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Almond

Performance:

- Excellent. Recommended for commercial use.
- Sensor data matches the pressure chamber, but can read 1-3 bars wetter during the spring.
- Thoroughly validated and used commercially.

Installation tips:

- Install after leaf out, on a 2+” branch. Installation into main trunk can be difficult if the bark is thick. Big and small sensors can work well.
- Sensors should be reinstalled after the winter, otherwise SWP will read too wet.

Troubleshooting:

- Sensor install site can get blocked and sensor will read too wet, with little to no diurnal pattern. Reinstall.
- Sensors can get disconnected from xylem due to breaks in the mating compound. The sensors will then read very negative values during hot part of day. Reinstall.

Guidelines:

ALMOND	
Recommended level (bars below baseline) Stress level recommended according to your specific crop, time of the season and daily weather. Uses baseline calculated from the nearest weather station data.	
Wet: 0+	Crop is too wet. Greatly increases disease risk.
Moist: 0 – 2	Soil is moist - let it dry before further irrigation. Sustaining this level increases disease risk and reduces life span.
Low: 2 – 4	Stimulates shoot growth, especially in developing orchards. May increase yields if sustained over a season, barring other limitations related to frost, pollination, diseases or nutrition. May increase disease risk.
Mild: 4 – 6	Suggested during the phase of growth just before the onset of hull split (late June).
Moderate: 6 – 8	Reduces growth in young trees and shoot extension in mature trees, but can still produce competitively. Suggested in late June up to the onset of hull split (July), and after harvest. Helps reduce energy costs and cope with drought conditions.
Strong: 8 – 12	Stops shoot growth in young orchards. Mature almonds can tolerate this level during hull split (July) and still yield competitively. Helps control diseases such as hull rot and alternaria leaf spot. Expedites hull split and leads to more uniform nut maturity. Helps reduce energy costs and cope with drought conditions.
High: 12 – 16	Slow to no growth in mature orchards. Interior leaf yellowing with some leaf drop. Avoid for extended periods. Likely reduces yield potential.
Very high: 16 – 24	Wilting observed. Stomatal conductance of CO ₂ and photosynthesis declines as much as 50% and impacts yield potential. Some limb dieback.
Severe: < 24	Extensive or complete defoliation is common. Trees may survive despite severe defoliation. Severely reduced or no bloom, and very low yield expected in the subsequent one to two seasons, until trees are rejuvenated.

References:

- [Using the Pressure Chamber for Irrigation Management in Walnut, Almond, and Prune](#)

Apple

Performance:

- Excellent. Recommended for commercial use.
- Sensor data matches the pressure chamber.
- Thoroughly validated and used commercially.

Installation tips:

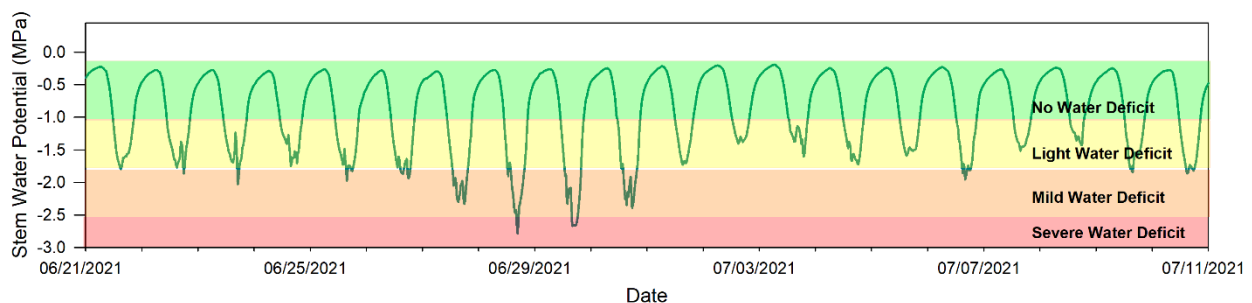
- Very easy install, apple xylem is usually uniform and healthy.
- Ensure the bubble wrap insulation is loose so that excess moisture can evaporate, particularly important in wetter climates.
- Sensors may freeze during the winter if temperatures go below 0 °C
- Big or small sensors can work well, depending on the trunk diameter.

Troubleshooting:

- Main issue seen is sensors reading 0 when trunk is wet. Attach insulation loosely to allow evaporation.

Guidelines:

- Not yet established. Recommend irrigation by SWP trend.



[*Sample guidelines for apple from Washington State University*](#)

References:

- [Microtensiometers: a new tool to monitor your apple trees for deciding when and how much to irrigate](#)
- [Trunk Water Potential Measured with Microtensiometers for Managing Water Stress in “Gala” Apple Trees](#)

Apricot

Performance:

- Untested, but sensors generally work well in stone fruits.

Ash tree

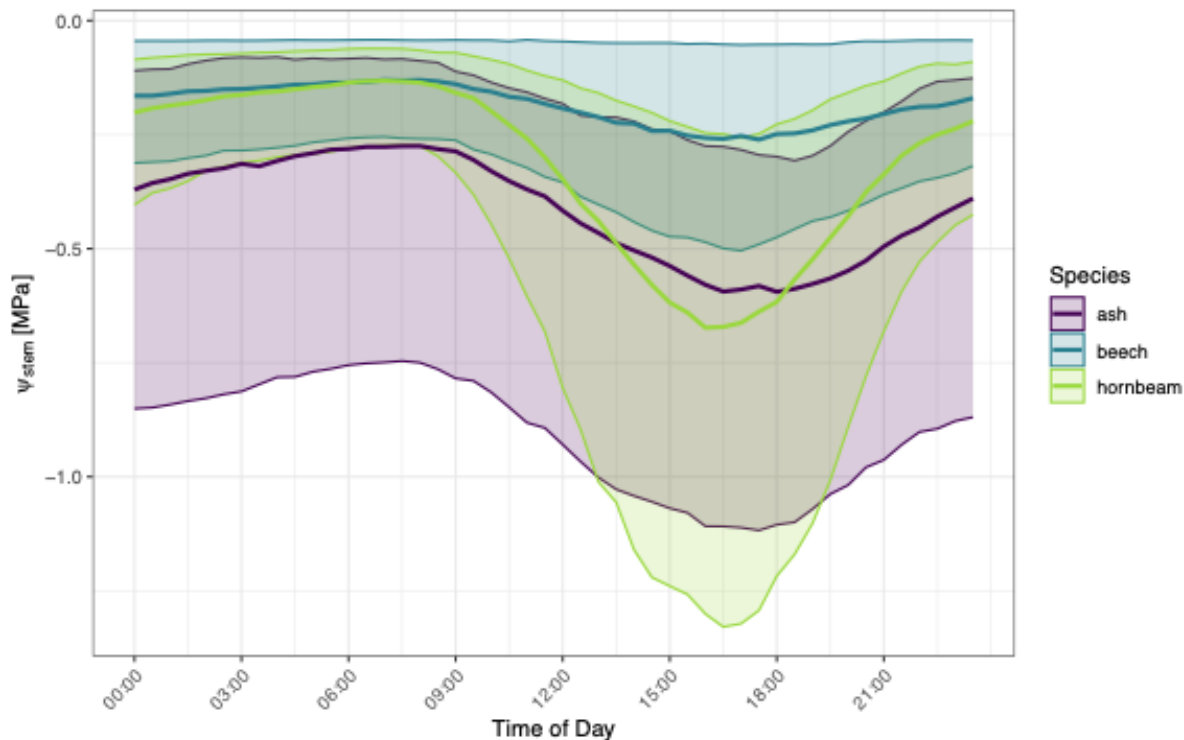
Performance:

- Recommended for early experimental use.
- Researchers tested sensors in Ash with reasonable results, but had issues with the sensor installation depth. In ring-porous species, the sensor must be installed in the outermost xylem for best results.

Installation tips:

- Likely will need to use thick-bark installation method.
- Use of the new 7mm probe strongly recommended. This probe has consistently shallow installation depth, as required by this specie.

