

## Product Offerings & Subscriptions

### What's included in the all-inclusive subscription service?

The all-inclusive subscription service includes two microtensiometer probes for measurement redundancy, a cellular datalogger with solar panel and battery, an irrigation pressure switch, cellular data and visualization service through our online dashboard, and yearly probe replacements. The subscription also includes full warranty coverage and technical support. The hardware is owned by FloraPulse and leased to you - you'll need to return the datalogger if you end service.

### What's the difference between analog and SDI-12 sensors?

Both use the same microtensiometer probe technology, but they communicate differently with dataloggers. Analog sensors output a voltage signal and require specific wiring and programming. SDI-12 sensors include a converter box that makes them easier to use with commercial dataloggers that support the SDI-12 protocol. SDI-12 sensors can be extended up to 60 meters and multiple sensors can be connected to a single datalogger channel, making them ideal for research applications.

### Can I get a trial or demo unit?

No, we do not offer trial units or free samples. However, we do provide a 60-day satisfaction guarantee with our subscription service. If you're not satisfied with the system's performance within this period, we'll provide a refund.

### What warranty coverage is provided?

Once installed, probes are guaranteed for one growing season. This only applies to verified species – installation into an untested species is encouraged, but not covered by warranty. [See our crop validation database](#). Dataloggers and SDI-12 boxes have a 3-year warranty against manufacturing defects. Installation tools and accessories have a 1-year warranty. For subscription customers, we replace equipment at no cost during the active subscription period. Warranty does not cover damage from freezing, mechanical damage, or misuse.

## Technical Specifications

### What is the measurement range of the sensors?

Our sensors measure water potential from 0 to -35 bars. The sensors will cavitate and require refilling if exposed to water potentials below -35 bars or to ambient air.

### What is the accuracy/resolution of the measurements?

The sensors have a resolution of 0.1 bar and accuracy of  $\pm 5\%$  of the reading. For example, at -10 bars, the accuracy would be  $\pm 0.5$  bars. Accuracy compared to the Schölander Pressure chamber is generally  $\pm 2$  bars, but will depend on the species and many other factors. These numbers are not guarantees, only guidelines for reference.

### **What power requirements do the sensors have?**

Analog sensors require 1-10V excitation (preferably 1V) with short excitation pulses to prevent heating. SDI-12 sensors require 6-18V power input. The FloraPulse datalogger is solar-powered with a rechargeable lithium battery backup.

### **What is the operating temperature range?**

The sensors operate between 5°C and 50°C (41°F to 122°F). They will freeze and become damaged below 0°C, and performance degrades above 50°C. We recommend removing sensors if freezing temperatures are expected.

### **How often do measurements get taken?**

With our dataloggers, measurements are taken every 20 minutes and uploaded hourly to the cloud. This provides detailed data about how tree water status changes throughout the day and in response to irrigation. Water potential generally changes slowly so even once per hour measurements could be enough for some species.

## **Data Management & Connectivity**

### **How is the data stored and accessed?**

For subscription customers, data is automatically uploaded to our cloud platform and accessed through our online dashboard. The datalogger also has an SD card that can be used (user provided) to store data offline. Customers using their own dataloggers will store and access data according to their system's capabilities.

### **What happens if cellular connection is lost?**

The datalogger continues recording measurements to its internal EEPROM memory during cellular outages. Once connection is restored, the backed-up data is uploaded to the cloud. If cellular signal is consistently poor, the datalogger can be operated in "SD-only mode" where data is manually retrieved from the SD card.

### **Can the sensors work with my existing irrigation control system?**

Our system provides water status measurements to inform irrigation decisions but does not directly control irrigation. However, the data can be used alongside your existing irrigation control system to optimize watering schedules. We're happy to discuss integration possibilities for your specific setup.

## **Installation & Maintenance**

### **Does the sensor damage the plant?**

Sensors have been installed into almonds, grapes, apple, and others for many years. We have not seen evidence of detrimental effects on plant health. Crops generally suffer much larger wounds due to pruning, shaking and harvesting.

### **What is the minimum branch size for sensor install?**

We recommend installation in branches or trunks at least 0.75" in diameter (19 mm) with our newest small sensor.

### **Can the sensors withstand a tree shaker?**

We recommend that FloraPulse-instrumented trees be harvested by hand and not shaken. The vibrations can damage the sensor and will certainly destroy the datalogger. Shaking damage is not covered by warranty.

