

# USING DENDROMETERS TO MANAGE PLANT STRESS

## DENDROMETERS

Dendrometers precisely measure plant growth, fruit maturity and stress. As plant growth is very sensitive to growing conditions such as water supply, weather conditions and nutrition, they can be useful indicators of how the crop is being managed.

Care is required in interpreting dendrometry growth data as many factors affect growth. They are best used as learning tools – for example, to watch finer-scale growth patterns in the crop – rather than a simple decision support tool.

## INSTALLING THE DENDROMETER

The following information serves as a brief overview of dendrometer installation. Specific installation instructions for your chosen dendrometer should be covered in the manufacturer's installation guide.

### General installation tips:

- A dendrometer should be installed on the south side of a tree (in the southern hemisphere) to reduce the equipment's exposure to direct sunlight
- Use your knowledge of the paddock, aerial photos, and satellite imagery to help locate a monitoring location that is typical for the crop

### Pivot dendrometer

- Attach and secure the dendrometer to the stem of the plant being monitored by opening the three pressured levers and closing them around the stem
- For smaller stems, the weight of the dendrometer may need an external support



Pivoting stem dendrometer installed on a young citrus tree

## TYPES OF DENDROMETERS

Dendrometers that can monitor and send data back in near-real time are required. There are two types of dendrometers commonly used in horticulture:

1. **Pivot dendrometers** are used for annual crops with stems up to 40mm in diameter. They are simple to install and are lightweight. They can be installed 4-6 weeks after seedling stage.
2. **Band dendrometers** are used for tree crops and are designed for long-term semi-permanent installations. They have a large range of motion and can be installed on all sizes of trees with trunk diameters greater than 80mm.

### Band dendrometer

- Measure the circumference of the selected tree, the steel dendrometer tape should be 25cm longer than this circumference
- Secure the tape to the dendrometer and wrap the tape around the tree, before inserting back into the dendrometer
- Ensure the tape remains under tension during the installation process



Band dendrometer installed on an avocado tree.

# DENDROMETERS

## May 2023



### MANAGING THE DATA

#### Stem growth rate

Trunk or stem growth rate is a good overall indicator of plant health. A healthy plant will show a consistent, continual growth rate, whereas a stressed plant will grow slowly.

There are many factors which can change trunk or fruit growth rates including soil moisture (waterlogged or dry soils), weather conditions outside the plants favoured conditions (e.g., to cool or warm), poor nutrition, crop load, tree phenology, shading, and pest and diseases.

It is best to compare stem growth rates to historical data from the same or a similar crop or compare data from other dendrometers installed on the farm.

#### Maximum daily shrinkage

High resolution dendrometers are used to monitor the diurnal swelling and shrinkage of stems or fruits, in other words the daily 'peak to trough' difference in stem or fruit diameter. The peak diameter is reached in the early morning, with most growth happening overnight.

During the day, stems and fruit will shrink and reach a trough by night-time. This occurs because large amounts of water is lost from the foliage as the plant captures CO<sub>2</sub> from the atmosphere as part of photosynthesis. With so much water being transpired, the trunk or fruit can shrink or not grow during the day.

**Maximum Daily Shrinkage (MDS)** measures the daily peak to trough, and with careful interpretation it can be

used as an early indicator of plant stress when combined with daily growth measures. MDS is the most sensitive physiological measurement for detecting early plant stress. There are strong positive relationships between MDS and evapotranspiration, solar radiation, and vapour pressure deficit.

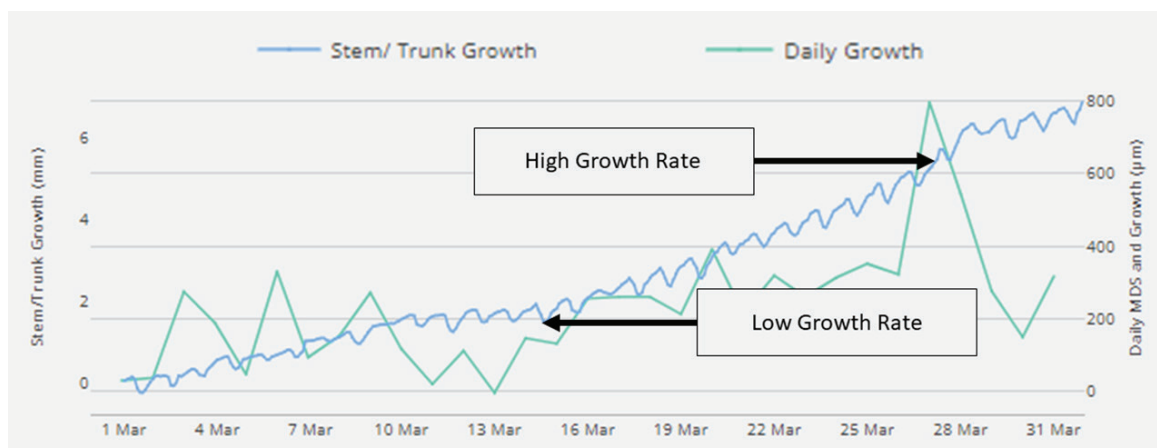
Under well-watered conditions, daily growth will be positive and the MDS values will vary depending on environmental conditions. When plants are under early water stress, growth stops (daily growth low or zero) and MDS values increase, indicating a water deficit.

If the water deficit increases, daily growth can become negative and the MDS values will increase further until a threshold value where the trunk of the tree has no water reserves. At that point, MDS values will rapidly decrease under severe water stress. This level of water stress might have a negative effect on long-term tree health and productivity.

### MAINTENANCE

**Pivot dendrometers** require very little maintenance over their service life but should be inspected periodically to ensure that they have not shifted on the stem

**Band dendrometers** use a strip of metal tape to measure changes in a trunk diameter, which needs to be replaced as the tree grows past the maximum range of the dendrometer.



Band dendrometer data showing changing growth rates