

System installation manual

This guide provides written instructions for installing the FloraPulse probes and datalogger. We strongly recommend watching the instructional installation video to see the whole process. Most customers should only watch and follow the default installation video. The other videos are mainly for experimental users and scientists.

Links to installation videos:

- [Default installation video](#) (written instructions shown below)
- [How to remove/reuse probes](#) (video only)
- [Installation into thick-bark trees](#) (video only)
- [Installation into small trunks](#) (video only)

Crop requirements:

- **Minimum trunk diameter of 2"**. Installation into smaller trunks may cause inaccurate readings because the sensor installation wound is too large in relation to the trunk/branch diameter.
- **Healthy**. Installation into diseased or very old trees/vines will produce inaccurate results.
- **Validated crop**. The sensor has been tested and validated in many crops. The lists below catalog the status of various crops. We recommend typical growers stick to **validated** crops. Curious growers and scientists can test our systems in **experimental** crops. We do not recommend use at all in **not recommended crops** because our testing indicates that the sensors usually flood and only measure zero SWP.

Validated	Experimental	Not Recommended
Almond	Citrus	Walnut
Prune / Stone fruits	Grape (< 2 inches)	Pecan
Grape (> 2 inches)	Cotton	Avocado
Olive	Blueberry	Persimmon
Hazelnut	Pistachio	
Fig		
Mango		
Apple		

Important notes:

- Sensor installations are generally permanent. The sensors are difficult to remove and reuse correctly. Plan accordingly. An experimental method exists to reuse the probes, but results are not guaranteed (see <http://florapulse.com/resources>).
- The sensors will accurately measure water potential for one growing season. We recommend sensor replacement every year at the beginning of the growing season for best results.
- Temperatures below 0 °C can freeze the water reservoir inside the sensor and damage it. This may cause problems in areas with cold winters. Sensors should only be installed after risk of frost has passed.
- We recommend that FloraPulse-instrumented trees be hand-harvested. Machinery, shaking and vibrations can damage the sensor wires and datalogger, and will void all warranties.

