Soil Plant Water Seed

SOILS NEWS

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Measuring Leaf Water Potential using Tru Psi.

by Colin Campbell.

RESEARCHERS ARE faced with a difficult question when making plant water potential measurements in a thermocouple psychrometer: should I use abrasion to speed up equilibration? The answer to that question really depends on several factors including: size of leaf sample, size of sample chamber, time limit for sample measurement, and accuracy of reading. Abrasion of leaf epidermis allows faster equilibration time and accurate readings for large sample sizes, but when chamber and sample size is small, abrasion can cause errors in water potential measurement.

Specific abrasion techniques have been

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Amy Treonis informs us about soils in Antarctica.

THIS PAST austral summer, a field team of six, led by Dr. Diana Freckman of the Natural Resource Ecology Lab at Colorado State University, spent 7 weeks conducting soil research in Antarctica. We stayed at McMurdo Station, one of three U.S. research bases in Antarctica. From there, we helicoptered to and from the McMurdo Dry Valleys, where we made collections of soils. Only 2% of the Antarctic continent, including the Dry Valleys, is free of permanent ice and snow cover. The dry valleys ecosystem is characterized by frigid temperatures, aridity, and lack of plants; the soils are poorly weathered, coarse, desiccated, and saline.

> "We also appreciated the customer service we received while in Antarctica and back at CSU *(without a doubt the best feature of the Tru Psi).*"

Dr. Freckman has been investigating the ecology of nematodes (microscopic roundworms) in these extreme Antarctic soils since 1989. Nematodes are the top of the soil food web in most dry valley soils. This year we collected soil from several experiments, including (1) a soil manipulation experiment investigating the effects of global warming on Antarctic soils, and (2) a disturbance

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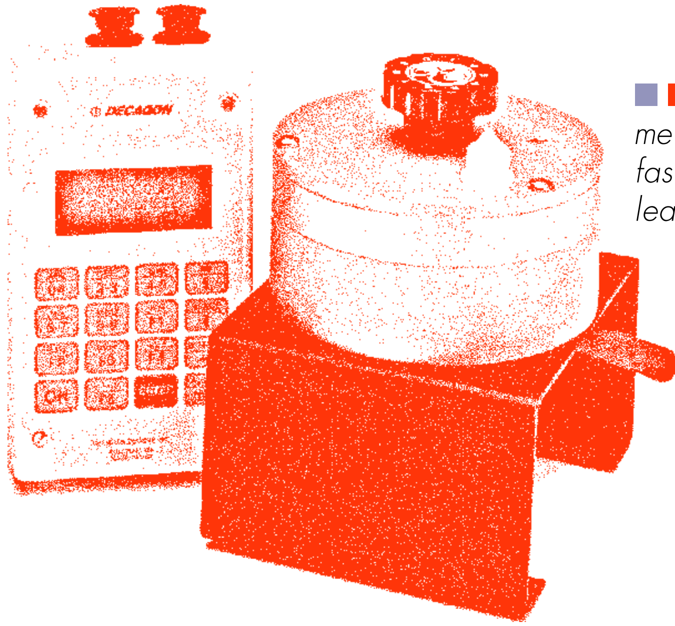
Tami Thomas and Theo Mbabaliye at the WSU Soil Physics Lab. See page 4 about soil infiltrometer experiments.



Tru Psi water potential meter has 10 chambers for faster equilibration of soil, leaf, or seed samples.

Antartica

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experiment, which investigates the effects on nematode communities of human impact (i.e., walking paths from scientists or tourists).

In addition, for my thesis research, we investigated the impact of soil properties on nematode activity. Like many nematodes in temperate soils, Antarctic nematodes depend on soil moisture for activity, but can employ a survival strategy when conditions get too extreme. This inactive, survival state is called anhydrobiosis, or "life without water", and is characterized by loss of body water and coiling of the nematode. I wanted to find out what conditions caused nematodes to be in anhydrobiosis. We collected soils from several sites, analyzed the nematode communities, and related this information to soil moisture and salinity.

