves per shoot at full crop with 12 leaves and full crop vines of 3.4 and 5.9°Brix for Pinot Noir and Sauvignon Blanc, respectively (2009-10), but trimming at veraison generated differences of 1.1 and 3.3°Brix (for Pinot Noir and Sauvignon Blanc, respectively, 2009-10). This indicates that the earlier trimming is applied, the more impact growers may potentially generate on harvest composition due to changing the start of the ripening period, as well as how fast TSS accumulate in the berries.

CAN CROP REMOVAL ALSO ALTER TSS ACCUMULATION?

Crop removal at fruitset of 12 leaf vines had little effect on delaying the start of the ripening period (Parker *et al.* 2014). However, when vines were trimmed to six main leaves per shoot, small advances in the day of reaching 8°Brix were measured for both varieties when crop was removed, notably in 2010-11.

Crop removal at both times altered TSS accumulation after veraison for both varieties. Initial rates of TSS accumulation were faster with crop removal at both trim heights. Crop removal in combination with 12 main leaves per shoot accelerated the initial rates of TSS, indicating that even at higher trim heights it is possible to manipulate harvest composition via crop removal. Crop removal compensated for a smaller leaf area (via trimming) when manipulated at veraison so that the effects of crop removal and trimming were equivalent at this stage.

WHAT SLOWS OR ADVANCES TSS ACCUMULATION THE MOST?

A greatly reduced leaf area (six leaves per shoot) and full crop had the biggest impact on reducing TSS accumulation. Crop removal at either fruitset or veraison accelerated rates of TSS the most, regardless of the severity of trimming (Figure 1). Pinot Noir and Sauvignon Blanc had the same yields and LA:FM at harvest when no crop was removed (Parker *et al.* 2013, 2014). Consequently, rates of TSS accumulation were similar for the two varieties at each trim height and crop removal combination suggesting that the two varieties were behaving in a similar manner.

DO OTHER BERRY COMPONENTS ALSO CHANGE?

Berry weight was unaffected by crop removal but was slightly reduced with trimming to six leaves per shoot (data not shown). However, this did not scale up to any effect on yield at harvest. Furthermore, TSS content (mg TSS/g berry) was also calculated and trends were similar to those observed for TSS concentration.

Other berry components such as TA and pH were less affected (TA shown in Figure 2, page 42). The major implication of these findings is that trimming and crop removal will, therefore, alter the TSS:TA ratio (TSS changes, TA does not change in response to trimming or crop removal). Whether this also occurs for other flavour, aroma and colour components needs to be investigated in the future. ▸

