Theme 1 | Mainstreaming soil data: innovations in analysis, standardization, harmonization and communication

CALIBRATION OF A WET-2 TYPE MOISTURE SENSOR ON A PALLEXEROLLS SOIL FOR MONITORING IRRIGATION IN A CULTIVATION

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INTRODUCTION

Measuring soil water content is essential to improve the water balance of the soil-crop-atmosphere system, and its availability in the soil is a key factor for plant growth and development. Therefore, the accurate of measurement soil volumetric moisture content (θ) is necessary for irrigation scheduling. The gravimetric method is standard and traditional for measuring soil θ, it is time-consuming in the procedure and is destructive but it is indispensable for calibration. In contrast, the dielectric sensors: Time Domain Reflectometry (TDR), Frequency Domain Reflectometry (FDR), and others (Zawilski et al.,2023) are widely used for non-destructive determination of the θ. However, the measurement accuracy in each technique is sensitive to soil characteristics as texture, clay content, bulk density and others. The WET-2 sensor FDR type, measures θ by soil dielectric properties. The manufacturer provides generalized calibrations for the most common soil types. However, some soil properties affect the dielectric constant and therefore the calibration parameters of each soil. Thus the objective of this study was to calibrate the portable WET-2 sensor in a soil of alluvial origin and clay loamy, for adequate monitoring of soil θ as an irrigation criterion for a crop.

METHODOLOGY

In 2019, we used a Mollisol (pallexerolls) soil from three 30 x 30 m plots, a composite sample was taken systematically in form "X" at a depth of 0-20 cm. Located at the experimental station of the University of Concepción Chillan, Chile (Fig.1)

Fig. 1 Ubication of the experiment and soil sampling

The apparent density of the soil was determined for convert gravimetric humidity to θ and relate it to the measurement of the WET-2 sensor through of a calibration curve (C.C). See experimental design in figure 1.

The humidity at field capacity and at permanent wilting point was determined using the Richards's pressure chamber method, to include such parameters in the C.V, since the difference between both corresponds to the usable humidity (HA) or water readily usable by plants (irrigation threshold). With the C.C, irrigation was programmed for an experiment with ryegrass crop (Fig.2)