To integrate these soil variables, we also measured soil water potential with a Tru Psi thermocouple psychrometer.

My preliminary results show that it is common to find water potentials for dry valley soils well below -7.0MPa, which is considered to be a threshold level for biological activity. In these very dry soils, most nematodes were anhydrobiotic, but interestingly, some were active. These active nematodes probably were confined to very small wet regions.

The Tru Psi thermocouple psychrometer with a Richards thermocouple was the ideal measurement device for these very dry soils. We measured over 200 samples this past season, and it was very convenient to be able to process many samples at once. We also appreciated the customer service that we received while in Antarctica and back at CSU ***(without a doubt the best feature of the Tru Psi).***

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Personal Letter: 8 May 1997
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http://www.nrel.colostate.edu/soil/amy.html

http://mcm.maxey.dri.edu/lter/

New Materials & References

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Measuring Leaf Water Potential using Tru Psi.

by Colin Campbell., Ph.D. student, Texas A&M

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developed by many who have published articles on leaf water potential measurement. Savage and Wiebe (1989) provide a list of the many techniques used, some of which work better than others. For our measurements, we have found a 0.05 m x 0.02 m piece of fine-600 grit sandpaper works nicely. Leaf preparation takes three steps.

First, a drop of distilled water is applied to the leaf. Next, 600 grit sandpaper is rubbed gently, but evenly, across the surface of the leaf (ten short strokes ought to be sufficient, but it depends on the cuticle thickness of the particular leaf). The leaf is then dried thoroughly using a lint-free tissue, and excised to the size of the sample chamber (the larger the sample size, the better and faster the reading).

Once inside the sample chamber, equilibration should take place in 30 minutes (leaf samples should be placed in the cup so as to come in contact with as much cup surface area as possible, thus speeding thermal equilibration). Care should be taken to sample quickly and repeat the same sampling procedure each time. Sampling inside a high humidity chamber will reduce the amount of water lost from the sample (Savage, 1984). Brown and Oosterhuis (1992) also provide precautions for leaf measurement.

Some researchers have raised concerns over the affect of abrasion on surface water potential. Wullschleger and Oosterhuis (1987) studied the affect of abrasion on leaf surface, and found only six percent of leaf volume was damaged during the process. They suggest the change in water potential may amount to -0.07 MPa decrease in water potential. The affect of abrasion will be significantly decreased for sample sizes such as those measured in the Tru Psi.

Leaf abrasion is a useful method of speeding equilibration time in thermocouple psychrometers, but must be used with caution and attention to detail. Careful, consistent sample treatment will lead to more accurate results, and decreased equilibration times with increase sample throughput.

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Measuring Soil Hydraulic Conductivity with a Minidisk Infiltrometer

Minidisk infiltrometers with different suctions will be available in 1998. Minidisk infiltrometers are good for student laboratory or for infiltration experiments in a specific site, on crusts, etc. Call now to order your infiltrometer and ask for a free application note.

A NUMBER OF methods are available for measuring soil hydraulic conductivity with a disk infiltrometer. We suggest using the method proposed by Zhang (1997). The method requires measuring cumulative infiltration vs. time and fitting the results to compute the hydraulic conductivity of the soil. The minidisk infiltrometer infiltrates water at a suction of 2.0cm and has a radius of 1.59cm.

Hydraulic conductivity can be measured as follows: Fill the infiltrometer by immersing it in a bucket of water with the stopper removed, and replacing the stopper while the infiltrometer is under water. Remove the infiltrometer from the bucket, keeping the stopper end up so water will not leak out, and use a ring stand and clamp to suspend the infiltrometer vertically over a smooth, level spot on the soil surface. Record the starting water volume. At time zero, slide the infiltrometer down to make solid contact with the soil surface. Record volume at regular time intervals as the water infiltrates.

The volume is converted to depth of water infiltrated by subtracting the starting volume reading and dividing by the area of the disk on the infiltrometer, 7.92 cm^2.