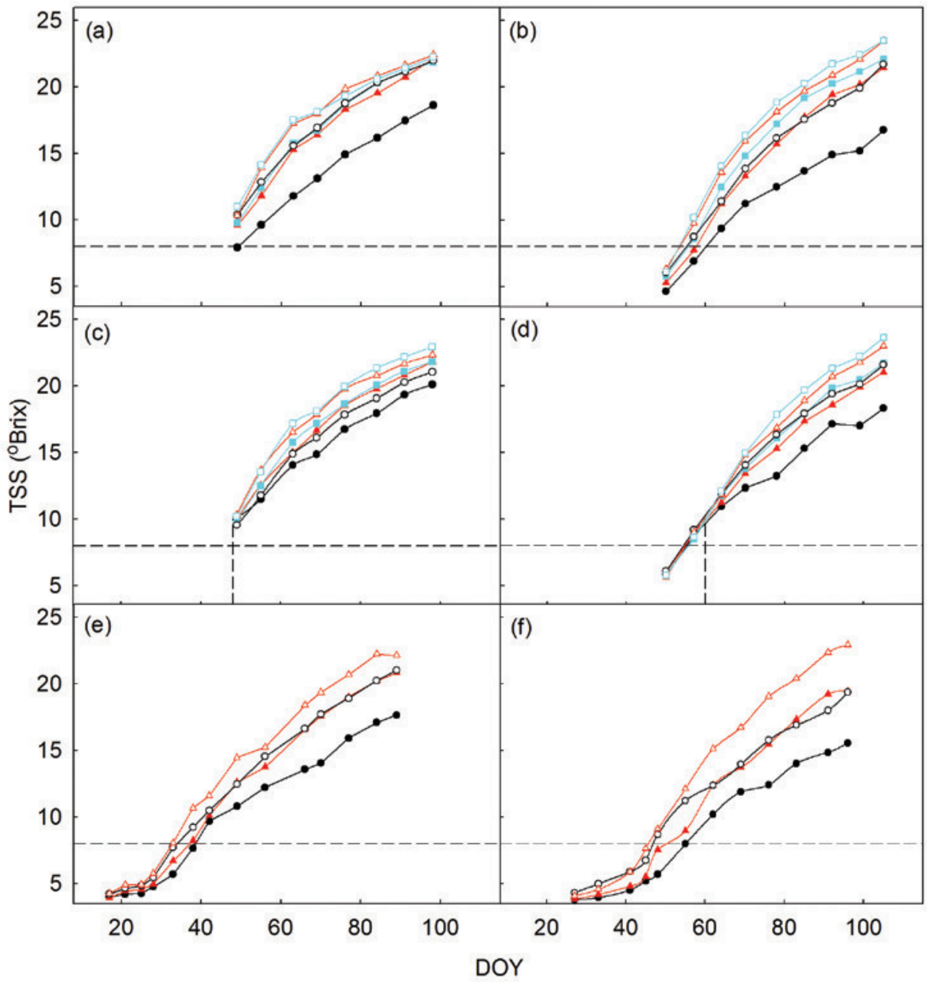

Figure 1. Effect of leaf-area-to-fruit-mass (LA:FM) ratio on total soluble solids accumulation (TSS) over time [day of the year (DOY)] in grapes for (a) Pinot Noir, LA:FM ratio altered at fruitset in 2009-10; (b) Sauvignon Blanc, LA:FM ratio altered at fruitset 2009-10; (c) Pinot Noir, LA:FM ratio altered at veraison in 2009-10; (d) Sauvignon Blanc, LA:FM ratio altered at veraison in 2009-10; (e) Pinot Noir, LA:FM ratio altered at fruitset in 2010-11; and (f) Sauvignon Blanc, LA:FM ratio altered at fruitset in 2010-11.

Treatments:
six main leaves per shoot and no crop removed (●);
six main leaves per shoot and 50% crop removed (▲);
six main leaves per shoot and 75% crop removed (■);
12 main leaves per shoot and no crop removed (o);
12 main leaves per shoot and 50% crop removed (△);
and 12 main leaves per shoot and 75% crop removed (□).
Vertical dashed lines (--) indicate the time at which the LA:FM ratio manipulation was applied at veraison and the horizontal dashed lines (--) indicate the DOY when 8°Brix was reached (based on Figure 2 in Parker *et al.* 2015).

