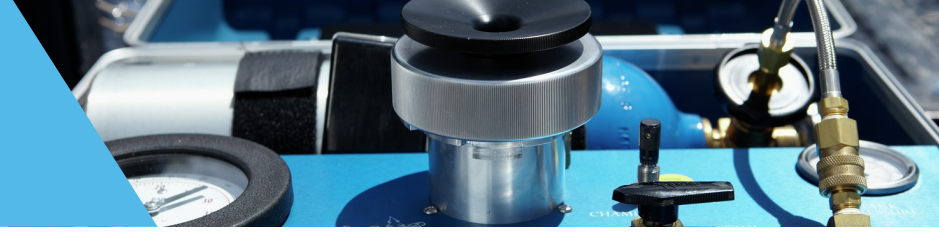
STEM WATER POTENTIAL
USING THE PRESSURE CHAMBER



Growers often use visual cues to determine the plant water status of their trees. However, in most instances, by the time you can visually detect issues with your trees the crop has already undergone irreversible damage. To be one step ahead and stop damage before it occurs, growers are advised to use a more quantitative method known as the pressure chamber to determine their trees' water status.

A pressure chamber measures plant water tension by applying pressure to a severed leaf and stem enclosed in an airtight chamber. The pressure required to force water out of the petiole of a severed leaf equals the water potential and is measured by an external pressure gauge.

How To Use A Pressure Chamber

Tools needed: Magnifying glass (10x Jeweler's loop), pressure chamber, razor blade, foil bags for leaves, and flagging tape

Process

1. Take measurements between 12-4 p.m. on a sunny day, as overcast days may affect your reading.

2. Choose 5-10 trees to test that are good representations of the orchard, taking into account variety, rootstock, tree age, degree of pruning and canopy size.

3. Once you have chosen your trees, select a leaf toward the center of the canopy that's around shoulder height. You should look for a healthy leaf with a long stem and no holes.

4. Place the foil bag on the leaf. Be sure to not crush the stem as a damaged stem can cause an inaccurate reading. Bag all the leaves in your sample at the same time.

5. Keep the bag on each leaf for at least 10 minutes. This time allows the leaf to get back to equilibrium of the tree.

6. Once 10 minutes is up, you can take your razor blade and make a clean cut at the stem. Make sure you do not cut the stem too short. Leave the bag on the leaf until after the reading is completed.
Note: You have about 1 minute from the time you cut the leaf off the tree to take the reading in the pressure chamber.

7. Insert the stem of the bagged leaf upward through the top of the pressure chamber. After the leaf has been inserted securely tighten the pressure chamber cap around the stem. Make sure you do not over tighten the gasket. Once leaf is in the chamber make sure to lock the chamber lid into place.

8. Open the valve to start inserting the gas into the chamber. Make sure the bars are moving at the rate of half a bar each second. If they are moving faster than that rate, adjust the rate valve but do not tighten it too much. If you hear gas leaking from the chamber, tighten the chamber lid. If that doesn't work, stop the chamber reading and release the gas. From there, you may try to gain a reading once more, but this time make sure the chamber lid is greased and well lubricated (a stick of Chapstick works well).

9. Take the reading (shut off gas) as soon as you see water coming out of the stem. Once you see air bubbles coming from the stem you have gone too far.

10. Document the reading, release the pressure and continue until all samples are complete.

11. Choose the method you want use to interpret your data: the Guideline Method or the Baseline Method.

california almonds
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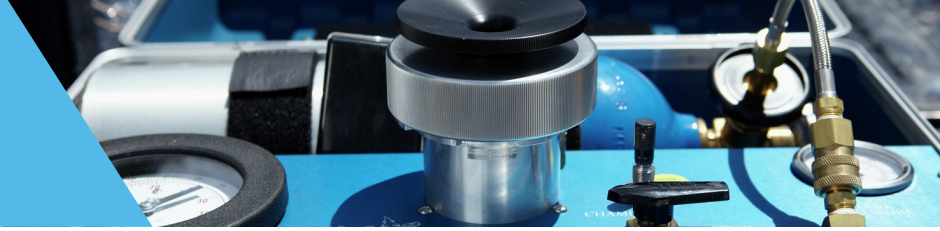

Interpreting Data

Guideline Method: For the guideline method take the average of all of your stem water potential readings for your orchard and see what reading level your average aligns with. Once you have determined the stress level, use that data to inform your next irrigation.