References:



In ring-porous and thick-barked species, improper installation depth was a major source of error in Ψ_{stem} measurements, resulting in little to no variability of readings. The problem occurred most frequently for microtensiometers in ash trees, due to small sapwood depth, and required reinstallation to ensure correct placement.

From “Microtensiometer-based stem water potential measurements reveal species and soil controls in temperate forests”

Avocado

Performance:

- Recommended for very early experimental use only.
- Normal sensor installation usually gets flooded and reads zero.
- Heading cut installation is being tested to solve this issue, and the results look promising. The validation continues. We will announce when avocado is ready for external testing.

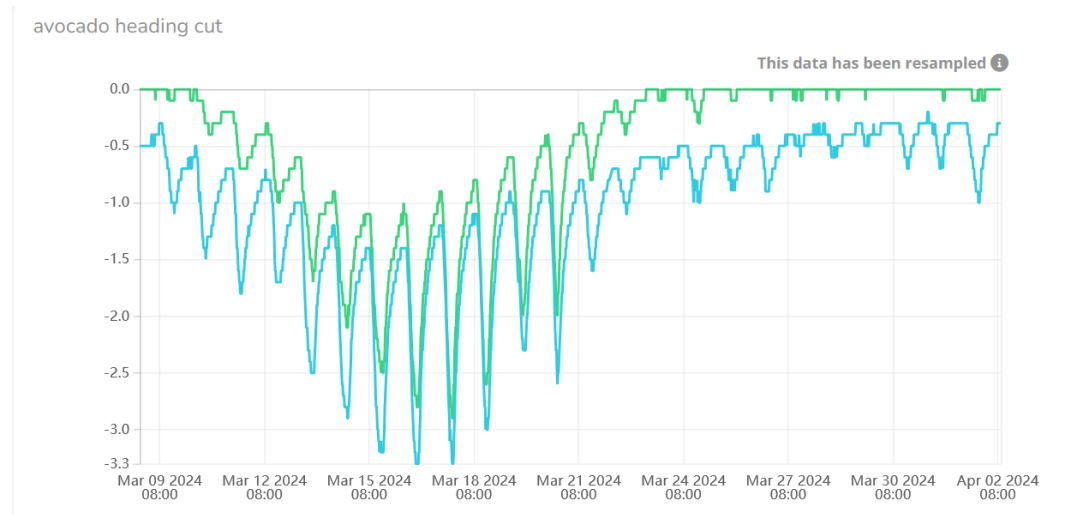


Figure 1 Typical behavior seen in avocado. Heading cut install.

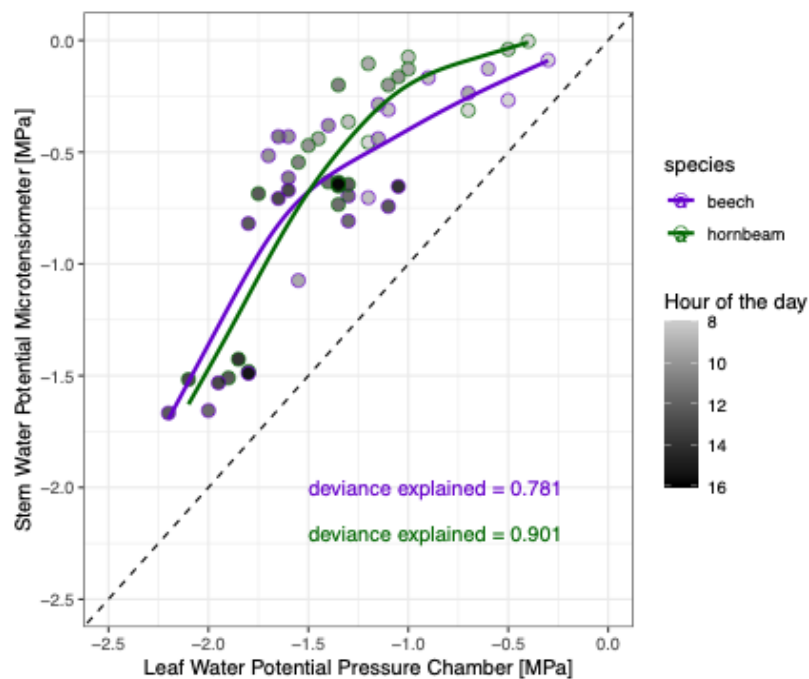
Beech tree

Performance:

- Recommended for experimental use.
- Initial testing showed two sensors installed into same tree measured SWP and agreed with each other. More testing needed.
- Potential issues seen where sensors break after 2-3 months installed. We're looking into this further.

Installation tips:

- Use thick-bark installation method.

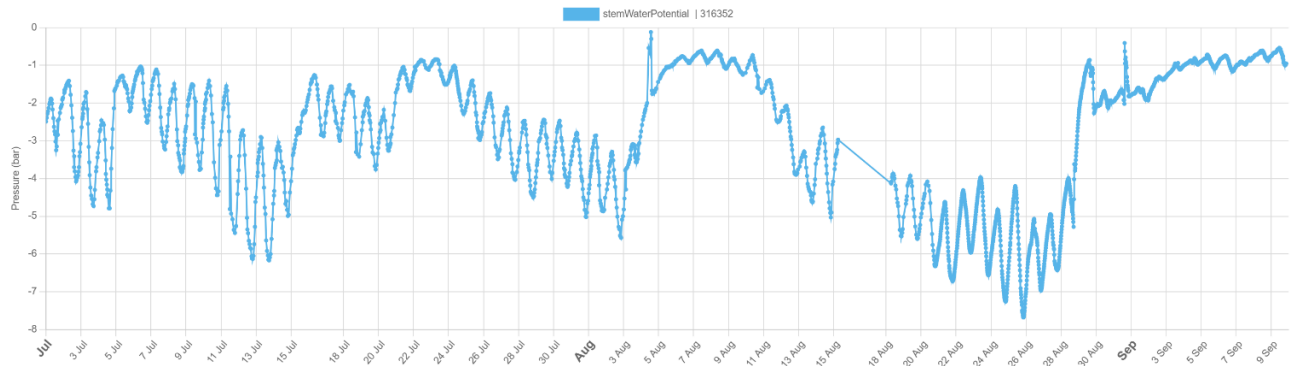


Source: Microtensiometer-based stem water potential measurements reveal species and soil controls in temperate forests. 2025

Betula pendula

Performance:

- Recommended for experimental use.
- Initial testing shows reasonable looking data.



Blueberry

Performance:

- Recommended for experimental use.
- Initial testing of small probes shows consistently good data that matches the pressure chamber trend. Still under testing.

Installation tips:

- Recommend using the 7mm sensor if the trunk is >16mm diameter, otherwise use the 3mm sensor.

References:

- [Irrigation of Blueberry, David Bryla](#)



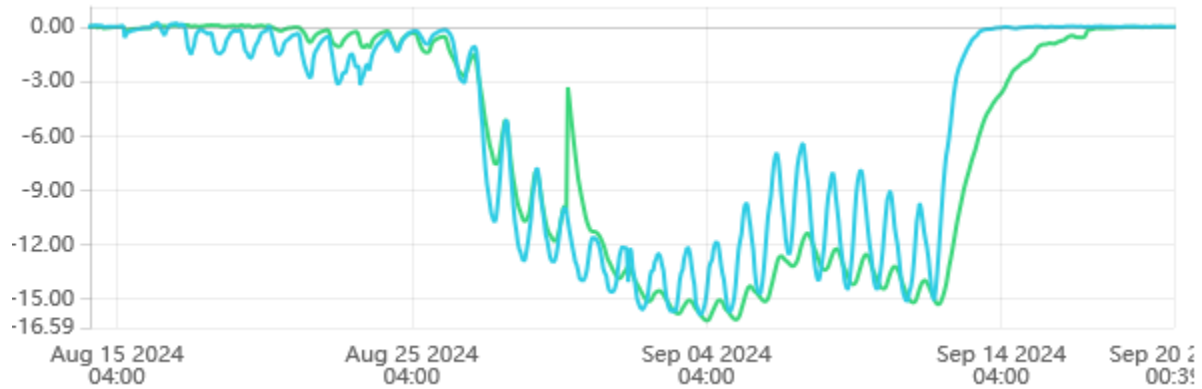
Cacao

Performance:

- Recommended for experimental use.
- New small 7mm sensors give good reasonable data, but our testing is limited.

