# Testing of ECH2O Soil Moisture Probes in Oasis Agriculture of Oman

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## Materials and methods

Five ECH2O Soil Moisture Probes, connected to a data logger with periodic readings every 30 min (CR10, Campbell Scientific, Shepshed, England) were tested on a periodically irrigated, man-made terrace soil profile at the oasis of Balad Seet (23.19° N, 57.39° E, 980 m a.s.l., Fig. 1 and 2) in the Northern Omani Jabal Akhdar Mountains. The selected 4m2 irrigation basin was planted with alfalfa (Medicago sativa L.). Four of the probes were placed at 0.1m depth with probe 1 and 2 being placed from the top (soil surface) and probe 3 and 4 being pushed in laterally after a pit had been dug and a small hole was made with a steel blade. Probe 5 was also pushed in laterally from within the pit at 0.8 m profile depth. All probes were positioned about 0.2 m inside the border of the irrigated basin. The soil texture was clayey at the top (0 to 0.6 m) and sandy in the bottom layer (< 0.6m). While placing probe 1 to 4 at 0.1m either from the surface or laterally was relatively quick and a close connection with the surrounding soil material was easily obtained, placement of probe 5 at 0.8m in the bone dry, compacted soil was almost impossible. After this probe had been finally pushed into the profile, we were unable to bring it into close contact with the surrounding soil material. The subsequently reported data therefore only include measurements of probe 1 to 4. During an initial calibration period, the averaged voltage output reading of probe 1 to 4 was regressed against the gravimetrically determined volumetric water content at 0 to 0.2m. The regression equation obtained (y = 0.0508x-11.48, r2=0.964; Fig. 3) was then used to derive the estimated volumetric water readings for all four probes. Soil moisture curves were plotted for a 27-day period, comprising three irrigation events.

*Figure 1. Overview of the mountain oasis of Balad Seet (Oman). The arrow indicates the position of the experimental site.*

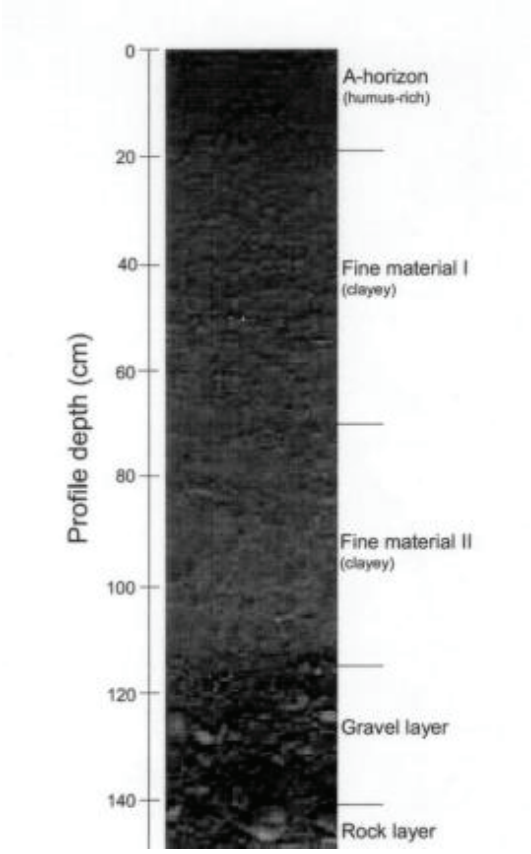


*Figure 2. Soil profile of the experimental terrace site 30.*

## Results

Probe readings were parallel and steady as long as battery voltage did not fall below 11 V. When this happened, erroneous increases in sensor readings were noticed (days 73 to 76, Fig. 4). We were, however, unable to investigate this input voltage induced error in more detail. The standard deviation of the pooled measurements from probe 1 to 4 was much higher immediately after irrigation, with 35mm of water than thereafter (data not shown). This might have been due to irregularities in the soil structure and surface of the plot. It was surprising that the moisture readings of probe 1 and 2 seemed to be continuously affected by the day and night cycle with increasing soil moisture readings around noon (Fig. 5). Probes 3 and 4, in contrast, did not show such differences of which the causes remain unknown.

