Impact of Early Leaf Removal Treatment on Aroma Profiles of Wine Made From Grapevine Red Blotch Disease Infected Grapes

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Introduction

Photo by Patty Skinkis

Grapevine red blotch disease (GRBD) was first recognized in Napa Valley, California in 2008.

GRBD has been confirmed in many US wine production regions, as well as Canada, South Korea, India.

Experimental Design

Vineyard methods:

Commercial Pinot noir vineyard in the Dundee Hills AVA, Pinot noir clone 777 grafted to 101-14 rootstock, planted in 2002. Whole vine rows were used for the trial and either hand labor crews or a mechanical leafer (roller-suction type) was used for leaf removal in the cluster zone only. A randomized complete block design for each treatment was applied to a whole vineyard row and replicated 5 times in the field.

Pinot noir vines in the early leaf removal treatment (ELR) at harvest, 2018. Photo courtesy of P. Skinkis.

E-only leaf removal (CTRL) at harvest, 2018. Photo courtesy of P. Skinkis.

Treatments:

Year 2018

- Leaf removal at pre-bloom removed by hand (ELR)
- Leaf removal at fruit set mechanically – E only (CTLR)

Year 2019

- Leaf removal just before bloom removed by hand, E and W sides of cluster zone (ELR)
- Leaf removal at fruit set mechanically – E-side only (CTLR)
- Leaf removal at fruit set mechanically on E and W sides of cluster zone (LLR)

Wine making:

Grapes were destemmed, transferred to fermentation vessels, and sampled for analysis. An addition of 30 mg/L SO_2 was made followed by an addition of 0.25 g/L of the yeast nutrient Fermaid K. Grapes were inoculated with *Saccharomyces cerevisiae* RC212 to induce alcoholic fermentation and ferments were conducted at 27°C. Fermentations for the early leaf removal trial were conducted on a 3 kg scale (4 replicates in 2018 and 3 replicates in 2019) with a submerged cap. At completion of alcoholic fermentation, wines were pressed and inoculated for malolactic fermentation (MLF). When MLF was complete an addition of 50 mg/L SO_2 was made and wines were settled at 4°C before racking and sampling for analysis.

Methods

Volatile compounds analysis

Fig 3. Headspace-GC-FID and SPME-GC-MS for major volatile analysis (left), SBSE-GC-MS for C_{13}-norisoprenoids (right).

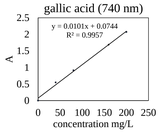
Monomeric anthocyanin

Fig 4. UV-1800 spectrophotometer

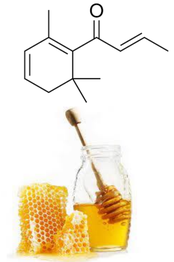
- MA (mg/L, malvidin-3-glucoside equivalent) = A × MW × DF × 1000/(ε × p)

A: $(ABS_{520nm} - ABS_{700nm})_{pH\ 1.0} - (ABS_{520nm} - ABS_{700nm})_{pH\ 4.5}$
MW: molecular weight of malvidin-3-glucoside
DF: dilution factor
p: pathlength in cm
ε: molar extinction coefficient for maldivin-3-glucoside

Total phenolic content



- Folin-Ciocalteu colorimetric method
- UV-1800 spectrophotometer (absorbance at 740 nm)
- Expressed as mg/L gallic acid equivalent.



β-damascenone

β-ionone

Results

Wine Monomeric Anthocyanin and Total Phenolic Content-2018

	Early Leaf Removal (ELR)	Industry Standard Leaf Removal (CTRL)
monomeric anthocyanin (mg/L)	173±8 a	168±2 a
total phenolic content (mg/L)	1709±9 a	1527±6 b
caffeoyltartaric acid (mg/L)	48.9±0.5 a	45.3±1.2 b
catechin (mg/L)	75.2±2.5 a	71.8±0.1b
cafferic acid (mg/L)	7.9±0.4 a	4.8±0.2 b
epicatechin (mg/L)	74.9±5.8 a	64.6±5 a
malvidin-3-monoglucoside (mg/L)	141±2 a	138±4 a

Wine Volatile Aroma Compounds-2018

Bound form C_{13}-norisoprenoids (µg/L)	Early Leaf Removal (ELR)	Industry Standard Leaf Removal (CTRL)
vitispirane	35.1±0.6 a	25.5±1.0 b
TDN	10.8±0.1 a	6.7±0.2 b
β-damascenone	15.0±1.0 a	12.3±0.8 b
β-ionone	0.31±0.05 a	0.24±0.01 a

Wine Volatile Aroma Compounds-2019

Name	Early Leaf Removal (ELR)	Industry Standard Leaf Removal (CTRL)	Late Leaf Removal (LLR)
	free form		
vtispirane (µg/L)	2.8±0.5	2.3±0.02	2.5±0.05
β-damascenone (µg/L)	6.4±1.1 a	4.7±0.1 b	6.3±0.3 ab
	bound form		
vitispirane (µg/L)	110±15.9 ab	98.5±2.3 a	132±4 b
TDN (µg/L)	30.5±4.7	30.3±1.8	36.6±3.7
β-damascenone (µg/L)	78.4±1.7 a	69.1±3.0 b	80.9±5.3 a
β-ionone (µg/L)	2.3±1.3	2.0±0.6	1.5±0.4

Conclusions

- Early leaf removal treatment (ELR) increased the levels of phenolic compounds in 2018. This may be due to the greater amount of leaf area removed and greater exposure of the clusters earlier in the season.
- No significant differences for major aroma compounds were observed among treatments. However, early leaf removal treatment (ELR) enhanced the accumulation of conjugated form C_{13}-norisoprenoids in GRBV+ wines in both years. Again, this may be due to the greater amount of fruit exposure during the season.
- Other studies have shown greater phenolics and aroma compounds with more cluster sunlight exposure.