Installation tips:

- Use our new 7mm sensors!



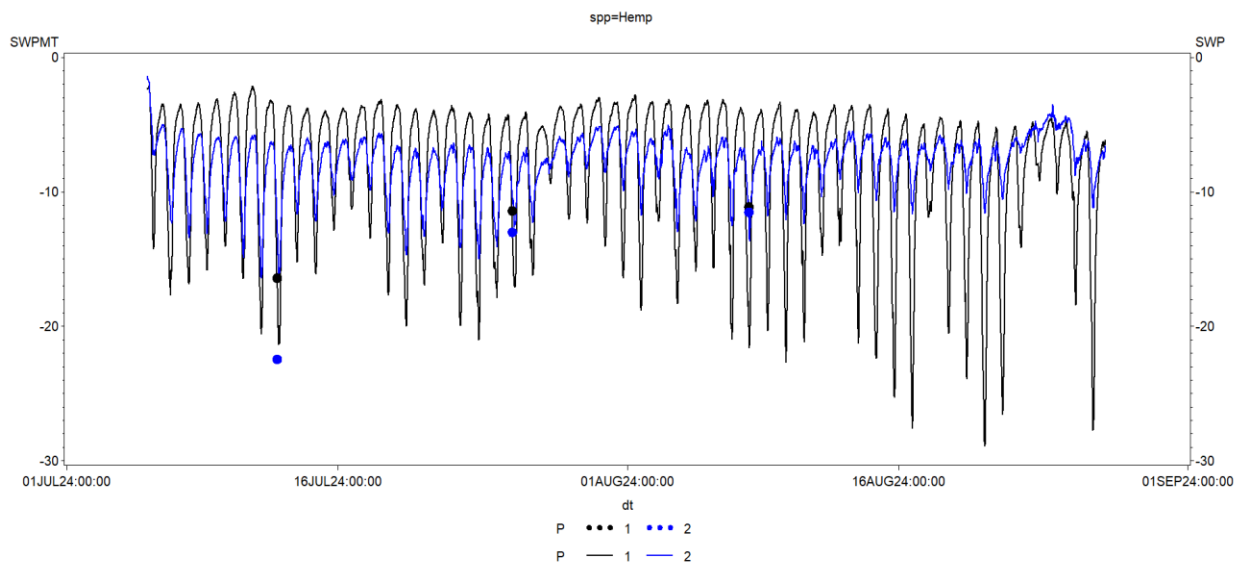
Cannabis

Performance:

- Small probes installed shallowly give reasonable data and agree with each other, at least for a few weeks. Our one dataset does show the sensors began to diverge after a few weeks (may be fixed by reinstalling the sensor).
- Recommended for experimental use.

Installation tips:

- Installation requires care because hemp stem is soft and hollow.



Cedar

Performance:

- Untested.

Installation tips:

- Should use thick-bark tree installation method.

Cherry

Performance:

- Recommended for experimental and commercial use.
- Guidelines are still missing, so irrigation should follow sensor trend and grower experience.
- Good results seen in research and commercial orchards.

Installation tips:

- Similar to almond, sensors should be installed in scaffolding branches, after leaf-out.
- Reinstall sensors after the winter for best results. Sensors may freeze in $< 0^{\circ}\text{C}$ temperatures.
- Big or small probes will work well.

Troubleshooting:

- Limited testing in cherry. Likely to see similar issues to almond.

Citrus – general

Performance:

- Recommended for experimental use only.
- Testing in citrus has shown mixed results with the BIG probes, but the new probe installation appears to work well. Try it out!

Installation tips:

- You should only use our new 7mm probes for citrus – they work best.

Troubleshooting:

- If sensor readings appear non-sensical, recommend removing and reinstalling sensor.

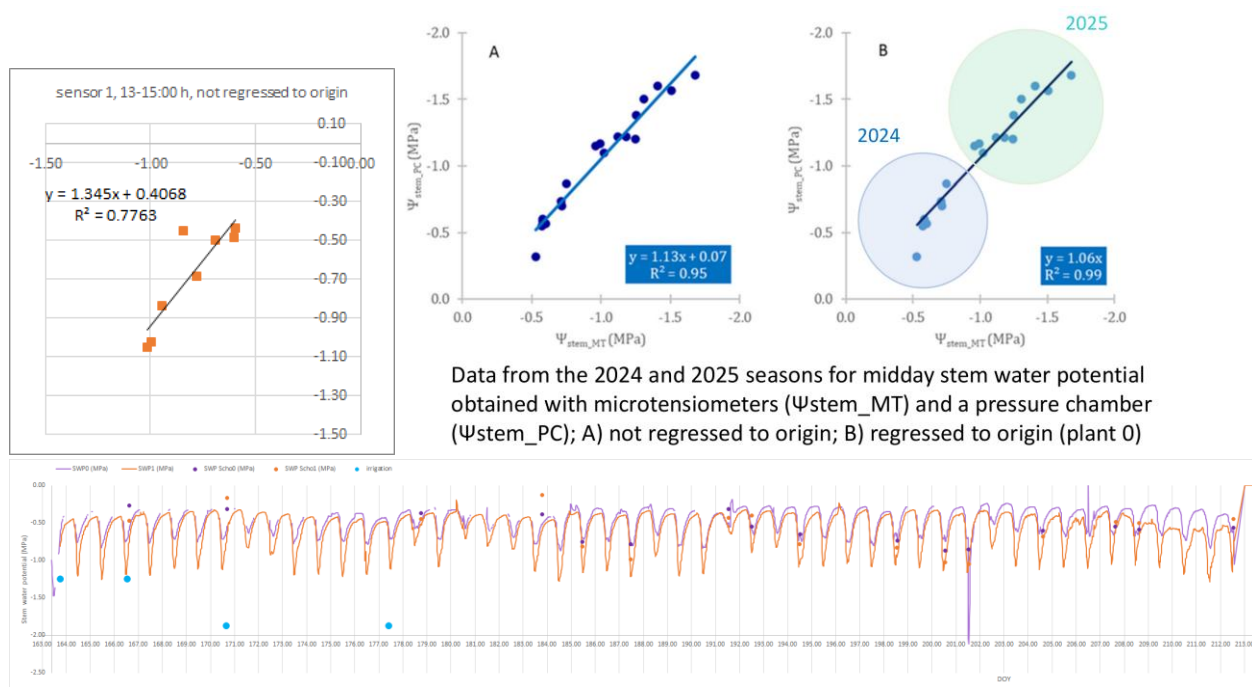
Coffee

Performance:

- Recommended for experimental use, and initial commercial testing.
- Initial results are very promising, data is consistent, and correlates well with the pressure chamber, though the measurements are somewhat different. We are exploring the reasons for this discrepancy.

Installation tips:

- Shallow installation with the new small probe design is likely critical. Requires small probes.



Preliminary data courtesy of Teresa Afonso do Paço.