Installation Kit and Tools needed

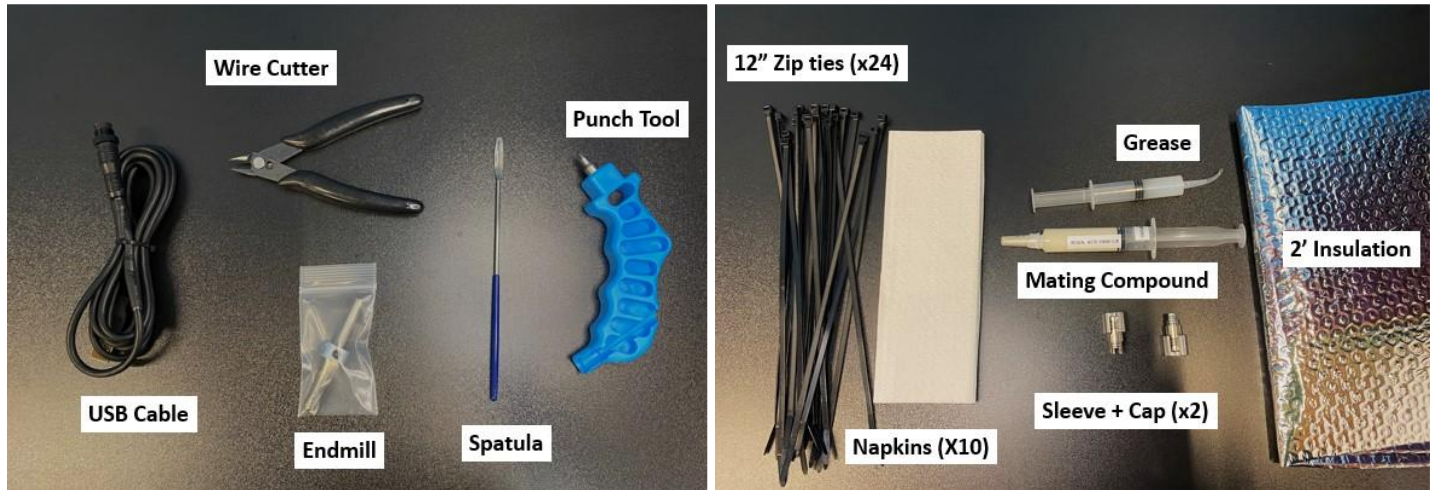


Figure 1: FloraPulse provided installation materials and tools. Install tools (left) are 1 per customer. Disposable install materials (right) will be provided per every 2 probes (1 datalogger).

Materials for Install

- Install Tools:
 - Cordless drill (not provided)
 - 2lb mallet (not provided)
 - Spatula
 - Wire cutter
 - Endmill with drill stop
- For Every 2 Probes:
 - 2 Sleeves and Caps
 - Mating Compound Syringe
 - Grease Syringe
 - Insulation
 - Zip ties
 - Napkins

If needed:

- Laptop with Serial Terminal Program downloaded (for checking cell signal status)
- USB Cable
- Phillips screwdriver to open datalogger lid
- Parafilm to reseal the mating compound
- Extra Sleeves
- Steps Checklist (on the last page of manual)



Figure 2: Drill and Mallet for installation (not provided)

Install Instructions

For the probe(s):



Install early in the season after leaf-out. Do installation without long pauses to avoid drying out the wound, sensor, or mating compound.

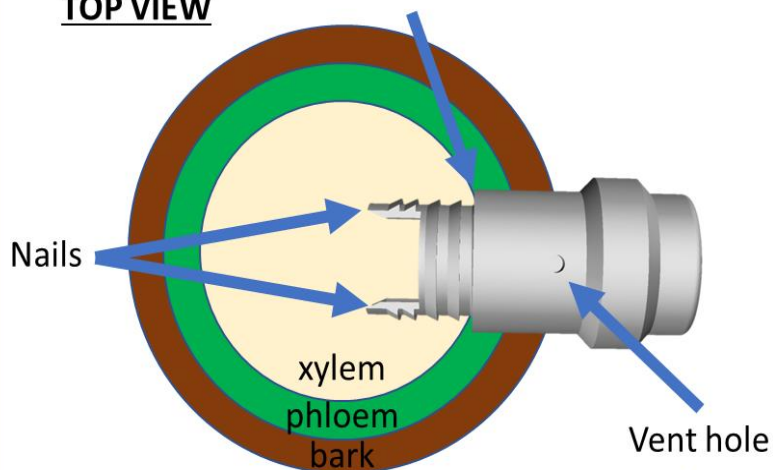
Install at the top of the main trunk, or at the base of a 2+” scaffold branch. Pick a site that is healthy and flat without knots.

Older trees often have thick bark (thicker than 4 mm) that will interfere with installation. Remove this outer bark at the installation site to create a flat site to hammer into.

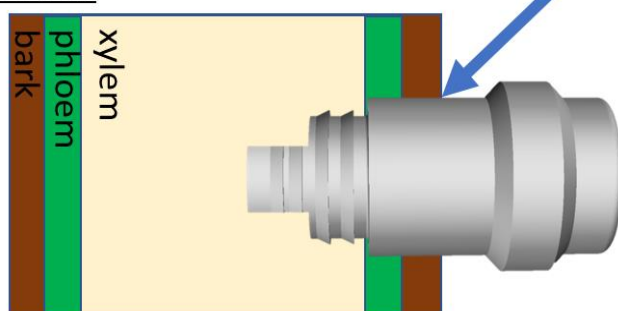


Hammer until step crushes through soft phloem/bark, cannot penetrate hard xylem wood.

TOP VIEW



SIDE VIEW



1. Remove the cap from the sleeve. Gently push the sleeve into the install site, with the vent hole facing up trunk/branch and the nails on the sides (parallel with the xylem direction).

Hammer sleeve into the wood. The sleeve step will crush through the soft bark and phloem tissue, but will stop at the harder xylem tissue.

In other words, use a hammer to **pound the sleeve into the tree until the sleeve will not penetrate into the wood any deeper**. The step will easily crush through the soft bark/phloem tissues, but it will not penetrate into the harder xylem tissue.

Insufficient hammering of the sleeve will allow wounding gels to infiltrate the install site and block the sensor!

2. Drill into sleeve with the provided end-mill until the drill stop. Pull out the bit periodically to remove the wood shavings.



Drill Stop





Use the spatula from your install kit to clear any remaining debris. The hole should look bright white - abandon install site if it looks brown or discolored.



3. Uncap the mating compound syringe, and fill sleeve with mating compound from bottom up to avoid air bubbles. **Ensure mating compound can exit through vent hole. In trees with thick bark or phloem, the vent hole may be covered. If so, use the spatula to dig into the phloem to open the vent hole.**

Cap syringe to prevent it from drying out. (Reseal with provided parafilm for long term storage).



4. Remove sensor plastic capsule and gently place sensor in sleeve. **The sensor will dry out if left exposed to dry air without the capsule – so insert it right away.** Follow with spring and cap. The spring goes between the sensor and cap and pushes the sensor towards the xylem.

Note: Handle the sensor with care, and do not force it into the sleeve. Cap and spring will push the sensor against the xylem with a pre-defined force as the cap is screwed in.





6. Clean off excess mating compound with spatula/napkin. Excess mating compound will prevent grease from sealing.



7. With the wire cutters, cut the end of the grease syringe and deposit grease over the vent hole and around the perimeter of the sleeve.

Note: if the install is reading dryer than expected and the sensor data seems to consistently drift down, the seal may have failed allowing humidity to escape. Adding more grease can sometimes fix this issue.



8. Install a second sensor into same tree/vine for verification. Install at least 3" to the side or diagonally away from the first sensor (not directly above or below because the sensors will interfere with each other).



9. Zip tie probe wire to trunk. This helps protect the probe from being yanked out if the cable is pulled.

Zip tie excess wire against the trunk as well. Loose wire can get caught in machinery.



10. Zip tie the bubble wrap insulation around the trunk. Add zip ties above and below the installed sensors. You can chain zip ties together to make a longer tie as needed.

The main purpose of the insulation is to protect the sensors from UV light and dramatic changes in temperature from sun exposure. In wet climates, the insulation should be attached loosely to allow condensation to dry out and prevent accumulation of water. Excess moisture in the install will hinder measurement accuracy and may lead to mold problems.

Hang the datalogger:



IMPORTANT Before Install:

Using a screwdriver, open the logger and remove the plastic tab from the battery to reconnect the circuit. Remove cardboard covering the solar panel to expose the logger to sunlight.

Note: You can complete this step inside and bring the logger to the field after.



1. Hang logger from branch, facing up and to the south. Attach each corner of the logger with a small loop to two branches in a 'Y'-shaped branch to prevent the logger from rotating. Ensure the logger will not rotate and is well-attached, with at least 3 attachment points.

	Alternatively, hang logger from trellis wire or support posts. If you plan to use a shaker to harvest this tree: hang the logger from a post. Shaking the logger will break it. Ensure the logger is placed in a location that will not be harmed by machinery.
	2. Zip tie extra wire in a loop to prevent it from catching onto machinery.

Pressure switch installation:

	1. Connect pressure switch wire to the 8-pin port on the datalogger and tighten the nuts to create a waterproof seal. Be careful to align the notch on the connectors. Do not force them together as this will break the fragile gold pins.
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	2. Using the provided drip punch tool, punch a hole in the nearby irrigation tubing (main line). Then push the pressure switch barb into the hole. *You can use the back of the hole punch to assist you when feeding the barb into the tubing.
	3. Use zip ties to attach the pressure transducer to the drip line. Then zip tie the cable tightly, following the drip line and tree trunk all the way to the logger. Tie all loose wiring so it doesn't get caught by passing machinery.