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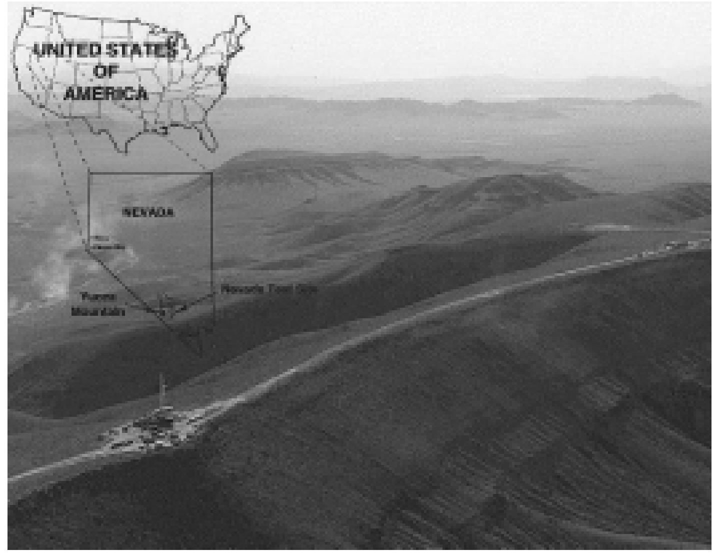
Hydrologic & geologic investigations: Can radioactive waste be safely stored at Yucca Mountain?

Yucca Mountain, in southwest Nevada, located near California's Death Valley, is one the most arid locations in the world. It is also the proposed site for a high level nuclear waste storage facility. It has been determined that the site needs to be able to store nuclear waste for 10,000 years, totally isolated from the natural environment.

A large cadre of scientists is performing hydrologic and geologic investigations to determine whether radioactive waste can be safely stored at the Yucca mountain site. These scientists are using Decagon instruments, including the ThermoLink with its heat dissipation matric potential sensors, in this vital research.

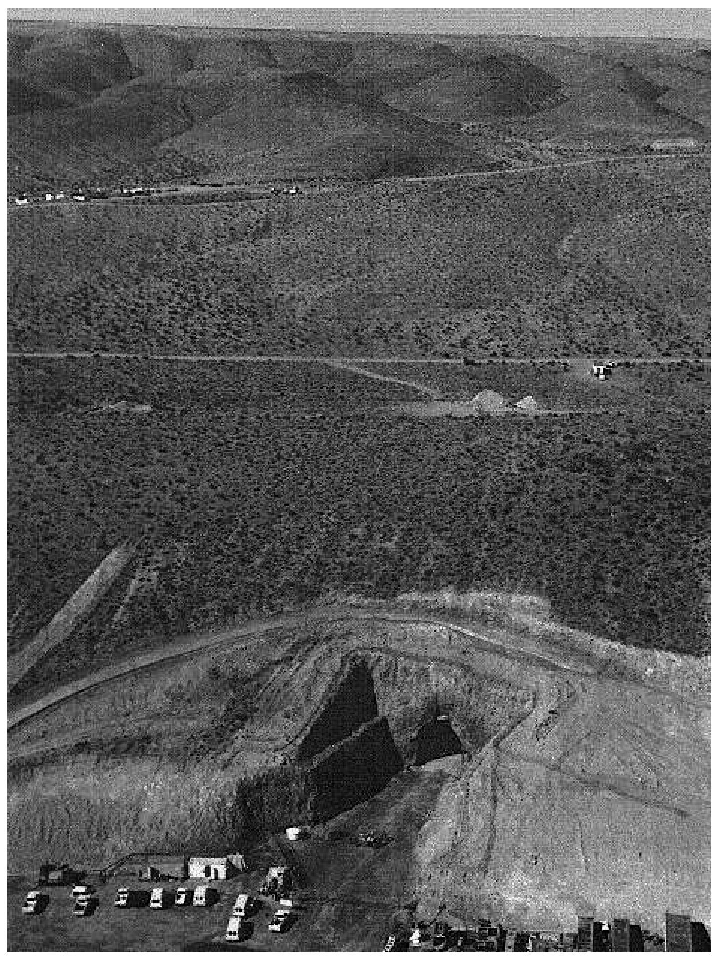
As a part of this effort, researchers have dug a huge 5 mile long tunnel, 25 ft in diameter, into the heart of Yucca Mountain. Scientists and technicians use this tunnel to analyze the suitability of the Yucca mountain site as a storage facility. Heat dissipation matric potential sensors have been placed all along this tunnel, to be read by the ThermoLink microcontroller. Knowing the matric potential of the soils in this tunnel is critical to understanding water movement in and around Yucca Mountain.