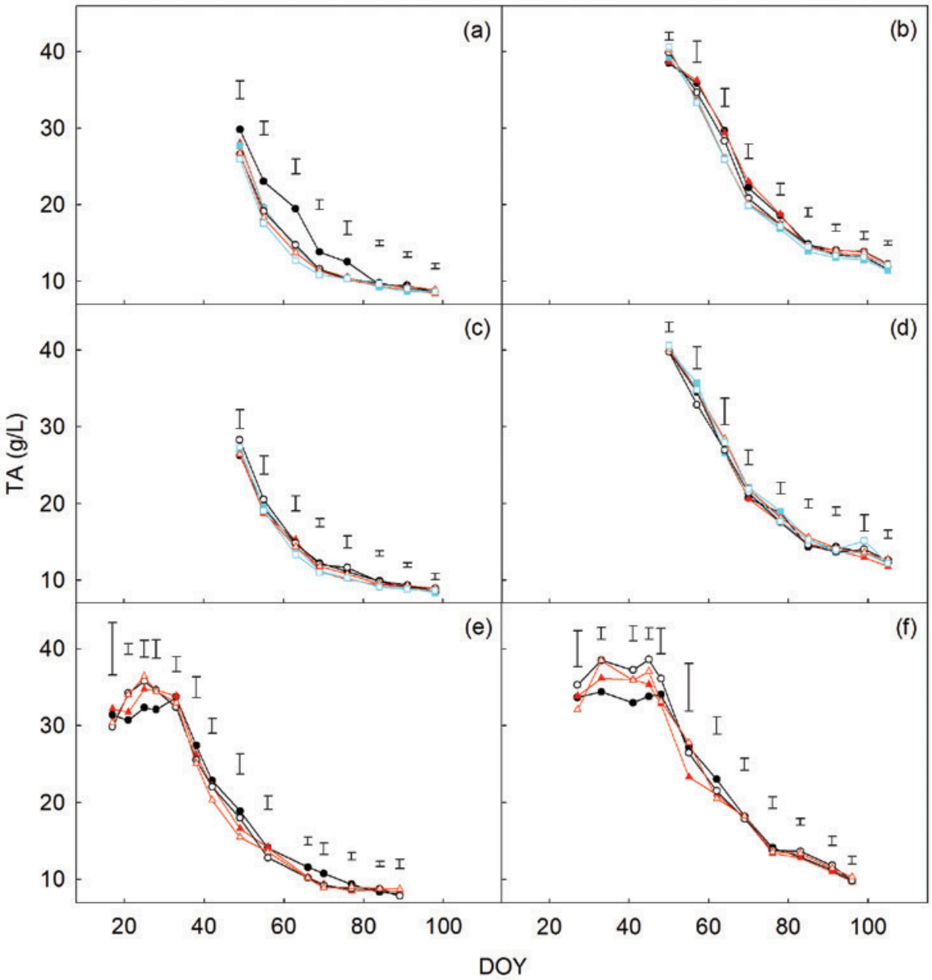

Figure 2. Effect of leaf-area-to-fruit-mass (LA:FM) ratio on grape titratable acidity (TA) over time [day of the year (DOY)] for (a) Pinot Noir, LA:FM ratio altered at fruitset in 2009-10; (b) Sauvignon Blanc, LA:FM ratio altered at fruitset 2009-10; (c) Pinot Noir, LA:FM ratio altered at veraison in 2009-10; (d) Sauvignon Blanc, LA:FM ratio altered at veraison in 2009-10; (e) Pinot Noir, LA:FM ratio altered at fruitset in 2010-11; and (f) Sauvignon Blanc, LA:FM ratio altered at fruitset in 2010-11

Treatments:
six main leaves per shoot and no crop removed (●);
six main leaves per shoot and 50% crop removed (▲);
six main leaves per shoot and 75% crop removed (■);
12 main leaves per shoot and no crop removed (O); 12 main leaves per shoot and 50% crop removed (△);
and 12 main leaves per shoot and 75% crop removed (□).
Vertical bars at each time point represent least significant differences (LSD) for Fisher's unprotected LSD (P <0.05) (based on Figure 3 in Parker *et al.* 2015).

PRACTICAL IMPLICATIONS

From this research we have gained an understanding of when and how to manipulate the LA:FM ratio of vines. Either technique may be used to manipulate target berry composition but the timing and severity will influence the outcome. Trimming at fruitset enabled us to generate the greatest differences in TSS, and crop removal at either time can accelerate TSS accumulation. Interestingly, TA and pH did not change for either management practices which indicates a lack of synchrony between these components and TSS in response to LA:FM modification. Therefore, the relative composition of berry components needs to considered if these management practices are used to slow or advance the ripening phase. The consequences on other berry components would need to considered and investigated further. It opens opportunities to generate a range of different harvest compositions as a result. Under warmer climate conditions, delaying veraison and slowing TSS accumulation could be advantageous to address logistical issues of time from potentially compressed harvests. Finally, understanding the differences generated throughout the ripening period will enable us to develop better predictive approaches around harvest composition in response to the trimming and crop removal management strategies.

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