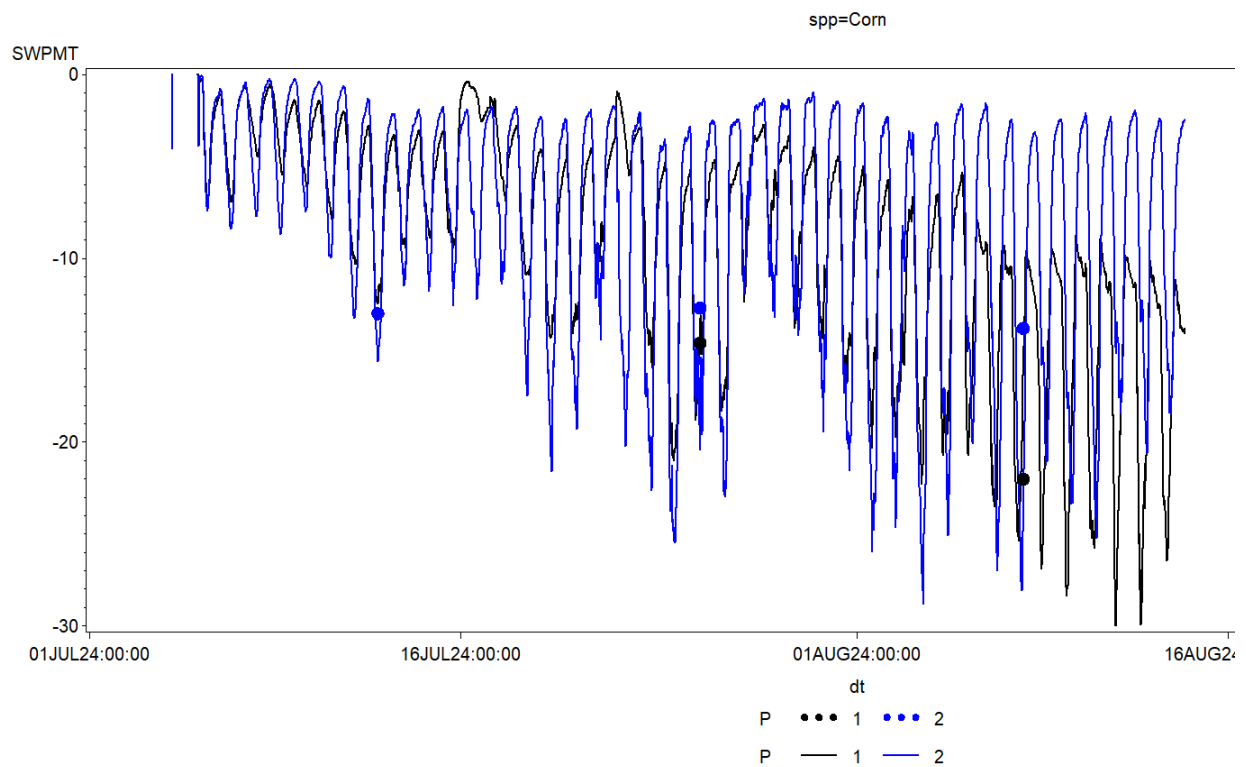
Corn

Performance:

- Small probes installed shallowly give reasonable data and agree with each other.
- Recommended for experimental use.

Installation tips:

- Installation requires care because corn stalk is soft.



Cotton

Performance:

- Recommended for experimental use and initial commercial field trials.
- Sensor measurements fit the pressure bomb very well, but some variability seen across years.

Installation tips:

- Recommend using the smaller 3mm sensor due to small trunk size of cotton.

References:

- [Bomb Your Cotton for Maximum Profit!!](#)
- [Monitoring cotton water status with microtensiometers](#)



Cypress

Performance:

- Untested.

Installation tips:

- Will need to use thick-bark installation method.
- Psychrometry has been used to measure SWP in this species, so microtensiometers will very likely work as well.

Dates

Performance:

- Potential for use in experiments if you can develop an new installation method. The default installation is challenging and only gives good data for 1-2 weeks.

Installation tips:

- Initial testing was challenging due to the need to dig through the palm frond stubs to get to the main trunk. The sensor installation sleeve would not attach securely to the trunk tissue and creating a good seal was challenging. The water-carrying tissue is soft so the sleeve nails don't hold very well. We managed to install sensors into the main stem of a frond and got data that looked reasonable for about 2 weeks before the sensors showed little/no diurnal fluctuations. Measuring water potential is theoretically possible, but a better installation method is needed. Using sleeves with nails that are 3-4x longer could provide adequate mechanical attachment.
-

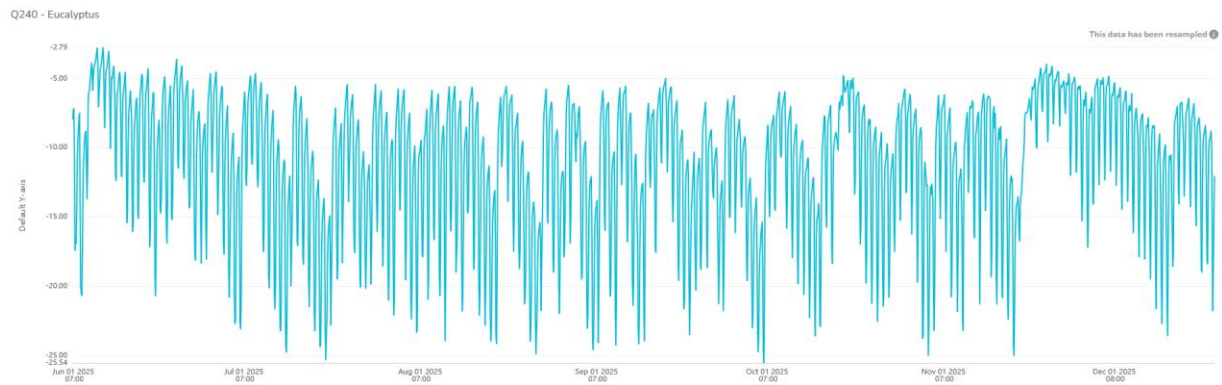
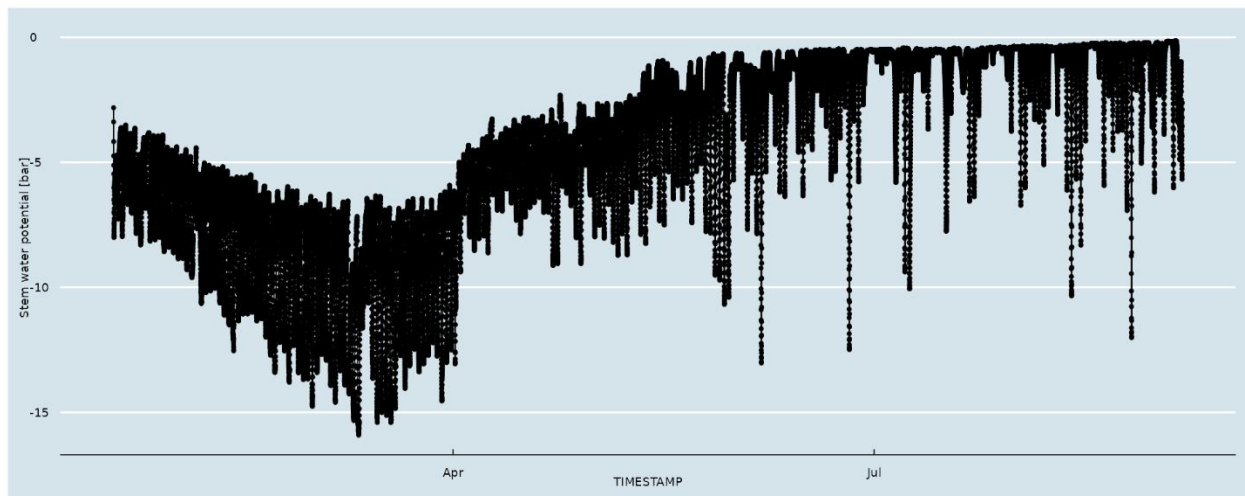
Eucalyptus

Performance:

- Recommended for experimental use.
- Good results seen in *Corymbia citriodora*.

Installation tips:

- Will likely need the thick bark installation kit.



Fig

Performance:

- Recommended for experimental and commercial field trials.
- Sensor measurements fit the pressure bomb very well.

Troubleshooting:

- Fig and related species are known for producing lots of latex. The latex generally does not interfere with sensor measurement. But if sensor is installed too shallowly, latex may block measurement and the sensor should be reinstalled.

