Timber Talks

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WATER STRESS IN PLANTS

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Plants absorb water through their roots by diffusion and mass flow and lose water through their leaves by transpiration. When the rate of transpiration exceeds the rate of absorption, a water deficit develops in the plant and the plant is subjected to a water stress. This will affect the physiological processes and cause a reduction in growth and, if the stress is high, mortality of the plant.

Water stress within the plant may be due to excessive loss from transpiration, insufficient absorption by the roots, or a combination of both. Hot, bright weather would increase the rate of transpiration and could result in wilting even in a plant that is growing in moist soil; conversely, a plant growing on relatively dry soil may not experience a high water stress when transpiration conditions are slow such as during cool or humid weather. Thus, deficits of water within a plant cannot be assessed reliably by measurement of the moisture in the soil or by the rate of evapo-transpiration.

Scientists express the water status in plants as an energy relationship and use the term "water potential" to describe the water available for plant growth. The measurement unit of water potential is "atmosphere" or "bar," which is given as a negative value. A low water potential signifies a high water stress; a plant without any water stress would have a water potential of 0 atmospheres.

There have been many investigations into measuring water potential in plants. Most of them are unsuited to field conditions or require elaborate laboratory equipment. An investigation was conducted to test the efficacy of the Schardakow dye method for determining water potential in leaves of Douglas fir. Measurements with leaves of bigleaf maple and red alder were included for comparison. This method, which is based on the recognition of an exchange of water between the plant and a sucrose solution of known concentration, requires only standard laboratory equipment and does not require precise temperature control. The water potential of the leaves is equal to the water potential of the solution in which no net water exchange takes place. To make the test, leaf sections are immersed in sucrose solutions of different concentrations, and after allowing time for water equilibration, a small amount of dye (methylene blue) is added. A drop of the stained solution is then injected into a control solution of the original concentration. The upward or downward movement of the drop of stained solution indicates the change in density.

Although the method was suitable for the determination of leaf water potential of bigleaf maple and red alder, it was not satisfactory for Douglas fir. This is attributed to exudates from the cut needles that contaminated the test solution and which must be compensated for by leaf water efflux before true leaf water potential can be estimated. Water stress is dependent on the relationship between water content and water potential of a plant leaf. In Douglas fir needles only a very small leaf water deficit is required to greatly influence the leaf water potential.

REPORT: Errors in Measurement of Leaf Water Potential of Some Woody Plants With the Schardakow Dye Method. Holger brix, Forest Research Laboratory, Victoria. B. C.