Summary 1

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Title: **"Relative proportions of seed, skin and flesh, in ripe berries from Cabernet Sauvignon grapevines grown in a vineyard either well irrigated or under water deficit"**

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The greatest merit of this article is that, given that every cluster has an inherent variation of berry sizes, the authors set-up a scenario in which they are able to compensate for this by classifying the berries into 6 weight categories. Then they study how three different water regimes affect berries in each of these 6 categories. This way, they are able to focus precisely on changes that the water status might create on berry size and berry components, without interference from the natural distribution of different berry sizes in the cluster. They conducted the study for 2 years, 1998 and 1999. The work is detailed and laborious because several small, but useful, berry components are painstakingly dissected and tracked. The authors' main findings and their implications follow.

- The authors find that the **water deficit treatment** (no water until leaf water potential reached -15 Bars (= -1.5Mpa), **inhibited berry growth, resulting in smaller berries.** In contrast, neither the normal irrigation vines (32 liters/vine/wk), nor the high irrigation vines (64 liters/vine/wk) showed any consistent changes. Interestingly, the higher irrigation vines did not produce larger berries.

- How does this reduction in berry size with deficit irrigation affect the different categories of berry sizes (<0.5 g, 0.51-1 g, 1.01-1.25 g, 1.26-1.5 g, and >1.5 g)? The authors find the reduction affects every size category, shifting the size distribution towards smaller berries. As an example, most (70% in 1998, 73% in 1999) of the berries in normal and high irrigation vines belonged to the medium berry size categories (comprised between 0.76 and 1.25 g). In the water deficit vines, most of the berries (85% in 1998, 97% in 1999) belonged instead to the smaller size categories (0.51-1.25 g). What that means is that with water deficit, we can expect smaller berries in every category: the small get smaller and the large get somewhat smaller too.

- How much smaller? If we were to compare two average clusters, one from the control vines and one from the deficit-irrigated vines of the study, the deficit cluster would generally weight about 12.5% less than the control cluster in 1998, and about 18.8% less than the control in 1999.

- Indeed, the authors observed that the reduction of berry size due to the water deficit was greater in 1999 than in 1998. They attributed this variation to higher pre-veraison temperatures in 1999, which in turn, triggered more negative leaf water potentials earlier in the 1999 growing season. The leaf water potential graphs presented support this interpretation.

- In this trial, the authors noted that it took a significant water deficit - enough to sustain a leaf water potential of –12.5 bars - to cause berry size to decrease. Both the control and the high irrigation treatments were able to reach this level but not to maintain it, and so only the lower irrigation treatment caused a consistent decrease in berry size.

- Amounts of seed, flesh, and skin per berry were all proportional to berry size. That is, larger berries have more of all of those components ("larger bags hold more"). Generally speaking, 5% of a berry weight is seed, 80% is flesh or pulp, and 15% is skin.

- Additionally, the water deficit caused the proportion of these berry components to change. In what currency (skin, flesh or seed) does the berry preferentially pay for the loss of berry weight? The answer, as expected, is mainly in its flesh. But surprisingly, both seed and skin weights increased, rather than decreased, during sustained deficit irrigation. The increase in seed weight was due to one of two reasons, depending on berry size: 1) to an increase in seed size, for the small berry categories -these carry only one seed-, or 2) to an increase in the number of seeds, for larger berry categories –these carried anywhere from 1 to 2.5 seeds.

- To be able to compare the response to water status of the different berry components, without interference from berry size, it is most appropriate to express the weights of seed and skin as a ratio or proportion of berry mass (g/g of berry mass). When we do this, and because water deficit berries are already smaller, the overall effects of water deficit on seed and skin components become even more pronounced. In other words, **water deficit berries have much higher ratios of seed and skin than either normally irrigated-, or highly-irrigated berries**. This may be the most important finding of this work.

- What might the take-home message be for the grower? Under the conditions of the study, it's best to initiate early and sustain very negative leaf water potentials (at least –12.5 bars) if we want to reduce berry size in Cabernet. This is because Cabernet's berry size is relatively insensitive to water deficits. We also know that a pre-veraison deficit is more effective than one happening after veraison. Additionally, we should pay attention to high temperatures early in the season, since they can cause an important decrease in berry size (as we saw in 1999). Finally, often times, we see that the year itself has more effect on berry size than any of these factors alone, and we still do not fully understand why!

- What might be the take-home message for the winemaker? If other factors such as solubility, seed surface, etc, remain constant, higher seed mass in the water deficit berry probably means higher potential for extracted seed compounds into the wine. So unless you want harsher tannins, you might avoid any prolonged extraction techniques that involve contact with seeds. Similarly, higher skin mass results in higher potential for skin compounds in wine. The latter is generally desirable, since the phenols and flavor compounds found in the skin are generally perceived as positive characters in most wines.

- But do concentrations of seed and skin solutes in the berry components stay the same? Dr. Matthews teams up with Dr. Adams on a later paper to address this topic.

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