One critical requirement for storing nuclear waste in Yucca Mountain is assuring that water could not be tainted with radioactive waste and then move into the ground water. This understanding is important to ensure the safe storage of nuclear materials to protect present and future generations.



Site characterization, a multi-year, in-depth evaluation, is an intensive scientific study of a potential geologic repository for nuclear waste disposal. Yucca Mountain is presently the only site under study in the US. This is one of the most closely reviewed programs ever undertaken by the US Department of Energy.

Aerial view of the north portal.



Geologic and hydrologic investigations help develop hydrogeologic, tectonic, thermo/mechanical, and geochemical conceptual models.

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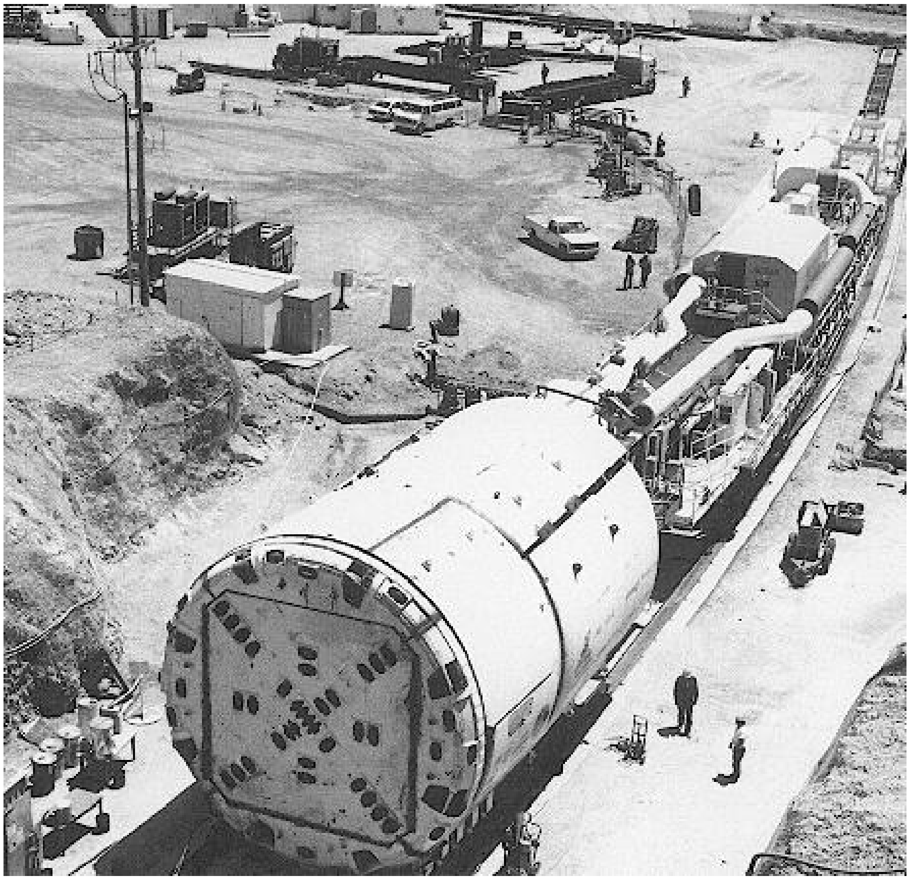

Tunnel boring machine. *Yucca Mountain Project. (see page 5 of Soils News for details) or* http://www.nwer.sandia.gov/ymp/

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