22 Effect of severity of leaf and cluster removal on juice and wine composition of Merlot

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• Merlot is considered a problem variety in cool-climate regions such as Hawke's Bay in New Zealand, where extensive leaf removal and cluster thinning form part of the standard management in order to achieve fruit quality.

• By increasing exposure to sunlight, it is generally accepted that *leaf removal* (LR) improves color and increases anthocyanin levels in red varieties. As for *cluster thinning* (CT), there are numerous studies where this practice helped increase levels of sugar, color, aromas, and flavor in red varieties. But there are also others in which cluster thinning produced neutral, or even negative, effects on wine composition. Indices of vine balance do not always accompany these cluster thinning studies, making it difficult to glean trends across studies and draw conclusions.

• The goals of the current study were 1) to evaluate the effect of various degrees of leaf removal and cluster thinning on Merlot fruit and wine composition, and 2) to measure vine balance parameters of the various treatments in an effort to help interpret the outcomes.

• The study took place in Hawke's Bay (New Zealand) during the 2006-07 and 2007-08 seasons. The block consisted of a drip-irrigated Merlot Clone 181/3309 spaced at 1.6 x 2.4 meters, growing on sandy loam soil on gravel. The trial consisted of 4 replicates - a replicate was 5 vines – in randomized blocks, with the following LR and CT treatments combined for a total of 9 treatments (3 LR x 3 CT):

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- **No LR**
- **Moderate LR = remove 2 basal leaves**
- **Severe LR = remove all leaves up to 2 nodes above the second cluster**

X

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- **No CT (40 clusters in 2007, 45 clusters in 2008)**
- **Moderate CT = thin to 30 clusters in 2007, 31 clusters in 2008**
- **Severe CT = thin to 20 clusters in 2007, 18 clusters in 2008**

• For each of the treatments, the authors calculated *yield components*, *fruit composition*, and wine *phenolic analysis*. They also used point quadrant analysis to measure canopy density, and used a ceptometer to measure canopy light.

• Before we move on to the results, let's review the optimal values for the main canopy density parameters that define **balanced vines**:

	Optimal range
Mean cane weight (g)	*20 – 40*
Pruning weight per meter of canopy (kg/m)	*0.3 – 0.6*
Yield per pruning weight (kg/kg)	*5 – 10*
Leaf area per yield (m^2/kg)	*0.8 – 1.2*
Leaf area per meter of canopy (m^2/m)	*2 – 5*
Leaf area per canopy surface area (m^2/ m^2)	*<1.5*

Results:

• **Effect of LR on canopy density.** Both the No LR and the Moderate LR were shaded in the fruit zone, with Severe LR considerably enhancing fruit exposure to light. In agreement, photosynthetically active radiation (PAR) was very low in all treatments except Severe LR, indicating that inner leaves were heavily shaded, receiving light at about the light compensation point (no net photosynthates). The high leaf layer number (2.6 to 3.2) and the high ratio of leaf area to surface area (2.2 to 3.1) confirmed that all the treatments had undesirable high canopy densities, and the corresponding canopy shading. To the authors, this shading is an artifact due in part to the widespread use of VSP training in the region.

• **Pruning weights and vine balance.** Pruning weights did not differ across treatments, likely due to the constant trimming to a height of 1.2 m. Pruning weights (0.86 kg/m of canopy) and mean cane weights (60-70 g) were three-fold those of optimal values (0.3-0.6 kg/m and 20-40 g, respectively), indicating that all the treatments were *overvigorous*. Considering the high ratio of vegetative growth to yield (1.5 to 3 m^2/kg) compared to optimal values (0.8 to 1.2 m^2/kg), the vines were also *unbalanced*.

• **Effect of LR and CT on yield components.** As expected, yield was significantly reduced in the Severe CT (72% of control in 2007; 54% in 2008). However, cluster numbers did not always differ between the moderate and severe CT, indicating to the authors the difficulty in consistently achieving similar crop levels when thinning a given percentage of clusters. As expected, vines compensated for the thinning and cluster weights increased in the Severe CT (by 10% in 2007; by 20% in 2008).

• **Effect of LR and CT on fruit ripeness.** LR had no significant effect on soluble solids, pH or titratable acidity. In contrast, CT enhanced ripening, as judged by the increased soluble solids and the decreased acidity. CT also increased pH, but only in 2007 (a cooler year in which harvest was delayed). The authors noticed less ripeness advancement between the Severe CT and Moderate CT than between the Moderate CT and the No CT. In other words, the small crop drop of the Moderate CT (25% drop in 2007, 31% in 2008) provided the most "bang for your buck" in terms of sugar accumulation.

• **Effect of LR and CT on phenolic analysis.** Small-scale wines (5 liter containers) were made from each treatment, with 4 replications per treatment, and analyzed for phenolic compounds. Overall, CT had no effect on anthocyanin levels whereas LR significantly increased anthocyanins. The opposite trend was observed with total phenols. That is, both CT treatments increased total phenols with respect to the control, whereas neither LR treatment had any effect on total phenols. The authors also analyzed the levels of quercetin, a phenolic compound thought to play a role as a cofactor in copigmentation, thus contributing to color stability. The Severe LR resulted in significantly higher quercetin levels than the moderate LR or the No LR treatments. Thus, enhanced light exposure from LR is likely to improve wine color – or at least its stability. The authors did not measure wine color (perhaps due to the challenge of achieving good color in small-scale fermentations).

In summary,

- Leaf removal enhanced fruit exposure to light of heavily shaded VSP-trained Merlot. LR had no effect on ripening (unchanged Brix, TA, or pH), but it increased anthocyanins and quercetin levels, both likely to improve wine color;
- Cluster thinning reduced yields and increased fruit ripeness (higher Brix, lower TA). Cluster thinning had no effect on anthocyanin levels, but significantly increased total phenols in the wine. In the current study, moderate cluster thinning was as effective in advancing fruit ripening as severe cluster thinning.

The authors highly recommend the practices of leaf removal and cluster thinning in cool areas where "green" characters associated with suboptimal maturity are often present in the wines.

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