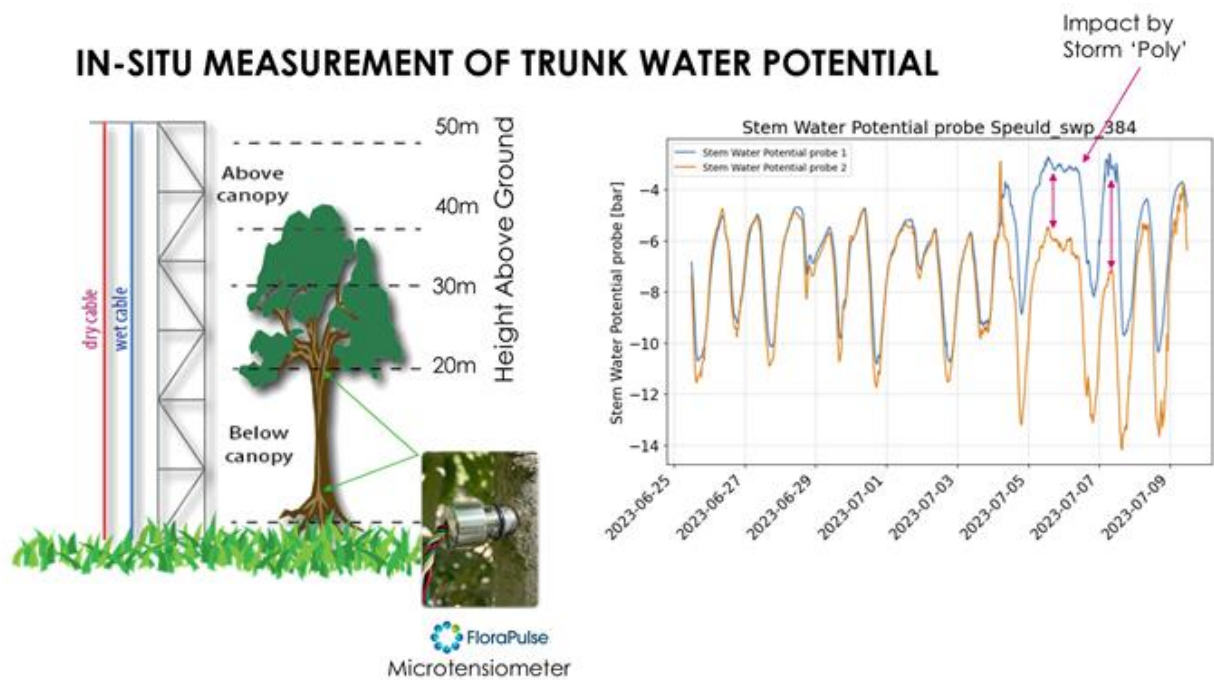
Fir (Douglas Fir tested)

Performance:

- Recommended for experimental use.
- Initial trials showed good data. Not validated against the pressure chamber.

Install tips:

- Likely will need to use thick-bark installation method.



Credit: Yijian Zeng

Grape – Wine and Table

Performance:

- Recommended for experimental and commercial use.
- Sensor readings generally correlate well against the pressure chamber.

Installation tips:

- Use the 7mm probes only, and install into a vine that is at least 0.75" in diameter.
- Sensors must be installed into vines that are large enough and healthy.
- Consider taking a core sample of nearby vines to ensure xylem is healthy. This is especially important if the vines are exposed to conditions that damage the xylem: trunk diseases (Eutypa, black foot, etc.), heavy water stress for years, sub-freezing temperatures.
- Sensors should be installed after leaf-out and re-installed each year. That being said, we have seen sensors work well for multiple years without re-installation (we're looking into this).

Troubleshooting:

- Sensors can get disconnected from xylem due to breaks in the mating compound. The sensors will then read very negative values during the hottest part of day. Reinstall.
- Sensor data will be non-sensical if sensors are installed into damaged/diseased/inactive part of wood. If your vineyard has lots of wood disease, consider installing sensors into younger vines that may be healthier.



Figure 2. Trunk disease will prevent accurate SWP readings.

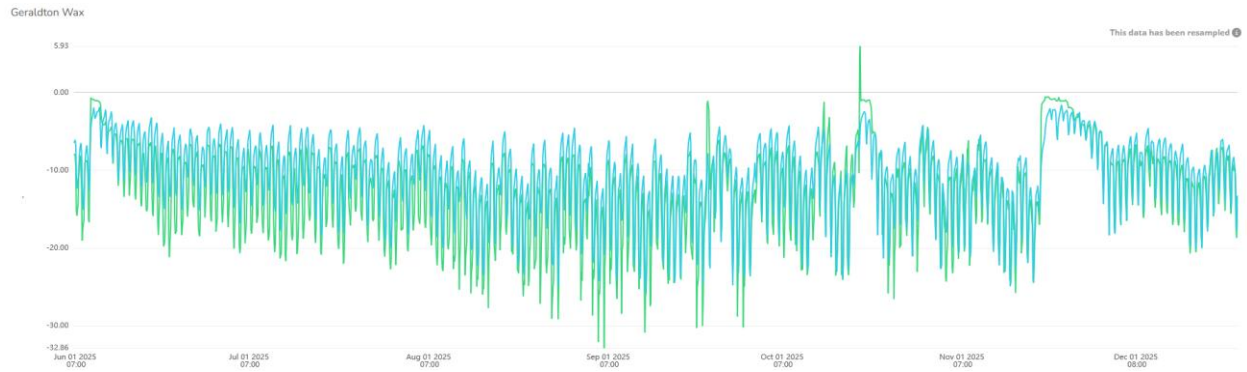
References:

- Scheduling irrigation with a pressure chamber. [Part 1](#). [Part 2](#).
- [What it's like to have real time plant stress](#)

Geraldton Wax

Performance:

- Recommended for experimental use.
- Initial testing with 7mm probes looks great.



Grapefruit

Performance:

- Recommended for experimental use.
- Initial testing with 7mm probes looks good.

Hazelnut

Performance:

- Recommended for experimental use.
- Initial testing showed good correlation with the pressure chamber.

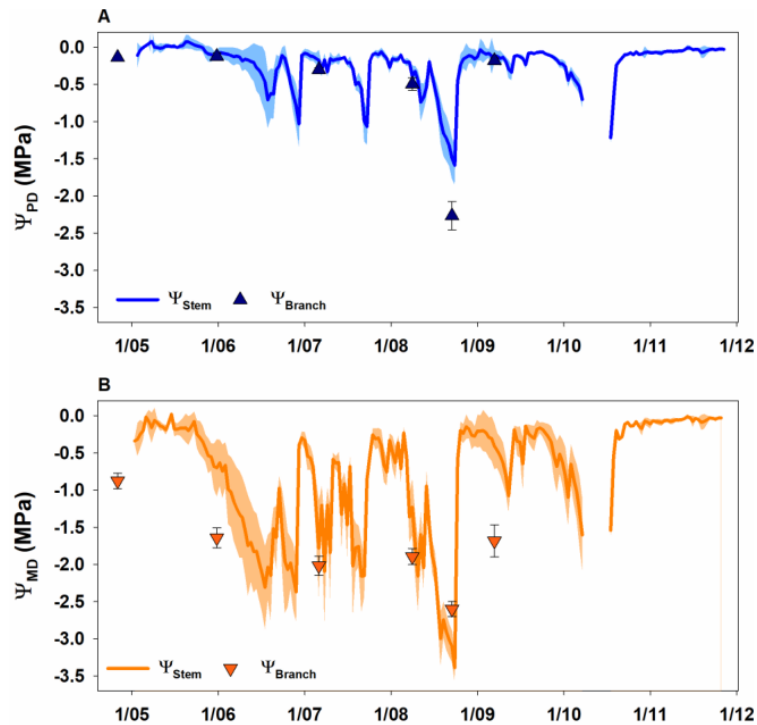
Hornbeam (*Carpinus Betulus*)

Performance:

- Recommended for experimental use.
- Initial testing of 9mm sensors looks excellent. See reference.

Installation tips:

- Thick bark method required.