Pressure Chamber reading or SWP (bars)	Stress level	Extent of crop and types of crop responses associated with different SWP levels in almond
0 to - 6	None	No stress. Not commonly observed in almond. Only observed in early spring.
- 6 to - 12	Minimal	Fully irrigated conditions. Stimulates shoot growth, especially in developing orchards. Higher yield potential may be possible if these levels of crop stress are sustained over a season, barring other limitations related to frost, pollination, diseases, or nutrition. Sustaining these levels may result in higher incidence of disease and reduced life span. Typical of mature trees from leaf-out through mid-June.
- 12 to - 14	Mild	Reduced growth in young trees and shoot extension in mature trees. Suitable from mid-June until the onset of hullsplit (July). Still able to produce competitively. Recommended crop stress level after harvest. May reduce energy costs or help cope with drought conditions.
- 14 to - 18	Moderate	Stops shoot growth in young orchards. Mature almonds can tolerate this level of crop stress during hullsplit (July/August) and still yield competitively. May help control diseases such as hull rot and alternaria, if present. May expedite hullsplit and lead to more uniform nut maturity. Also may help reduce energy costs and cope with drought conditions.
- 18 to - 22	Very High	Wilting observed. Widespread defoliation. Stomatal conductance of CO2 and photosynthesis declines as much as 50% and impacts yield potential due to reduced leaf activity. Some limb dieback.
- 30 to - 60	Severe	Extensive or complete defoliation is common. Trees may survive despite severe defoliation and may be rejuvenated. Some limb dieback. Much less or no bloom and very low yield potential can be expected the following season until trees are rejuvenated.
less than - 60	Extreme	Complete defoliation, no flowering in the subsequent year. Dieback likely.

Guidelines for interpreting SWP measurements in almonds.

Baseline Method: Estimating the baseline will require access to public or private weather databases (e.g., CIMIS) that provide hourly temperature and relative humidity data. Growers may also use an inexpensive handheld psychrometer that can measure temperature and relative humidity in the orchard at the same time that stem water potential measurements are taken. The baseline is based on CIMIS, which should be equivalent to the temperature and relative humidity above the orchard, rather than in the orchard (presumably under the canopy). This difference in temperature and humidity has been reported to impact pressure chamber readings by about one bar.

	Air relative humidity (RH,%)						
Temp. (°F)	10	20	30	40	50	60	70
75	- 7.3	- 7.0	- 6.6	- 6.2	- 5.9	- 5.5	- 5.2
80	- 7.9	- 7.5	- 7.0	- 6.6	- 6.2	- 5.8	- 5.4
85	- 8.5	- 8.1	- 7.6	- 7.1	- 6.6	- 6.1	- 5.6
90	- 9.3	- 8.7	- 8.2	- 7.6	- 7.0	- 6.4	- 5.8
95	- 10.2	- 9.5	- 8.8	- 8.2	- 7.5	- 6.8	- 6.1
100	- 11.2	- 10.4	- 9.6	- 8.8	- 8.0	- 7.2	- 6.5
105	- 12.3	- 11.4	- 10.5	- 9.6	- 8.7	- 7.8	- 6.8
110	- 13.6	- 12.6	- 11.5	- 10.4	- 9.4	- 8.3	- 7.3
115	- 15.1	- 13.9	- 12.6	- 11.4	- 10.2	- 9.0	- 7.8

Baseline SWP (bars) to expect for fully irrigated almond trees under different conditions of air temperature and relative humidity.

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