Loggers need cellular data to upload

Dataloggers need cellular data to upload. The included SIM card connects to most cellular carriers in the United States. Please ensure your field has some cell coverage. You can use the included USB cable and a laptop to connect to the logger and check for cellular connection. If cellular signal is poor, you can add an external antenna to increase reception. These options are discussed in the datalogger manual.

Protecting the system during harvest:

*****DATALOGGERS SHOULD NOT BE LEFT ON THE TREE WHEN SHAKING OR MACHINE HARVESTING*****

Ideally, the FloraPulse system should be installed and running continuously. However, harvest machinery may damage the logger if it is left attached during the harvest period. You can protect the FloraPulse datalogger for harvest as follows:

1. Leave sensors installed in tree or vine.
Add more covering around the sensors for protection if desired. You may use cardboard boxes or more batting for this purpose.
2. You may choose to leave the datalogger attached to the probes and place it on the ground away from harvesting machinery.
3. Alternatively, write down the datalogger number and which sensor is connected to each logger channel (i.e., mote #340-1 has sensor delta55, #340-2 has sensor delta 57), disconnect the sensors and remove the datalogger. After harvest, mount logger again in area with sunlight and reconnect sensors.



Figure 3: Probe labels are found at the 5-Pin connectors.

Winter storage of loggers:

Disconnect the logger as detailed above. Open and wedge a plastic piece (such as part of a credit card) between the battery and terminal to cut off power. Leave the plastic inside the datalogger for the winter season. Disconnecting the battery this way will prevent the battery from draining when the logger is stored over the winter.

Keep the logger indoors, away from sunlight. You may choose to remove the probes as well to protect them from the cold (see reuse manual).

If storing the probes over the winter, keep track of which port is connected to which probe by writing down the names on the labels (Fig. 3).



Figure 4: Use a plastic tab to cut off datalogger power for storage

Installation Steps and Checklist

Bring this page to field installations to check off each installation step and bring all the materials.

Probe Install:

- ☐ Hammer the sleeve into 2"+ trunk/branch. Vent hole faces up.
- ☐ Drill into sleeve with end mill until stop.
- ☐ Fill sleeve with mating compound.
- ☐ Uncap the probe and place probe inside the sleeve right away.
- ☐ Screw on metal cap to push spring against sensor.
- ☐ Clean off excess mating compound.
- ☐ Add grease around sleeve/bark.
- ☐ Install second probe 3" away diagonally.
- ☐ Wrap both probes with insulation.

Hang Datalogger:

- ☐ Remove plastic tab from battery.
- ☐ Remove cardboard from solar panel.
- ☐ Check for cell signal (optional).
- ☐ Hang the logger in the canopy with 3 attachment points facing the sun.
- ☐ Zip tie secure excess wiring to tree.

Pressure Switch:

- ☐ Connect pressure switch to logger.
- ☐ Punch a hole in the top of the main irrigation line
- ☐ Press hose barb inlet on pressure switch into irrigation tubing hole.
- ☐ Secure pressure transducer to the line.
- ☐ Secure loose wiring.

Bring to Orchard:

<u>Item</u>	<u>Needed</u>	<u>Verify #</u>
Dataloggers + 2 probes	# to install	
Sleeve + cap	1 per probe	
Mating compound + grease	1 per logger	
Insulation	1 per logger	
Napkins + zip-ties	Lots	
Pressure switch	1	

Tool Bag and Extras

Cordless drill	1	
2 lb. mallet	1	
Endmill w/ step	1	
Spatula	1	
Wire cutter	1	
USB cable (optional)	1	
Laptop (optional)	1	
Screwdriver	1	
Drip punch tool	1	
Extra sleeves	1 per probe	
External antenna	as needed	