Increasing Speed, Accuracy, and Safety of Pressure Chamber Determinations of Plant Moisture Stress

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A newly developed paper-spot technique can increase the efficiency, accuracy, and safety of the pressure chamber method routinely used by many nursery specialists and silviculturists to evaluate seedling moisture stress. Tree Planters' Notes 39(3):3-4 ; 1988.

The pressure chamber provides a simple, accurate, rapid, and practical means of measuring plant moisture stress (PMS) (2, 3). PMS is a measure of the internal moisture stress that occurs in the wood vessels, or xylem, of plants. Forest scientists often use the term xylem water potential for PMS and express PMS as negative bars or megapascals (MPa), i.e., 1 MPa = 10 bars.

In addition to its use in diagnosing plant moisture stress, the measurement of PMS is particularly useful in analyzing the environmental conditions associated with stress in nurseries and established plantations and in trouble-shooting establishment problems (1). The pressure chamber is now being routinely used to evaluate seedling moisture stress by nursery personnel and regeneration specialists.

Methods

Standard methods. To use the pressure chamber, a small twig or, in the case of pines, a group of needles in a fascicle, is cut from the seedling and placed in the steel chamber with the cut end protruding from the lid (fig. 1). The chamber is then pressurized with nitrogen and the water column within the sample is forced up to the cut surface. The pressure required to do this is equal to the tension of the water column at the time the sample was cut. When water is first observed on the protruding cut surface, the chamber pressure is recorded (fig. 2).