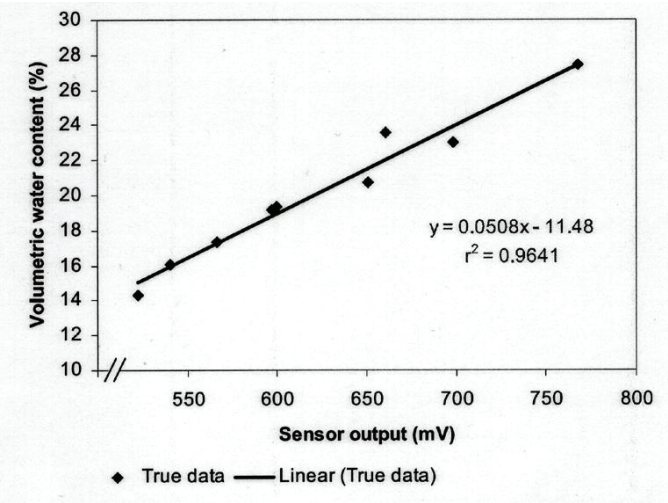


*Figure 3. Regression between ECH2O Soil Moisture Probe readings and gravimetrically determined volumetric water content (%).*

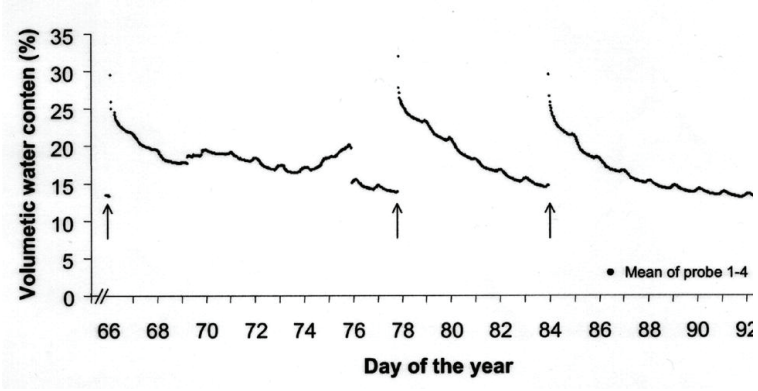


*Figure 4. Time course of soil water content(%) at 0.1m depth after four irrigation events of 35mm (indicated by arrows) at Balad Seet, Oman (2002).*

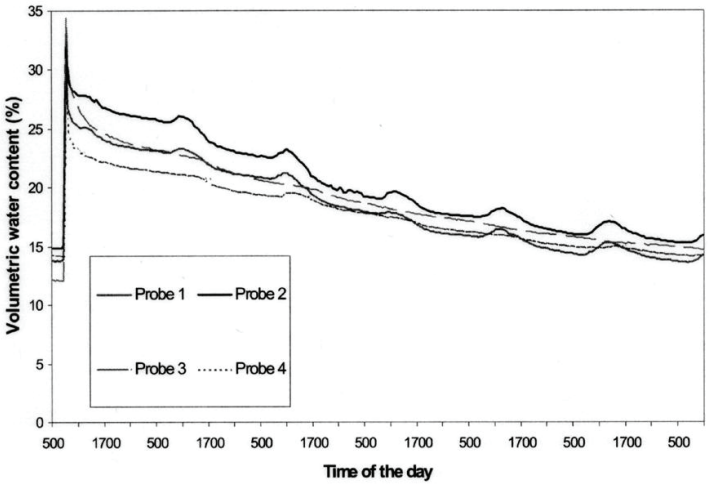


*Figure 5. Time course of soil water content (%) at 0.1m separated for each of the four probes after an irrigation of 35mm. Note the peaks around noon. Balad Seet, Oman (2002).*

## Conclusions

If properly connected to a data logger and in close contact with the soil, the ECH2O Soil Moisture Probes seem to offer a low-cost, automatic and sturdy method to monitor soil moisture under field conditions. For soil

moisture measurements at lower depth, however, the probes will have to be placed after digging pits. This will necessarily lead to the destruction of the soil structure and subsequent alteration of the hydraulic conductivity around and above the probes. Our findings confirm the reliability of the probe readings but also indicate that soil-specific calibrations are helpful to increase their precision which otherwise depends on the factory calibrations. The causes for the differences in the readings of the four probes also merit further investigation.

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