EGU21-13082
https://doi.org/10.5194/egusphere-egu21-13082
EGU General Assembly 2021

Improving the efficiency of HYPROP by controlling temperature and air flow

Ioannis Daliakopoulos, Dimitrios Papadimitriou, and Thrassyvoulos Manios
Hellenic Mediterranean University, Department of Agriculture, Heraklion, Greece (idaliak@hmu.gr)

Soil water characteristic curve (SWCC) is a critical relationship with application in drainage, irrigation, soil physical behavior, and modeling water and nutrient transport. However, constructing the SWCC is tedious, time consuming, and often inaccurate. Recently, METER Group, Inc. (USA) introduced the HYPROP2© measurement system which allows semi-automated direct measurements of water retention and conductivity pairs over a relatively wide range of pressure head values using the Extended Evaporation Method (EEM) (Schindler et al., 2010). Nevertheless, even with HYPROP, depending on soil type, measurement of the characteristic curve under ambient conditions requires from 2 (clay) to 10 days (peat and sand) (Schindler et al., 2010). To expedite the method, here we propose a modification of HYPROP that facilitates consistent temperature and air flow around and over the soil sample ring to ensure constant evaporation from the soil sample. The prototype regulates soil sample temperature using two 5X10 cm heating pads (SparkFun Electronics, USA) insulated with glass fiber belt around the sample ring. Air flow is regulated by a blushless 40x40x10 mm fan (SparkFun Electronics, USA) mounted over the HYPROP apparatus. Temperature and fan speed are regulated by a DC step down module based on the LM2596 Simple Switcher® Power Converter (Texas Instruments, USA). All parts are 5 VDC and can be conveniently powered by USB. Here we compare the time required for HYPROP to estimate the SWCC curve for two hydroponic substrates (cocodust and perlite) and show that the resulting curve is identical, while the time required to process the sample is significantly reduced. These results, as well as extensive testing conducted by Daliakopoulos et al. (2020) and Papadimitriou et al. (2020) show that the HYPROP method can greatly benefit in terms of efficiency from including a similar system to control the evaporation rate.

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Acknowledgements

This research has been co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship, and Innovation, under the call RESEARCH-CREATE-INNOVATE (project codes: T1EDK-03372, T1EDK-04171)