References:

[Continuous stem water potential measurements of a diffuse-porous tree species offer new insights into tree water relations. Simon Haberstroh 2024.](#)

Jujube

Performance:

- Recommended for experimental and initial agricultural use.
- Initial testing of 7mm sensors looks good, trend is reasonable.

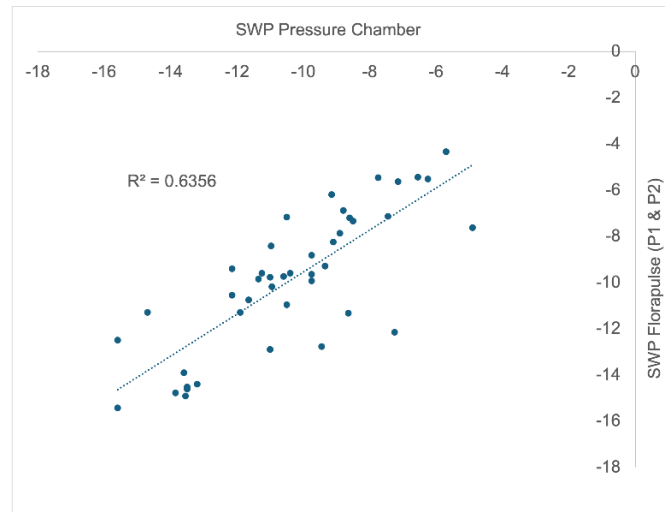
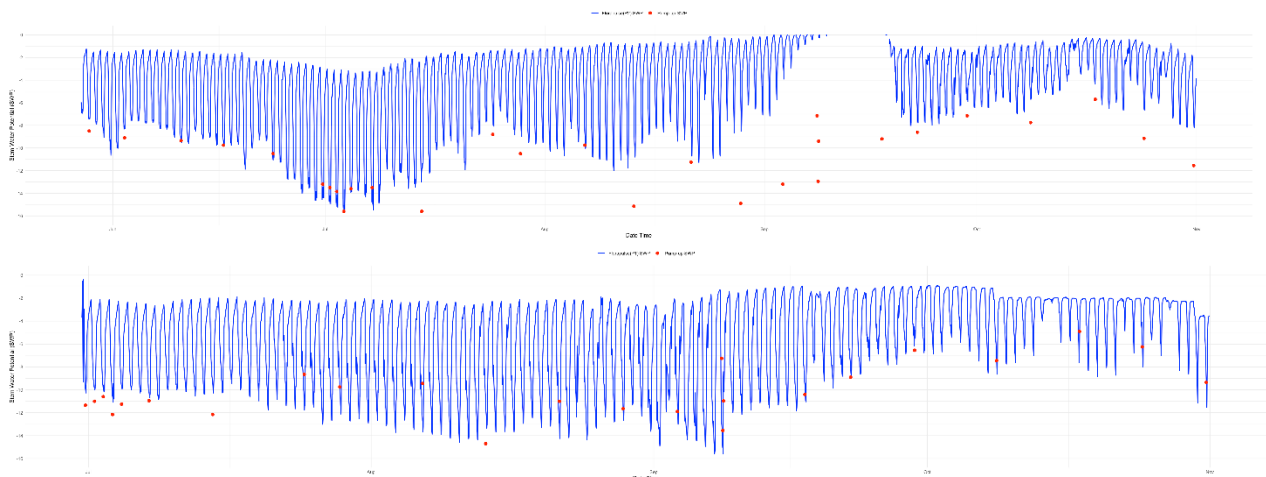


Figure 3: UC ANR Kearney REC Center Jujube trial

Comments from trial (Manpreet Singh)

- P1 produced nearly double the expected readings early in the season, then performed normally after re-installation.
- P2 readings gradually moved toward zero in mid-season but returned to normal after re-installation.
- Overall, the sensors appear to perform well and track reasonably closely with the pump-up chamber values. However, it does seem to require periodic pressure-bomb checks during the season to confirm the sensors are reading correctly.



Kiwi

Performance:

- Recommended for experimental and initial agricultural use.
- Initial testing with 7mm sensors showed mostly good results and decent correlation with the pressure chamber.

Installation tips:

- Will need to use the 7mm probes with the c-clamp installation method

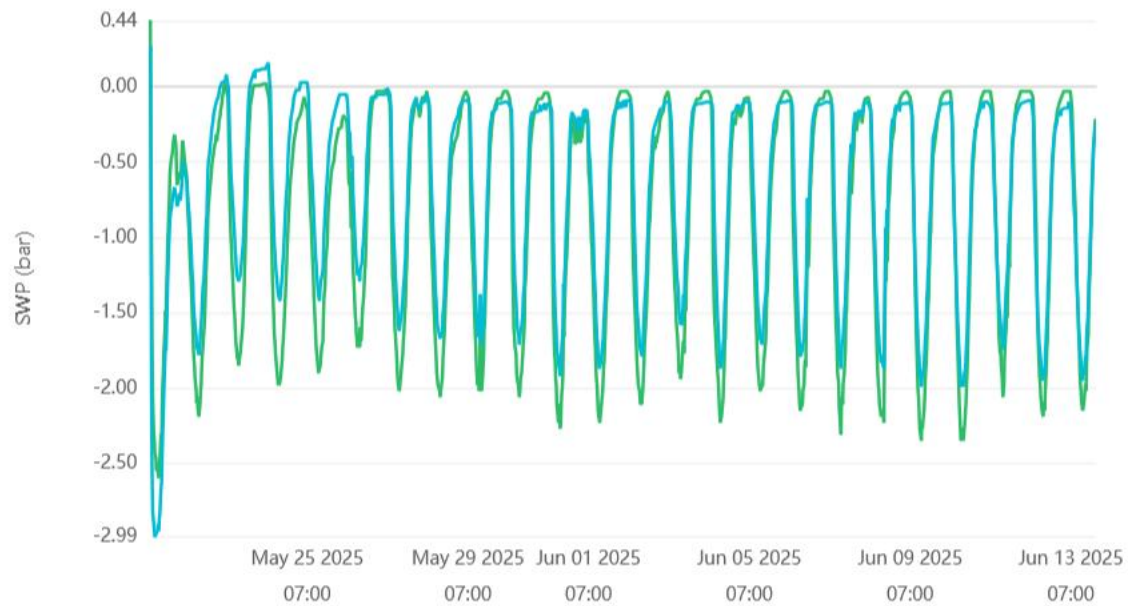


Figure 4: Quinco Kiwi trial

Lemon

Performance:

- Recommended for experimental use.
- Initial testing with 7mm probes looks good!

Lime

Performance:

- Untested. Will probably work similarly to other citrus fruits.

Lychee/longan

Performance:

- Untested.

Macadamia

Performance:

- Untested.
- We are looking for a partner to test the new 7mm sensors in macadamia. Contact us!

Mandarin orange

Performance:

- Recommended for experimental and initial grower use.
- One commercial tester, with the BIG probes, stated he “was happy with the data. Although he noted there was a fixed offset when compared to bomb measurements, the correlation made sense”.
- We expect the new 7mm probes will give even better results.
- Sensors [tested by researchers](#) displayed good correlation with pressure bomb data.

References:

- [Assessing microtensiometers for monitoring stem water potential in mandarin \(Citrus reticulata Blanco\) orchard under different irrigation regimes.](#)

Mango

Performance:

- Recommended for experimental and initial commercial use.
- Sensor testing by commercial grower was successful and met customer expectations.
- Correlation against the pressure bomb has not been tested, and irrigation thresholds are undeveloped. Recommend irrigating according to the sensor trend and past experience.

Troubleshooting:

- Mango trees produce latex. This is generally not an issue, but can happen if the sensors are not installed deeply enough. If sensors begin to read zero for more than a couple of days, recommend reinstalling them.

Maple

Performance:

- Not tested. It is possible that sensors may flood due to well-known sweet maple sap.
- Heading cut type install could give good data in this species.

