

Measuring moisture stress in Christmas trees

Gary Chastagner and Marianne Elliott, WSU Puyallup

Email: chastag@wsu.edu; melliott2@wsu.edu

Most Christmas trees in the Pacific Northwest (PNW) are not irrigated and the bulk of production occurs in areas of Western Washington and Oregon that experiences a Mediterranean climate with mild temperatures, wet winters, and dry summers. The heaviest rainfall occurs in November–January, while July and August are driest, often receiving less than an inch of rainfall per month. During the past decade, significantly higher temperatures and lower than normal precipitation during the growing season have increased the risk of drought stress in Christmas tree plantations.

Several projects are underway at Washington State University to understand the levels of drought stress that are associated with seedling mortality and predisposing trees to sunburn and diseases, such as *Armillaria* root diseases in PNW Christmas tree plantations.

Growers can help with these research projects by providing information and samples about moisture stress and irrigation practices.

How moisture stress is measured

Using a highly specialized, expensive device called a pressure chamber (or "pressure bomb") is the gold standard method to provide a rapid, accurate way to measure a plant's xylem water potential (Ψ). A sample is placed in a specialized stainless-steel chamber which is pressurized with nitrogen gas. The pressure is monitored and the Ψ is directly related to the pressure required to force water to appear on an exposed end of the shoot stem. It quantifies the negative tension or water stress within the plant's vascular system. The Ψ units of measure are -bars. The greater the stress the more negative the number.

An alternative method is to measure the moisture content (MC) of sample shoots. It requires a scale to measure the fresh and dry weights of each sample, which must be dried in an oven for 24-48 hrs at 80C. Once the fresh and dry weights have been determined, the following formula is used to determine the "Wet basis" MC of the samples:

$$\%MC = ((\text{FreshWT} - \text{DryWT})/(\text{FreshWT})) * 100$$

Previous work at WSU Puyallup has shown there is a high correlation between Ψ and the percent MC of samples of commonly grown Christmas tree species, such as Fraser fir. Both methods have been used to monitor changes in the moisture status of harvested trees at various points in the supply chain. In the Moisture Content method, a portable scale is used to measure the fresh weight of the samples right after they are collected and the samples are then either transported or mailed back to WSU Puyallup to determine their dry weights.

To engage growers in collection of drought stress data, we have developed the following protocol that enables growers to collect samples and send them to WSU Puyallup to determine BOTH their fresh and dry weights.

Collecting moisture content samples

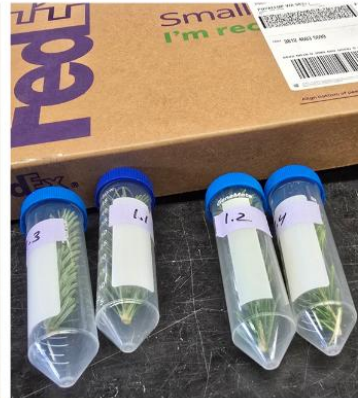
At Christmas Tree Farms



Collect shoots from designated trees



Place samples into labeled 50 mL Falcon tubes sent from lab



Mail sealed samples to the lab



In The Lab



Fresh weight determined



Samples dried in oven



Dry weight determined and moisture content calculated

Some benefits of monitoring the seasonal levels of drought stress at Christmas tree farms are:

- Connecting growers with research
- Helping growers understand seasonal drought stress levels in their fields
- Expanding geographic sampling
- Increased sampling frequency
- Improved understanding of regional drought impacts
- Enabling growers to monitor the effectiveness of their drought stress mitigation management practices
- Helping confirm drought tolerance among Christmas tree species

Moisture content datasheet

Name:

Date Collected:

Farm Name:

It is best to collect samples early in the morning while trees are fully hydrated. Cut a current year shoot from the midpoint of the tree and place it into the numbered tube. Immediately cap the tube to prevent moisture loss. Record information about the sample below. Hold samples in a cool place (room temperature is ok) until shipping, no more than 3-5 days. Send samples to

Marianne Elliott
WSU Puyallup
2606 West Pioneer
Puyallup, WA, USA
98371-4998
melliott2@wsu.edu

Tube ID	Tree species	Size or age class	Other information (eg. irrigated, field location, etc.)

Your contact information for results: