18 Estimation of vineyard water status through shoot tip observation

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• The goal of this study was to determine the relationship between the visual aspect of shoot tips in the vineyard (S) and leaf water potential (Ψ). Most methods to evaluate leaf water status are labor-intensive, require expensive equipment or specialized personnel, and can cover only a small number of plants. Lured by the simplicity and non-destructiveness of shoot tip status as a guide for plant water status, the authors set up an experiment to establish the relationship between the two.

• To determine **leaf water potential**, researchers measured 15 random plants with a pressure chamber at midday at 4 different phenological stages:

- *pea size*
- *bunch closure*
- *veraison*
- *close to harvest (11.5 ^{o} potential alcohol)*

• To determine **shoot tip status**, they used the following code at the phenological stages above:

- *Stage **3** = tip undergoing rapid growth*
- *Stage **2** = slow shoot growth*
- *Stage **1** = shoot growth has stopped and tip is dead*

When more than one stage co-existed, the final number (S) was the sum of the proportion of tips in each of the three stages ($S = w_1 S_1 + w_2 S_2 + w_3 S_3$). The observations were done by 3 different operators (to be able to compare results) and an average of the three numbers was calculated.

• On the second year (2010), they used a nearby vineyard planted to the same variety (Tempranillo) to measure water status and shoot tip status ("Observed S"). Using the relationship (linear regression) between S and Ψ they had obtained in 2009, they predicted the value of shoot tip stage in 2010 ("Predicted S"). By comparing the two values (*observed* vs. *predicted*), the authors were able to determine how adequate using shoot tips as an estimation of water status was.

• **Results.**
1) Veraison marked a shift in Ψ (with values before veraison between -1.5 to -0.9 MPa, and after veraison between -1.8 to -1.35 MPa). To an extent, it also marked a shift in S, in the sense that no active organogenesis (shoot tip growth) was recorded after veraison.

2) The authors found a highly significant correlation (R=0.917) between the predicted and observed shoot tip stages. This fit was very good when the shoots were growing either actively or slowly, but it became poor when the shoot tips were dead (S≈1). This is expected given that, once growth ceases due to water stress, a more severe deficit does not have any additional effect on shoot tip stage.

3) Shoot tips showed slower growth when mean Ψ was around -1.3 MPa, which corresponds to a moderate stress level such as is desirable after veraison to prevent new shoot growth. The authors found that this desirable stage could be achieved with **S values between 1.9 and 2.0.**

• Previous studies suggest that water stress from fruit set to veraison may reduce berry quality. After veraison, a mild stress seems desirable, but if this stress is severe (Ψ < -1.12 MPa) quality would suffer once again. The authors note that, in the specific case of Tempranillo, the ideal level of water stress tends to be less severe than for other varieties.

Even though the relationships between water status and shoot tip stage might require some adjustment for specific varieties, the message of this article is that growers could easily leave a few un-tipped vines as sentinel vines throughout the season, and use shoot tip appearance to help estimate water status. Normally, shoot tip stages between 2 and 2.5 will be the values to look for after veraison.

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