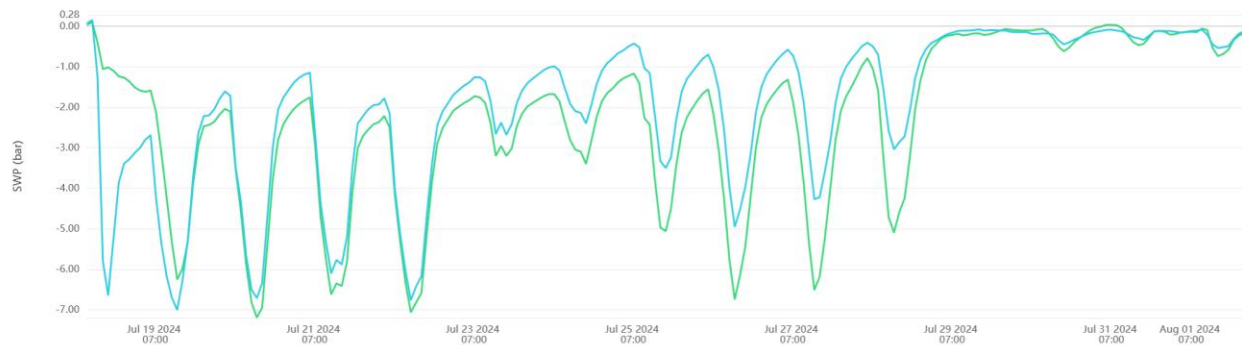
Installation tips:

- Thick bark may necessitate using the thick-bark installation method.

Oak

Performance:

- Likely poor. Initial testing showed that sensors worked well for about 10 days, then the reading got stuck at zero SWP. The tree's wounding response likely floods the sensor site, or closes the wound.
- It might be possible to get data for longer time periods if the sensors are re-installed, but it's likely to be a hassle.
- Research is needed on this tree's wounding response and ways to avoid it.



References:

- [Using midday stem water potential to assess irrigation needs of landscape valley oaks](#)

Olive

Performance:

- Recommended for experimental and commercial use.
- Favorable comparison with the pressure chamber.

Installation tips:

- Do not use in fields where SWP is expected to drop below -35 bars.

Troubleshooting:

- Depending on the region, olive trees are water stressed to -60 bars or lower. Under such negative water potentials, FloraPulse sensors will invariably cavitate and become unusable. We thus only recommend installing FloraPulse sensors where SWP is generally above -35 bars.

References:

- [Establishing a Reference Baseline for Midday Stem Water Potential in Olive and Its Use for Plant-Based Irrigation Management](#)

Orange

Performance:

- Recommended for experimental use.
- Initial testing with 7mm sensors looks promising.

Peach/nectarine

Performance:

- Recommended for experimental and initial commercial use.
- Initial testing showed favorable results, but more testing needed.

References:

- [Plant water stress derived indexes from water potential and diameter fluctuations measurements. Conesa 2023](#)
- [Moisture management in peaches – Soil Doctor tests FloraPulse in peaches](#)

Pear

Performance:

- Recommended for experimental and commercial use.
- Favorable comparison with the pressure chamber.

References:

- [Microtensiometers Accurately Measure Stem Water Potential in Woody Perennials](#)

Pecan

Performance:

- Recommended for very early experimental use.
- Normal installations get flooded due to excessive sap production at the installation site.
- Heading cut install seems to give at least decent data, but more validation/testing is needed. We'll keep testing and announce when we're ready for commercial testing.

Installation tips:

- If you wish to try various installation methods in pecan – go for it!

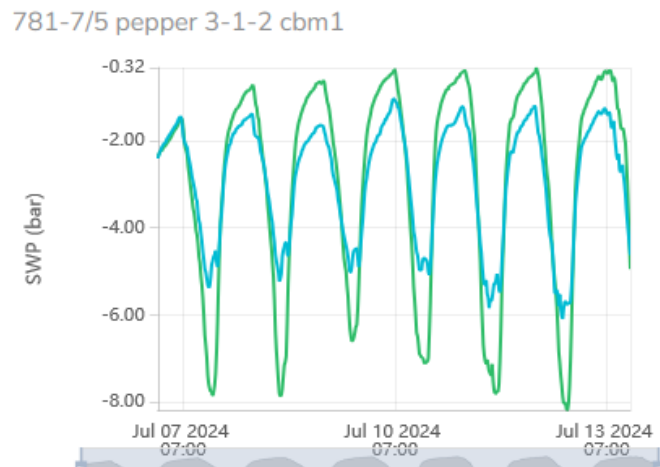
Pepper (Bell pepper tested)

Performance:

- Recommended for experimental and initial commercial use.
- First season field trial showed good correlation with the pressure chamber.

Install tips:

- Recommend using the 3mm small sensor for this crop due to the small trunk size.



Pepper installation with 3D printed jig that holds the sleeve in place.

Persimmon

Performance:

- Not recommended.
- Black oozing from sensor wound prevents measurement.
- It's possible that our new 7mm probes will work better, but this needs to be tested.

Pine

Performance:

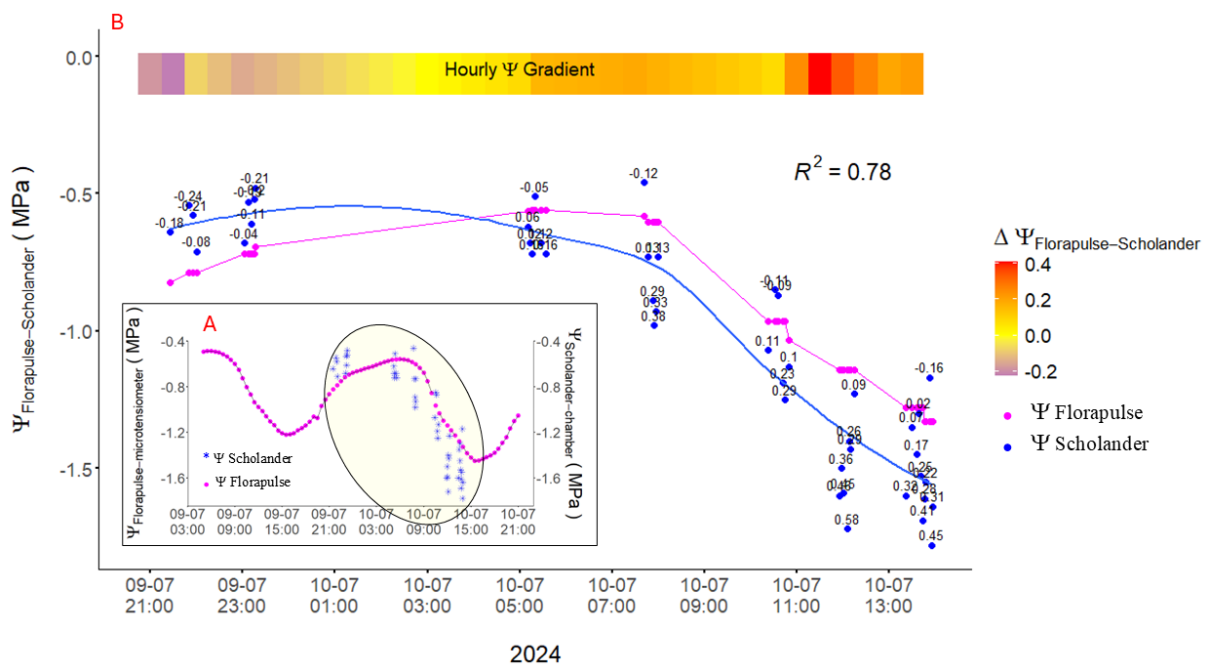
- Initial testing shows sensor can work well

Installation tips:

- Will need thick-bark installation method.
- There is concern about resin ducts blocking the sensor measurement, but initial testing has not shown this to be a problem.

Performance:

- Initial trials showed good data. Validated against the pressure chamber.



Reference: Cachinero-Vivar, A.M. and Pérez-Priego, O. (2025b, in preparation)

Pistachio

Performance:

- Recommended for experimental use.
- Field trials show good agreement between the sensor and pressure chamber.
- Sensors sometimes randomly get flooded and proceed to measure zero SWP. Reinstalling the sensor will usually fix this. We are testing to better understand what causes this wounding response and how to prevent it.