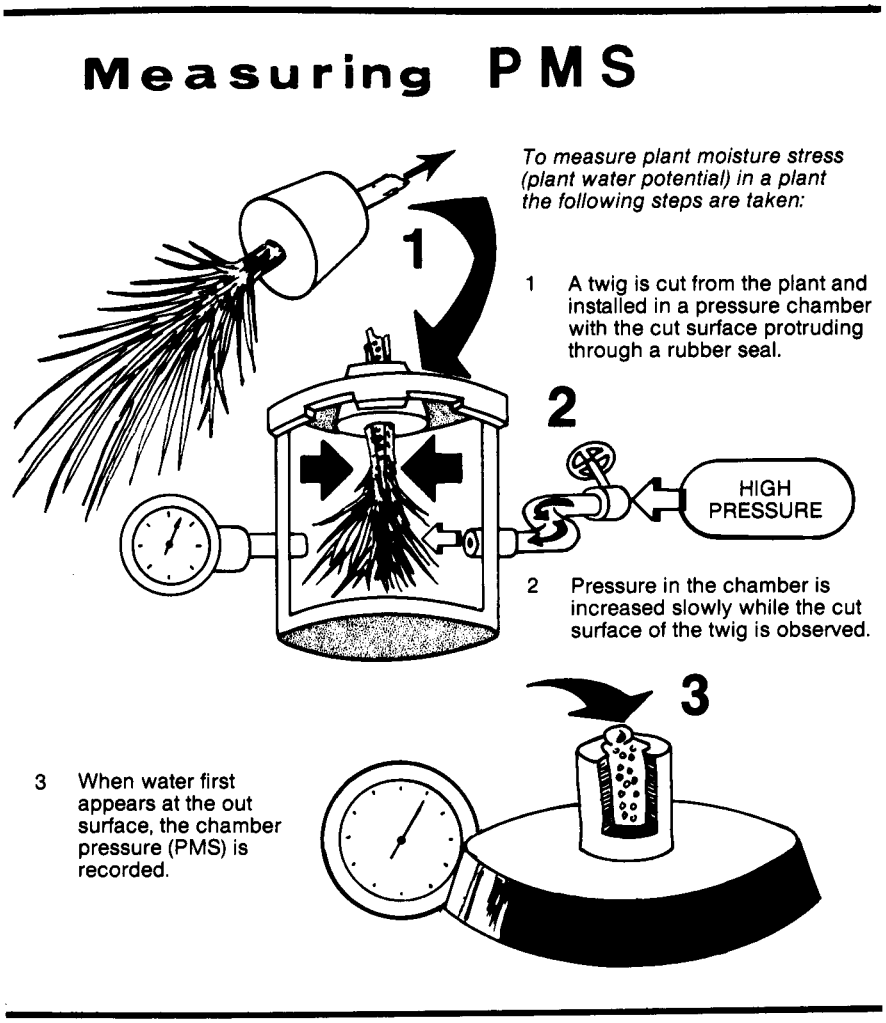

Figure 1—*Pressure chamber for monitoring plant water stress.*

In most conifers, resin bubbles appear before the water droplet and may indicate a false end point. Experience and the use of a hand lens are usually needed to determine when the true end point is reached. The determination of the true end point slows the measurements, is a source of error, and is sometimes unsafe. Because people using the pressure chamber tend to observe the cut twig or needle with a hand lens from directly above, they are at risk of being struck in the eye by needles ejected around the seal by the pressure.

New Steps. The following technique overcomes some of the current problems of determining the true end point in PMS measurements. Hold a small piece (about 1 by 1 inch) of *brown* paper hand toweling firmly against the end of the cut stem. As soon as a droplet of water reaches the cut surface and the true end point is reached, a readily visible, wet spot appears on the paper towel. The wet spot will appear darker than the dry toweling. Although the resin is released before the water, the resin exudation is not absorbed and therefore does not change the color of the paper. No hand lens is needed, and the wetting of the towel can be seen from a distance, so there is no need to bend directly over the seedling to observe the end point.

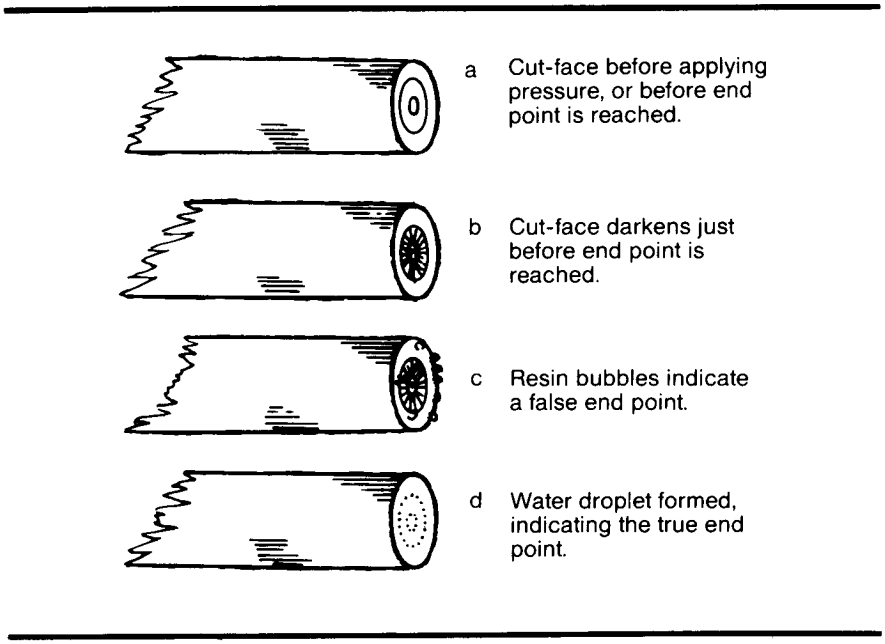

Figure 2—*Reading the end point on a cut seedling surface.*

When PMS measurements are made of fascicled needles (a more difficult operation), the moisture droplet is so small that ordinary paper toweling may not work. In this case, a finer textured paper such as cigarette paper can be used. Again, brown paper works best because the wet spot is more readily visible, and the use of a hand lens is not necessary.

Results

This paper-spot technique greatly simplifies the recording of PMS measurements. It results in more accurate determinations, greater speed in making measurements, and increases the safety of the process.

Literature Cited

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