### **How long does the sensor last?**

We have tested the sensors to last at least a growing season or longer. In specific crops, such as almonds, we have seen that sensors become less accurate in the second season due to wound closure. We currently recommend that new sensors be installed at the beginning of each growing season.

### **Can I reuse the sensor?**

FloraPulse sensors are designed to be installed and left in one tree permanently. Thus, we generally advise against trying to move a sensor. That being said, newer FloraPulse sensors can be removed and reinstalled in a new tree, or in the same tree, with varying levels of success. This video shows the suggested steps. This should only be attempted by advanced users (usually scientists) that can validate the data after re-installation. We recommend that growers, who need sensors that 'just work' without fuss, use new sensors every year.

### **How long does installation typically take?**

Installation typically takes 15-30 minutes per system once you're familiar with the process. This includes installing two sensors and setting up the datalogger. First-time installations may take longer as you learn the procedure.

### **What tools are required for installation?**

We provide most required tools in our installation kit, including a spatula, wire cutter, drill bit with depth stop, and installation sleeves. You'll need to provide your own cordless drill and mallet. The kit also includes consumable materials like mating compound, sealant, insulation, and zip ties.

### **At what height should sensors be installed?**

Sensors should be installed in the interior shaded canopy, in the scaffolding branches near the main trunk. Choose a spot that's easy to access and has healthy, fully-grown leaves nearby.

### **How far apart should multiple sensors be placed?**

When installing two sensors in the same tree, place them at least 3 inches apart, diagonally from each other (not directly above or below). This prevents the sensors from interfering with each other while measuring the same general area of the tree.

### **Can sensors be installed during dormancy?**

While technically possible, we recommend installing sensors after leaf-out in spring. All our testing and validation has been done with post-dormancy installations. Installing during dormancy could lead to unforeseen issues with the wounding response.

### **What maintenance is required after installation?**

Very little maintenance is required after proper installation. It may be necessary to move the datalogger if the solar panel is not receiving sunlight. Sensors should be replaced once per year after leaf-out. For scientists who own and wish to reuse sensors, it's prudent to remove and store sensors over the winter if freezing conditions are expected, then re-install them in the spring.

### **How do I know if installation was successful?**

After installation, you should see data appearing on your dashboard within a few hours. Good installation is indicated by clear diurnal patterns in the measurements - higher (less negative) water potential at night and lower during the day. Two probes in the same tree should show similar patterns.

### **What are common installation mistakes to avoid?**

Common mistakes include: not pushing the sleeve deep enough into the xylem, improper sealing around the installation site, damaging the probe during installation, placing sensors too close together, and not securing cables properly. We provide detailed installation videos and manuals to help avoid these issues.

### **Why must M1 sealant be used? Can I substitute a different sealant?**

FloraPulse requires the use of M1 sealant (Chemlink M1) at the sensor installation site. We spent months evaluating many alternative sealants and adhesives before selecting M1. The sealant must meet several critical requirements: strong adhesion to wood, long-term flexibility, absence of chemicals that could interfere with the sensor or plant tissue, and a reliable moisture barrier to prevent the installation site from drying out. No other product we tested met all of these requirements as well as M1. We have not validated any alternatives, and using a different sealant may compromise sensor performance and void warranty coverage. One tube of M1 is sufficient for approximately 20 sensor installations. M1 (Chemlink M1) is commercially available and can be purchased from FloraPulse or various online retailers.

## **Field Placement & Setup**

### **Do you need one in every plant?**

No. When a new field is set up, irrigation blocks are shaped so that the soil and plants in each block have similar characteristics and thus will have similar water status. We recommend installing 1 system per irrigation block in a representative tree. You may choose to install the sensors at sites you use for pressure chamber monitoring.

### **Do you need cell reception?**

Our datalogger uses a cell modem to send the sensor information to the cloud through 2G/4G signal. Thus, you will need adequate cellular reception to use the FloraPulse dataloggers. Our sensors are sold individually and you can connect them to third-party dataloggers with other connection modalities.

### **Sales & Distribution**

#### **Do you sell worldwide?**

FloraPulse current sells sensors worldwide through distribution partners and direct sales. Our subscription service and dataloggers are generally only sold in the USA, but we can make exceptions. We have a minimum order size for all international order containing telemetry equipment (dataloggers). Please contact us and we can find which option works best for you.

#### **What are your lead times?**

Depending on the season, lead times can vary. Most orders start at the beginning of February and continue into the summer. Please place your order in advance to ensure you get it on time!

#### **How do I place an order?**

Contact us through our website or via an email to [admin@florapulse.com](mailto:admin@florapulse.com). We can then send you initial information and discuss quotes. Each client is different and we want to ensure that you have the best experience possible!

#### **Can you install the probes for us?**

At this time, we rarely install the probes for our customers. The installation process is pretty easy and is generally done by the grower. Call us and we can figure something out if you have concerns about the installation!

### **Crop Compatibility**

#### **Which crops have been validated for use?**

Our sensors are thoroughly validated in many tree crops including almond, prune, apple, peach, apricot, plum, cherry, olive, hazelnut, and grapevines. We also have experimental success in crops like citrus, pear, mango, blueberry, and others. Some crops like walnut, avocado, and pecan are currently not recommended due to their strong wounding response.

#### **Can I use the sensors in greenhouse crops or container plants?**

Our sensors are designed for woody plants with stems/trunks at least 0.75" (19mm) in diameter. While we have some experimental success in greenhouse crops like tomatoes and peppers, the sensors are primarily validated for orchard and vineyard use. Container plants typically don't have large enough stems for proper installation.

#### **Do different varieties of the same crop respond differently?**

In our experience, different varieties of the same species respond similarly to the sensors. For example, all varieties of almond or wine grape varieties show similar measurement patterns. The main requirement is adequate stem size for installation.

### **What trunk/stem size is needed for installation? Can sensors be used in young/developing trees?**

Our newest 7mm sensors require a minimum stem diameter of 0.75" (19mm). Young trees can be monitored once they reach this size, though you'll need to be more careful with installation as the wound represents a larger portion of the stem circumference. The sensors work well in developing orchards to help optimize irrigation for maximum growth.

### **Understanding Stem Water Potential**

#### **For knowing the water stress that plants are feeling, what is the best measurement?**

The performance of plants (growth, opening of stomatal pores on leaves to allow photosynthesis and evaporative cooling, movement of sugars and minerals, etc.) depends on the water potential or how hard the plant has to pull to extract water from the soil. Thus, for understanding the amount of stress plants sense, measuring the water potential is best, especially if it is measured directly inside the plant. For this reason, we developed the FloraPulse microtensiometer.

#### **What is SWP?**

The data collected by the microtensiometer is Stem Water Potential (SWP). SWP is a measure of the tension within a plant's stem, or in other words the force required to move water up the tree. It is typically measured in bars or megapascals. Stem water potential cycles throughout the day as sunlight and temperatures change.

#### **What is the difference between water content versus water potential?**

When dealing with any wet material such as soil or plant tissue, there are two important properties related to water. Water content is how much water the material holds, expressed as a percentage or amount (30% water or 0.3 grams of water per cubic centimeter of soil). The water potential is how tightly the tissue holds the water, expressed as a pressure (-3 bars). This can be illustrated by thinking of a sponge and a chunk of clay. It is easy to squeeze almost all the water out of a wet sponge, but much harder to squeeze out of the wet clay even though both may have the same water content when wet.

#### **Can you gather data over the winter?**

Yes – the sensors measure the plant water status over the winter, even when there are no leaves. This data could help ensure that plants are not water-stressed when the growing season re-starts in the spring. But this capability is still under study and development. Keep in mind, the sensors will freeze and break if temperatures drop substantially below 0 °C.

#### **How have you tested the microtensiometer?**

FloraPulse has done season-long field trials in fruit and nut crops with academic and industry partners. Look us up online and you will find a number of published research papers that validate the sensor function in many crops.

## **Data Interpretation & Analysis**

### **How do I interpret the measurement data?**

Our dashboard shows both 24/7 real-time measurements and daily midday stress levels. The measurements are in bars, with more negative numbers indicating higher water stress. Each crop has specific stress ranges that guide irrigation decisions. Look for patterns in the daily cycles and how trees respond to irrigation events.

### **What do the different stress levels mean?**

We use color coding to indicate stress levels from low (blue) to severe (red). For example, in almonds, -10 to -14 bars indicates mild stress suitable for most of the season, while -14 to -18 bars represents moderate stress that might be appropriate during hull split. Each crop has specific guidelines based on research and field validation.