Troubleshooting:

- Pistachio trees produce latex, which can (randomly) interfere with sensor measurement. Sensors should be reinstalled if they get stuck at zero SWP.

References:

- [2021 Pistachio Irrigation: Mitigation Strategies for Drought](#)
- [Pistachio Irrigation: Determining Water Needs and Managing Drought](#)
- [Water stress thresholds for regulated deficit irrigation in pistachio trees: Rootstock influence and effects on yield quality](#)

Pomegranate

Performance:

- Untested. We are looking for a testing partner in California! Contact us.

Pomelo

Performance:

- Untested. Likely similar result to other citrus crops.

Prune/plum

Performance:

- Excellent. Recommended for commercial use.
- Sensor data generally matches the pressure chamber.
- Thoroughly validated and used commercially.

Installation tips:

- Install after leaf out, on a 2" branch. Installation into main trunk can be difficult if the bark is thick. Big and small sensors can work well.
- Sensors should be reinstalled after the winter, otherwise measured SWP will read too wet.

Troubleshooting:

- Sensor install site can get blocked and sensor will read too wet, with little to no diurnal pattern. Reinstall.
- Sensors can get disconnected from xylem due to breaks in the mating compound. The sensors will then read very negative values during hot part of day. Reinstall.
- Very old or diseased prune trees will sometimes give nonsensical data, such as reading the lowest SWP at night. If this happens, sensors should be installed in a different tree.

Guidelines:

PRUNE

Recommended level (bars below baseline)

Stress level recommended according to your specific crop, time of the season and daily weather. Uses baseline calculated from the nearest weather station data.

Wet: 0+

Crop is too wet. Greatly increases disease risk.

Moist: 0 – 2

Soil is moist - let it dry before further irrigation. Typical in March and April. Sustaining this level increases disease risk and reduces life span.

Low: 2 – 6

Favors rapid shoot growth and fruit sizing in orchards from April through mid-June

Moderate: 6 – 10

Suggested stress during late June, July and early August. Shoot growth slowed but fruit sizing unaffected. Helps decrease energy and irrigation costs.

High: 10 – 14

Avoid until fruit sizing is completed. Appropriate for late August after fruit sizing is completed. Imposing moderate to high levels of crop stress by reducing irrigation about two weeks before harvest may increase sugar content in fruit and reduce moisture content or "dry-away" (fruit drying costs).

Very high: 14 – 24

Likely to occur in late August and early September during and after harvest. Extended periods of high crop stress before harvest will result in defoliation and exposure of limbs and fruit to sunburn. Extended periods of high stress after harvest may also negatively affect the condition of trees going into dormancy.

Severe: < 24

Avoid extended periods of severe crop stress. Trees will defoliate and be exposed to sunburn, increasing risk of canker diseases. Will shorten the productive life of orchard.

References:

- [Using the Pressure Chamber for Irrigation Management in Walnut, Almond, and Prune](#)

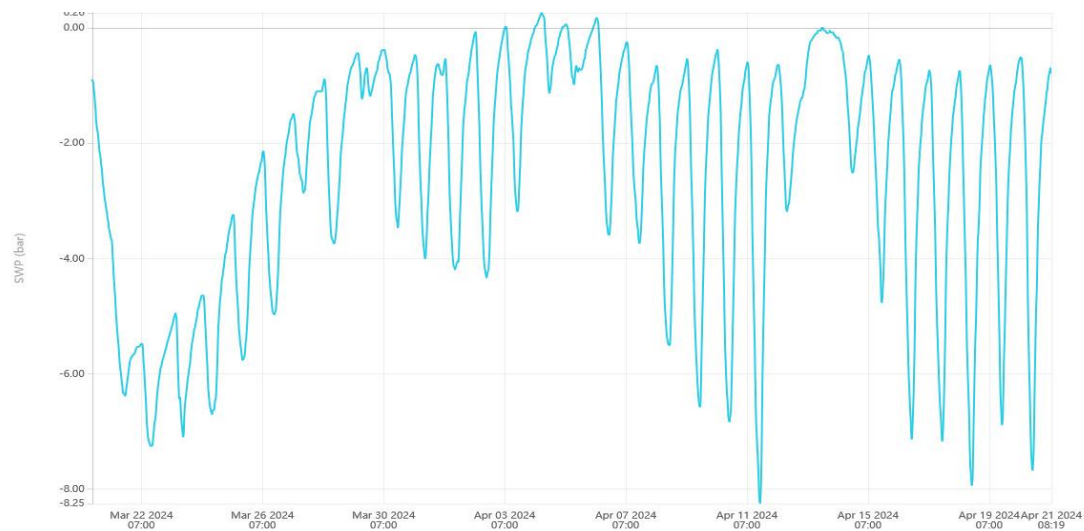
Redwoods

Performance:

- Very good. Initial testing shows strong sensor-sensor agreement and consistent diurnals. Recommended for experimental use.

Installation tips:

- Redwood bark can be over 2" thick. You will need to use the thick-bark installation method.
- Be careful with sensors installed in freezing-prone areas. Temperatures below zero can damage the sensors.



Soil

Performance:

- Microtensiometer sensors not recommended for use in soil. The existing installation method does not translate well to soil installation and would give inaccurate data. Furthermore, the sensor resolution of ~ 0.2 bars is too coarse for most soil applications, where the full range is often 0 – 1 bar.
- It's likely possible to use microtensiometers to measure WP in very dry soils, but the installation method needs development.

Install tips:

- If you wish to try our tensiometers for soil WP, go for it. Just know you'll need to test and develop an installation method. We would be happy to consult/discuss.

Soybean

Performance:

- Untested.

Spruce

Performance:

- Poor overall performance due to wounding response. Not recommended.

Install tips:

- Will need to use thick-bark install method.

Troubleshooting:

- Freezing temperatures may damage the sensor.

Tobacco

Performance:

- Initial trial started.

Tomatoes

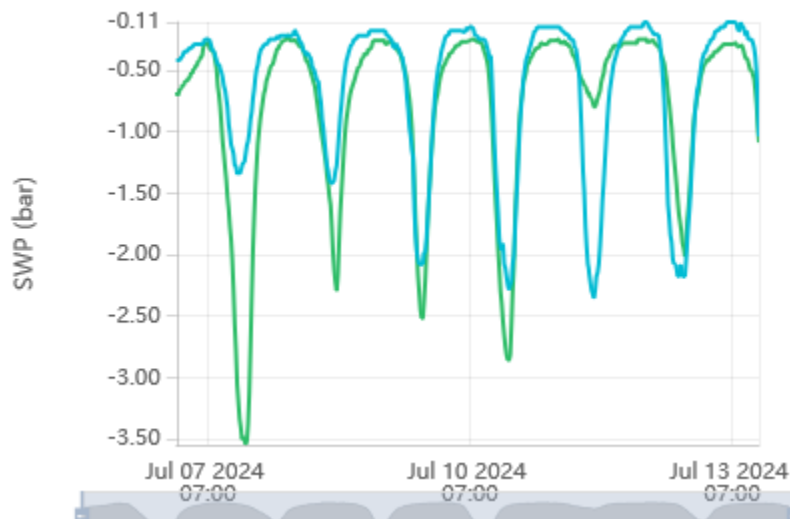
Performance:

- Small probes installed shallowly give reasonable data and agree with each other.
- Recommended for experimental use.

Installation tips:

- Installation requires care because tomato trunks are soft and small.

940-7/5 tomato 3-1-2 cbm1



Walnut

Performance:

- Recommended for early experimental testing.
- Normal sensor installations get flooded after a few days and measure zero SWP indefinitely.
- The new heading cut install appears promising and gives reasonable results about 60% of the time. We continue field trial on this crop with UC Davis.

Installation tips:

- Let us know if you wish to try this...

References:

- [Using the Pressure Chamber for Irrigation Management in Walnut, Almond, and Prune](#)