Summary 55

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Title: **"Towards a simple indicator of water stress in grapevine (*Vitis vinifera* L.) based on the differential sensitivities of vegetative growth components"**

By: A. Pellegrino, E. Lebon. T. Simonneau, and J. Wery

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These authors study the growth response of potted grapevines to mild, medium, and severe water deficits in order to identify sensitive, easy-to-measure indicators for early diagnosis of water stress.

• There are 2 major categories of water status indicators in grapevines: soil-based measures and plant-based measures. Those that measure the amount of water in the **soil** (like *soil water content*) are time consuming and have questionable value in vineyards with great spatial variation. For this reason, indicators that measure the **plant** directly tend to be preferred. Two useful water plant indicators are *leaf water potential* and *stomatal conductance*. Other measurements (sap flow, trunk diameter, canopy temperature, leaf reflectance, chlorophyll fluorescence) have promise but are still impractical for the average grower. Finally, *vegetative growth indicators* offer several advantages. They are sensitive (tissue expansion is the first to be affected when water stress occurs), easy to observe or measure, and tend to correlate well with crop yield and grape quality.

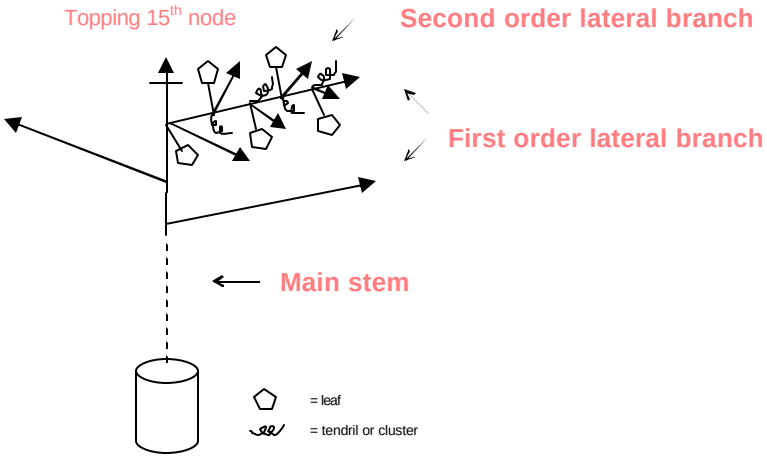
• So the authors decided to study the response of various vegetative growth parameters to soil water deficits. But to do that, they had to overcome an important built-in hurdle first. *Plant growth parameters that take several days to express themselves* (the authors use the word "settle") *cannot be related to a unique soil water measurement.* And that's because the soil water status would have changed –both spatially and temporally- over the period in question. Not unlike trying to hit a moving target. As the authors point out, experiments in pots may overcome this problem, as the water status in a pot could be stabilized and strictly controlled by applying the appropriate irrigation regime.

• The authors subjected 2-year old Syrah vines grafted to Fercal to 4 water regimes: control (C), and mild (S1), medium (S2) and severe stresses (S3). The vines were growing in soil columns of clay/loam/sand mix in a greenhouse in Montpellier, France. The authors expressed the water content of each treatment as "Fraction of transpirable soil water". As the name indicates, this parameter measures the portion of the total water that is still available to the plants (difference between soil water content at field capacity and the water retained by soil particles and that is not available to plants). "Fraction of transpirable soil water" for the treatments studied were: 87%, 61%, 40% and 19% for C, S1, S2, and S3, respectively. The authors also measured predawn leaf water potential: approximately to -1.1, -1.2, -1.25, and -2.4 bars, for C, S1, S2, and S3, respectively. There were 7 replicated vines for each water regime.

• The potted vines were vertically trained and topped at node 15 to mimic field conditions. All clusters were removed to avoid complex interactions. If we refer to the shoots arising from the main stem in the soil pot as Lateral branches 1 ("first order laterals"), and to the shoots arising from them as Lateral branches 2 ("second order laterals"), the authors measured the following growth parameters for each water regime:

- number of leaves on lateral branches 1 and number of leaves on lateral branches 2
- length of individual leaf laminas and leaf area
- length of internodes
- rate of emergence of leaves on lateral branches 1 and of leaves on lateral branches 2.

[Alternatively, "Lateral branch 1" and "Lateral branch 2" could be called "Shoot" and "Lateral branch 1", respectively, since the main stem might be considered more of a vertical cordon than a primary shoot in this setup.]



Modified from the authors

• The authors found that *leaf emergence rate* was the most sensitive of all the individual indicators studied. This was true particularly for the emergence rate of those leaves on lateral branches 2, which was more sensitive than the equivalent for lateral branches 1. They could also observe that **predawn leaf water potential was only sensitive to severe soil water stress, while stomatal conductance was sensitive to mild stress.**

• Since the main goal of the authors was to identify simple parameters indicative of early water stress, and leaf emergence rate is not the easiest parameter to measure (it involved the calculation of the number of new leaves per unit of time), the authors defined two additional "composite parameters": 1) *final length of lateral branches 1* **(L1)**, which gives an idea of shoot vigor, and 2) *number of leaves on lateral branches 2 divided by number of leaves on lateral branches 1* **(LN2/LN1)**. This was an attempt to dissociate the vigor of lateral branches 2 from the vigor of lateral branches 1.

• The author's main findings were: 1) Final length of lateral branches 1 (L1) was reduced for all water regimes, although the differences were only significant for medium and severe water deficits. 2) Final ratio of the number of leaves on lateral branches 2 to the number of leaves on lateral branches 1 (LN2/LN1) was reduced for all the range of water deficits. Thus, L1 was a more sensitive indicator of water stress than LN2/LN1. Not only that, but the authors were also able to see how **the composite indicators were more sensitive to water deficit than leaf water potential, and, in the case of LN2/LN1, even more sensitive than stomatal conductance.**

To avoid a moderate stress from becoming severe, it is important to have indicators that are sensitive and can give early warning when a mild stress is developing. Here the authors identify two such indicators: an indicator of growth of lateral branches, and an indicator of branching intensity of these same branches. The authors note that both of these indicators are easy to measure, correlate well with available water content, and are more sensitive to water status than leaf water potential. But it occurs to me that, evidently, for the proposed indicators to be useful, we need to have lateral growth occurring in the first place.

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