### **How does weather affect the measurements?**

Weather conditions, particularly temperature and humidity, affect tree water stress. Our baseline feature accounts for these effects by calculating the expected water potential for fully-irrigated trees under current weather conditions. This helps distinguish between stress from lack of water versus environmental conditions.

### **What is baseline water potential?**

Baseline is the expected water potential for a fully irrigated tree under current weather conditions. The difference between your measurements and the baseline indicates tree stress due to soil moisture depletion. This helps separate the effects of weather from irrigation needs.

### **How do measurements compare to pressure bomb readings?**

Our sensors measure the same parameter (stem water potential) as a pressure chamber, but continuously and automatically. The measurements typically correlate well with pressure chamber readings, though there may be slight timing differences since our sensors have some response lag. You can enter pressure chamber readings on our dashboard to compare.

### **What time of day should I look at the data?**

While we provide 24/7 data, midday measurements (typically between 12:00-4:00 PM) are most important for irrigation decisions as this represents maximum daily stress. Predawn measurements (just before sunrise) can indicate soil moisture status. The dashboard automatically calculates and displays midday SWP.

### **How do I know when to irrigate based on the readings?**

Generally, irrigate when measurements reach your target stress threshold for your crop and growth stage. For example, you might irrigate almonds when they reach -14 bars during normal growth. The tree should recover to milder stress levels after irrigation, then gradually increase stress until the next irrigation is needed.

### **Can historical data be downloaded?**

Yes, all data can be downloaded as CSV files from the dashboard. This includes raw 20-minute measurements, daily midday values, and irrigation events. Historical data is valuable for understanding long-term patterns and improving irrigation management.

## **Troubleshooting**

### **What if my sensors show unusual readings?**

First check that the installation site is properly sealed and the probe isn't damaged. Common issues include: readings stuck at zero (cavitation), very negative spikes (poor hydraulic connection), or gradually decreasing response (drying installation site). Contact support if issues persist. Check out our [Data Analysis and Troubleshooting Guide](#).

### **How do I know if a sensor has failed?**

Signs of sensor failure include: completely flat readings, extreme variations, positive pressure readings, or no response to irrigation. Having two sensors per tree helps identify failures since both should show similar patterns. Contact support if you suspect sensor failure.

### **What causes sensor readings to drift over time?**

Drift can occur from the tree's wound response, seasonal changes in wood structure, or installation site issues. This is why we recommend annual probe replacement for subscription customers. Some crops are more prone to drift than others.

### **How do I check cellular signal strength?**

You can check signal strength by connecting to the datalogger with the provided USB cable. A signal strength above 15 is good, while below 10 is considered poor. External antennas are available to improve reception if needed.

### **What should I do if the datalogger stops uploading?**

First check that the solar panel isn't blocked and the battery is charging. You can verify logger operation by connecting via USB. Sometimes a simple power reset solves upload issues.

### **How long do batteries typically last?**

The datalogger's lithium battery typically lasts 3-5 years with proper solar charging. Battery voltage should stay above 3.6V during normal operation. If voltage drops consistently, check solar panel placement or consider battery replacement.

## **Business & Support**

**Do you have distributors in my region?**

We work with distributors in various regions worldwide. See [our distributor page](#) for current distributor information. International customers can also purchase directly from FloraPulse depending on order size and location.

**What technical support is provided?**

We provide installation guidance, troubleshooting assistance, and data interpretation support via email and phone. Subscription customers receive priority support and equipment replacement as needed. Response time is typically within 2-5 business days.

**Can you provide training for our staff?**

While we don't typically provide on-site installation, we offer comprehensive installation videos, manuals, and remote support to train your staff. Our installation process is designed to be straightforward and can be learned quickly.

**Are there any ongoing maintenance costs?**

For subscription customers, all maintenance and replacement costs are included. For individual sensor purchases, you may need to budget for annual probe replacements and one-time-use installation parts (such as sleeves and mating compound).

**What happens if I need replacement parts?**

Subscription customers receive replacement parts at no cost. Other customers can purchase replacement parts as needed. We maintain stock of all replacement components and can usually ship replacement parts quickly.

**Do you offer consulting services?**

We focus on providing reliable measurement technology rather than consulting services. However, we're happy to provide general guidance on using our system for irrigation management and can recommend consultants if needed.

**Can the system integrate with other farm management software?** FloraPulse data in the cloud can be accessed through API for large-enough clients. Contact us for details.