

## Background

Vine water status monitoring is an essential component in any vineyard irrigation management program. Two tools that can be used to measure vine water status are the pressure chamber and the porometer.

The *pressure chamber* measures leaf water potential, which is loosely defined as the sap tension (or suction) within the xylem vessels of the stem. The tension arises from evaporation from the leaf's stomatal cavities (transpiration), as well as to the matrix forces holding onto the water in the soil—a tug-of-war situation. The drier the soil, the tighter the water is held and the more energy is required to extract the water to feed the transpiration stream.

But leaf water potential only describes the energy state of the water in the vine. We don't know how the vine is responding to the condition it is in. Ideally, we would like to know about the state of all of the physiological processes in the leaves and in the fruit, but that is not at all practical. However, an instrument that measures one important physiological response to stress is the porometer, which measures the degree of stomatal opening or closing. *Stomata* (tiny leaf pores) are very important because they regulate the amount of water vapor loss from the leaves but also control the rate of CO<sub>2</sub> gas that enters the leaf to be assimilated as carbohydrates. So, knowledge of the *stomatal conductance*, as it is referred to, gives us very good insight into the response of the vine to current water and environmental stresses.



### The Decagon Leaf Porometer

The porometer measures stomatal conductance: how open or closed are the leaf stomata. Closed leaf pores mean that the vine is experiencing some stress (among those stresses is water stress, but low humidity, deep shade and high wind can also close stomata). While not a measurement of photosynthesis, stomatal conductance may imply a relative measurement of same.

The important thing is that, no matter what you use to measure vine water status, logs must be kept of vine water status throughout the season. Sometimes patterns of water status are more revealing than absolute numbers. Keep records of visual indicators, like leaf senescence or sun-avoidance. Note the values of water potential or stomatal conductance at those times and make sure that you don't hit those stress levels again.

### Measurement technique

Leaf selection is essentially the same as for a pressure chamber reading. Measurements are usually made during mid-day. Typically, the time between 12:00 and 2:00 pm are optimal, but times before and after this window are allowable, but be consistent about the measurement time in each vineyard/block.

Select a typical shoot and find the most recently, fully-expanded (i.e. mature) leaf on the shoot. Make sure that it is in full sunlight. Press the "enter" button on the leaf porometer and then position the sensor on the leaf. Select a portion of the leaf that is in-between two major veins. This is to assure a proper seal against the leaf surface. The porometer will automatically begin its measurement cycle. Hold the leaf in the same position during the measurement period (default is 30 seconds).

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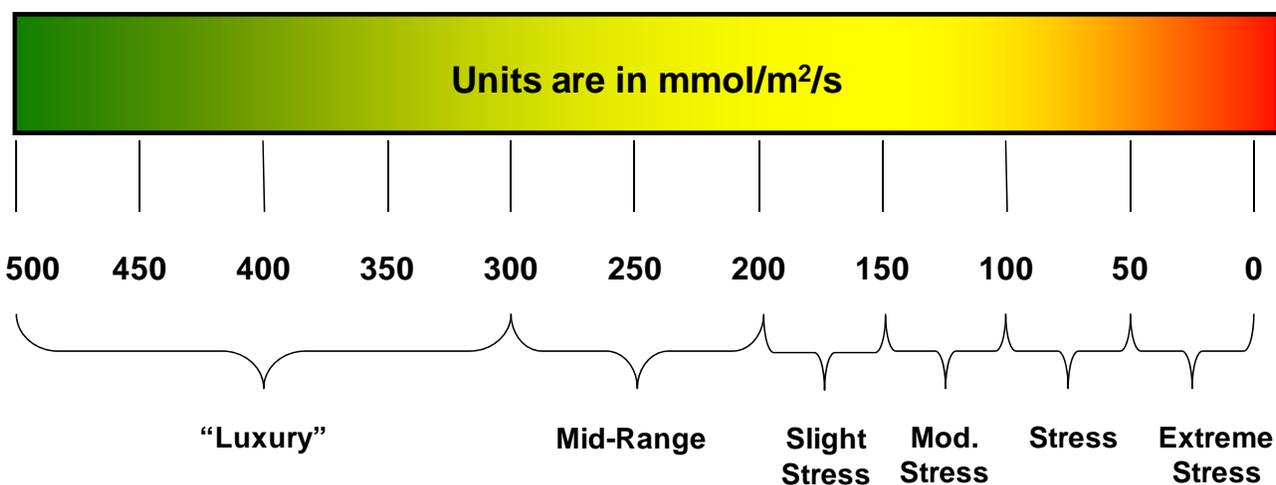
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Once the measurement is complete, it may be written down, logged (with annotations) in the Leaf Porometer, or entered into another type of field database. The units  $\text{mmol/m}^2/\text{s}$  are recommended, as that is the one most commonly used. The leaf porometer exhibits more variability than the pressure chamber. To compensate for the variability, it is suggested that a greater number of measurements be made to arrive at the average. About 5 measurements is a good idea. Fewer if the measurements are quite consistent and perhaps even additional measurements if the readings are highly variable at the location being measured. Since the measurement is quite rapid, the additional measurements will not require a substantial amount of additional time.

Additionally, it has been found through research and practice, that weather conditions (particularly humidity or vapor pressure deficit) has a strong influence on stomatal conductance. Be sure to take weather into account when interpreting the data. Fortunately, practice has indicated that as vineyards get more stressed as the season progresses (for instance around the target levels of stomatal conductance described below), the environmental effects are less pronounced.

### Interpretation and usage

Like the pressure chamber, the leaf porometer does not indicate *how much* irrigation to apply. That decision depends upon too many factors to discuss here. Nevertheless, the porometer does tell you how stressed the vines are. This stress level can be used to modulate the irrigation applications (either by increasing/decreasing the amount applied or the number of days per week, which is preferred). Are the vines at “luxury” levels? Decrease the irrigation applications. Are the vines getting too stressed? Increase the irrigation applications. It is highly suggested that the leaf porometer be used in conjunction with continuous-measured soil moisture devices to determine irrigation volumes and intervals. Here is a general guideline about its interpretation:



For premium wine grapes, it is a good idea to arrive at the ideal stress level about 2 weeks prior to veraison. For most red varieties, aim for the “Moderate Stress” range of between 100 and 150  $\text{mmol/m}^2/\text{s}$ . For most white varieties, that level of stress is not needed and the “Slight Stress” range of between 150 and 200  $\text{mmol/m}^2/\text{s}$  is appropriate. Levels below 100 are indicative of excessive stress and below 50 is a warning sign that severe consequences may result if that level is sustained. Some rootstocks have difficulty in recovering from severe water deficits, so it is important that those levels be avoided. On the other hand, quality wine grapes are produced when some stress is applied to the vines, so avoid the luxury levels of stomatal conductance, especially during and after veraison.

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