Timing of Cluster Light Environment Manipulation during Grape Development Affects C_{13} Norisoprenoid and Carotenoid Concentrations in Riesling

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Background. The compound TDN (1,1,6-trimethyldihydronaphthalene) is associated with "kerosene" and "petrol" aromas in bottle-aged Riesling. Modest TDN concentrations are often acceptable in Riesling, but excessive concentrations are considered undesirable, especially in young Riesling. In grape berries, TDN exists in non-odorous, "bound" forms which are subsequently released during fermentation and storage. In addition, the carotenoid family of compounds is suspected to be the source of TDN precursors, but the specific carotenoid(s) is still unknown. Past research has shown that cluster shading in the vineyard reduces the TDN content of resulting wines, but cluster light exposure has other desirable effects on fruit quality. Our goal was to identify the key period during berry development in which sun exposure affects the production of TDN precursors, related compounds, and TDN in finished wine.

Experimental design. Removal of 75% of leaves in the fruit zone was applied at three different time points: 2, 33, and 68 days past berry set in *V. vinifera* cv. Riesling. The concentrations of TDN (petrol aroma) and β-damascenone (fruity aroma) precursors were measured in the resulting juice and wine and compared to a control without leaf removal. In addition, the concentrations and identities of carotenoids were determined in grapes at mid-season and maturity. The aroma compounds and their precursors were also measured in finished wines.

Results. The timing of leaf removal affected the concentration of TDN precursors in grapes and TDN in wine (Table 1). Mid-season leaf removal (33 days post berry set) increased the concentration of TDN precursors in juice and TDN in wine. The concentration of TDN precursors in juice was closely correlated to the concentration of free TDN in wine. β-damascenone was increased in juice, but this did not translate to higher concentrations of this compound in wine. In addition, mid-season leaf removal also resulted in higher concentrations of one carotenoid (zeaxanthin) in berries at veraison.

Table 1. The effect of leaf removal timing on the concentrations on total TDN, total β-damascenone, and the carotenoid zeaxanthin compared to the control. "Total" refers to the sum of free and bound forms of an aroma compound.

Compound measured	Sample	Early leaf removal	Mid leaf removal	Late leaf removal
TDN	Juice	-	↑	-
	wine	-	↑	-
β-damascenone	juice	-	-	↑
	wine	-	-	-
zeaxanthin	berry (mid-season)	-	↑	-
	berry (harvest)	-	-	-

No significant difference from control treatment is indicated with a dash (-)

Conclusions

- The timing of leaf removal can alter concentrations of TDN precursors in mature Riesling grapes and resulting wines. Concentrations of β-damascenone in wine were unaffected by the leaf removal treatments.
- Leaf removal at the mid-point (33 days post berry set) had the greatest effect in increasing TDN in juice and wine.
- Leaf removal at 33 days post berry set also resulted in elevated concentrations of a specific carotenoid (zeaxanthin) at veraison. Zeaxanthin may be a source of TDN precursors in grapes.

The bottom line: Our results suggest that leaf removal implemented at berry-set and post-veraison does not have a significant effect on TDN ("petrol") potential in the wine. Leaf removal mid-season can increase TDN concentrations in Riesling juice and wine. For dry sites which typically produce wines with excessive petrol aroma, irrigation to close the canopy in the fruit zone may be a useful management strategy. For vigorous sites, leaf removal early or late in the season should not increase petrol aromas in the resulting wine.

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