Application Note

Measuring Water Content in Organic Soils using ECH2O Probes

- SMR110

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Introduction

Since the introduction of the ECH2O soil moisture probe, there has been considerable interest in using them to measure volumetric water content of organic soils. Applications of this measurement include potted plant and greenhouse studies, where planting media typically have a high organic component, and seasonally flooded wetlands where water content is important to determine fire potential, among other things, during the dry season. Because of their unique makeup, soils high in organic matter have been dealt with separately from mineral soils. In this brief note, we investigate the calibration of ECH2O sensors in two organic matter samples and determine if a specialized ECH2O probe is adequately suited to this measurement.

Materials and Methods

A 3:1 organic soil (Premium Potting Soil, Whitney Farms, Independence, OR) and a pure sphagnum peat moss (Sunshine) were packed around ECH2O probes in a 30 cm x 15 cm x 15 cm container. Mixing tap water with media artificially created a wide range of water contents, where actual water contents were determined using a small cylinder (16.7 cm3) that was inserted in the soil. The resulting sample was carefully weighed, dried in a microwave oven for 10 min, and weighed again.

Two different ECH2O probes were used in the experiment: a production model (PM) and a 10 cm, shortened probe (SP). The 10 cm probe was a production probe that had been cut to the desired length; a 10 cm probe (versus 20 cm) seems to be more useful in plant pots. Each probe was read individually by connecting to an ECH2O Check hand-held reader. Probe output was plotted against actual water content to determine calibration.

Results and Discussion

Probe output was correlated with volumetric water content (VWC) for the two probes in both media (Fig. 1 and 2, Table 1 and 2). The production probe showed excellent output change (mV per unit VWC) for VWC between 0 and 0.5 m3 m-3 (Fig. 1) for both the sphagnum peat moss (SPM) and potting soil (PS), but showed very little change between the last two points above 0.5 m3 m-3 in PS. The modified probe also showed large changes in output below 0.5 m3 m- 3 VWC, while changes above 0.5 m3 m-3 were much smaller. When working in near-saturated conditions, the mV per unit VWC change in probe reading is of obvious importance. While each probe showed some change near saturation, neither of them was clearly better in this region than the other. Interestingly, both probes showed considerably higher mV per unit water content change in the peat moss compared to the potting soil near saturation. This suggests that, because of the extreme saturation of the potting soil, some measurement error may have caused spurious readings in either of the last two readings. Ideally, sensor calibration would not change measurement in different media. Although the curves are similar, the output of the two probes in potting soil and peat moss show that individual calibration is required, depending on the medium being measured.

Summary

Tests show that the ECH2O probes can be used to measure the volumetric water content of organic soils. Although resolution was considerably diminished in the upper water content region, the probes were sensitive over the entire water content range. Of the two different probes tested, neither preformed considerably better than the other. This suggests that the 10cm ECH2O probe, which is more desirable in potted plants, is a viable option for measuring potting soil water content. These calibration curves also suggest that individual calibration curves be made for each organic medium where the probes will be placed.

Table 1: Volumetric water content (VWC, m^3, m^{-3}), bulk density (Mg m^3), and probe output (mV) for the two test probes in potting soil.

VWC (m^3 m^{-3})	Bulk Density (Mg m^3)	PM (mV)	SP (mV)
0.051	0.344	216	401
0.114	0.357	346	565
0.217	0.395	546	782
0.376	0.382	657	897
0.563	0.372	737	996

Table 2: Volumetric water content (VWC, m^3, m^{-3}), bulk density (Mg m^3), and probe output (mV) for the two test probes in sphagnum peat moss.

VWC (m^3 m^{-3})	Bulk Density (Mg m^3)	PM (mV)	SP (mV)
0.143	0.131	446	284
0.320	0.163	706	463
0.434	0.184	852	566
0.579	0.152	930	672
0.671	0.143	965	713

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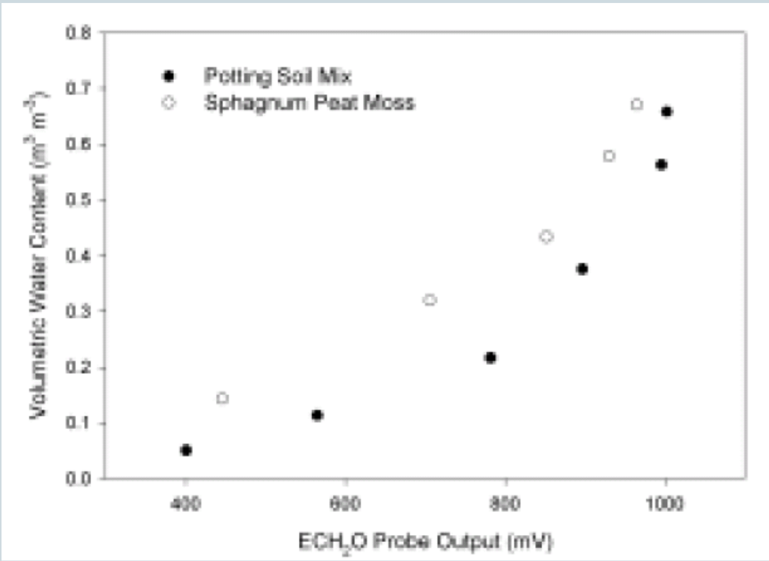

Fig 1. Calibration curves for organic polling soil mix and sphagnum peat moss using typical ECH_2O probe.

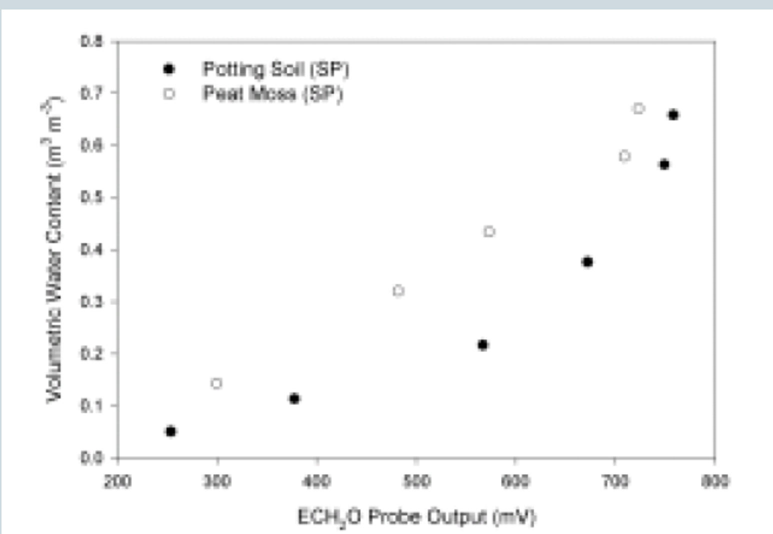

Fig.2 Calibration curves for polling soil and sphagnum peat moss using the 10cm ECHO probe. The 10cm probe was shortened to allow it to be completely buried in plant pots.

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