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Vine microclimate and norisoprenoid concentration in Cabernet Sauvignon grapes and wines

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• Norisoprenoids are important flavor compounds in many varieties. Some examples are *ß-damascenone* (flowery, fruity character), *TDN* (or trimethyl-dihydro-naphthalene, kerosene-like aroma), and *vitispirane* (eucalyptus or camphoraceous odor). Many other norisoprenoids have been identified that contribute complex aromas to red and white wines, such as grassy, tea, lime, honey, oak, and pineapple characters. Norisoprenoids in grapes arise from photochemical and enzymatic degradation of *carotenoids* present in the skin and pulp, such as ß-carotene and lutein.

• We have some knowledge of how canopy manipulation affects fruit parameters such as Brix, pH, and TA. But we know little about the effect of canopy manipulations on fruit and wine flavor. The goal of this study was to evaluate the effect of vine microclimate on norisoprenoid concentrations in Cabernet Sauvignon grapes and the corresponding wines.

• To manipulate vine microclimate, 6 canopy densities/cluster exposure treatments were established immediately after berry set:

1 - Clusters tucked into the interior of the canopy
2 - No manipulation of leaves or clusters (Control)
3 - Clusters exposed by removing lateral leaves in fruit zone
4 - Clusters exposed by removing primary leaves in fruit zone
5 - Clusters exposed by removing primary and lateral leaves on every other node in the fruit zone
6 - Clusters exposed by removing primary and lateral leaves in the fruit zone

Each fruit exposure regime was replicated 6 times in a randomized complete block design. The experiment took place in 2002 in Gonzalez, California, in a vineyard with east-west rows. Overall yield was the same for all treatments (15.7 t/ha, or 6.4 t/a), as vines were adjusted to the same crop load before starting the experiment.

• The authors measured the following: 1) photosynthetically active radiation (PAR) at set, veraison, and right before harvest; 2) leaf area, 3) leaf layer number, 4) berry temperature, by using dual hypodermic thermocouples, and, most importantly, 5) norisoprenoid concentrations, using gas chromatography-mass spectrometry applied to extracts from random cluster samples.

• **Effect of canopy manipulations on light**. 1) Those canopy treatments that did not involve removing leaves ("control" and "clusters tucked into the canopy") allowed the least amount of light to reach the clusters. 2) The greatest difference in light exposure between treatments could be observed at <u>4 pm</u> (PST) on the <u>south</u> side of the rows. 3) As expected, as leaf layer number in the fruit zone decreased, light intensity to the clusters increased. 4) Light exposure in the afternoon was 2-3 times greater when leaf removal took place.

• **Effect of canopy manipulations on temperature**. 1) The highest temperatures were observed when all lateral and primary leaves were removed, which was also the treatment with the highest light exposure. 2) The highest temperatures were recorded at 4 pm, on either side on the row. When leaves were removed, cluster temperatures increased by up to 9°C over the Control. 3) Clusters on the south side reached higher temperatures than those on the north.

• **Effect of canopy manipulations on norisoprenoids**. 1) Grapes on the south side of the vines had higher levels of norisoprenoids than those on the north side. 2) The most exposed clusters had the highest levels of TDN and vitispirane. Generally, as leaves were removed, and fruit was more exposed, norisoprenoid concentrations increased. Also, as temperature increased –normally associated with higher sun-exposures- norisoprenoid concentrations also increased. 3) Despite the previous statement, the most shaded treatments (treatments 1 and 2, where leaves had not been removed) had very high levels of ß-damascenone and vitispirane. That is, even though light intensity was low on these clusters that had not had any leaves removed, their concentrations of ß-damascenone were the highest of all treatments. These results suggest to the authors that **leaf removal** and other microclimate effects **may influence norisoprenoid concentrations independently of sunlight exposure**. 5) Norisoprenoid concentrations in the wines were correlated with those in grapes, even though the values in grapes were 2 to 3 times higher.

In summary, increasing sunlight exposure to the clusters tended to increase norisoprenoid levels. However, removing the leaves seemed to have the opposite effect, particularly on ß-damascenone and vitispirane, which were highest in the intact control (non-leafed) and when clusters were tucked in the canopy. The authors' results may have been the result of the interplay of several opposing forces, and as they note, more research is needed. Additionally, different individual norisoprenoid compounds responded differently to microclimate effects. This is likely due to differences in their synthesis pathways. The potential good news here is that we might be able to identify practices that favor ß-damascenone and vitispirane -floral/fruity characters-, while minimizing TDN -often considered an off-flavor and whose synthesis follows a different pathway.

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