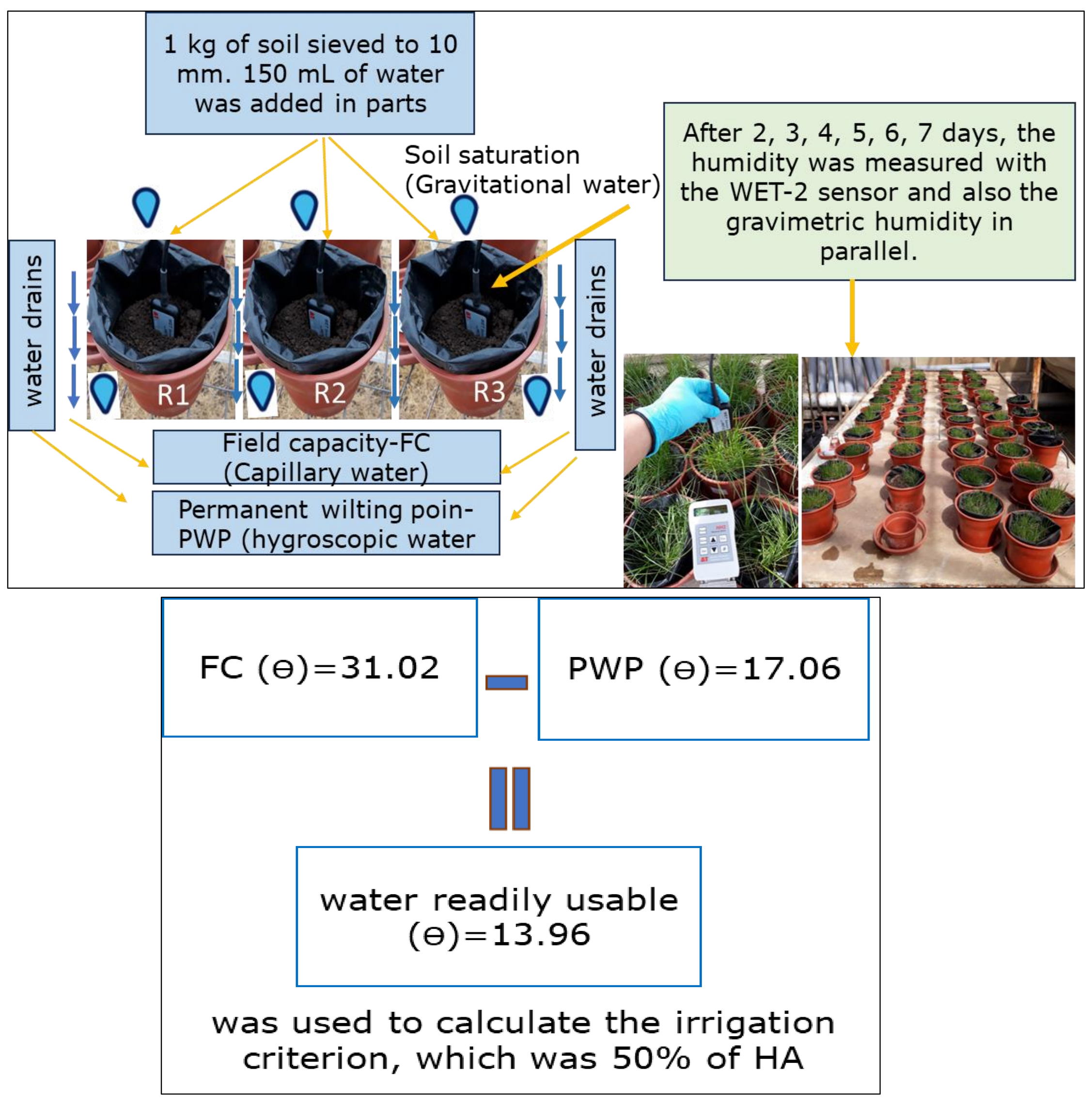

Fig. 2: Calibration experimental desing and irrigation threshold.

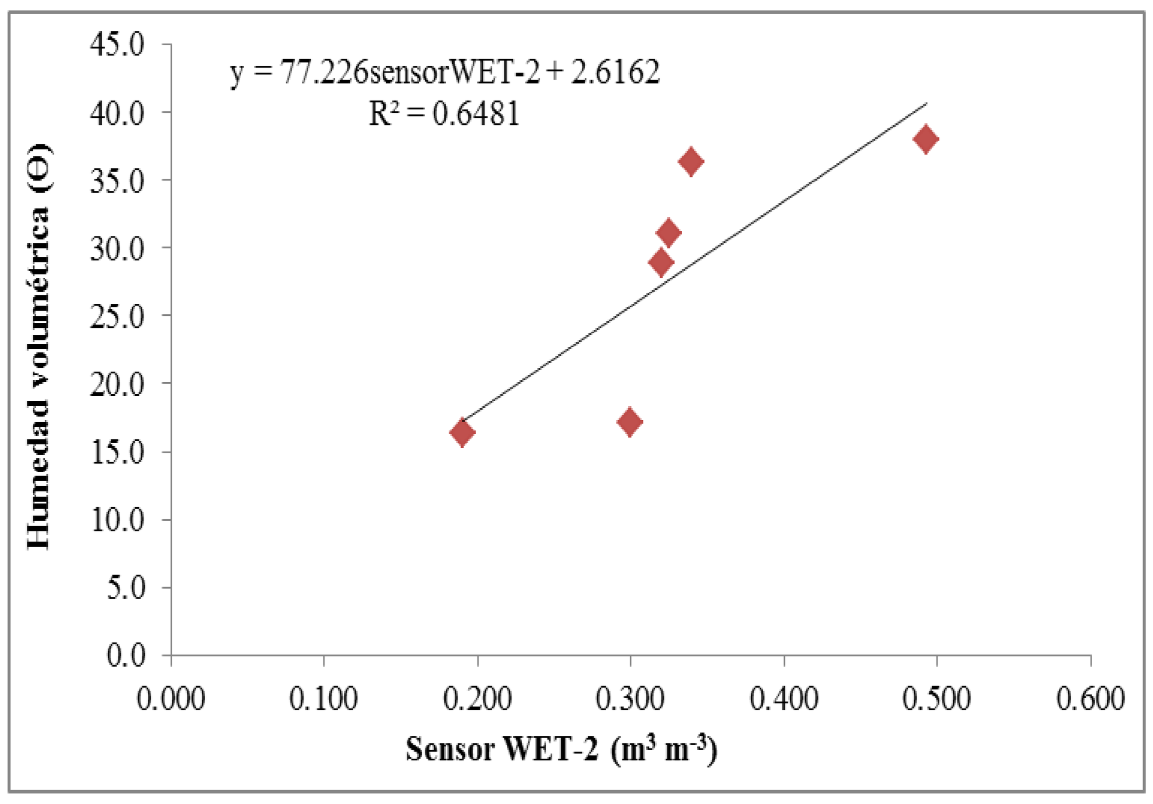

Fig. 3: Calibration curve of a WET-2 moisture sensor in a Pallexerolls soil. θ= volumetric humidity; R2 = coefficient of determination.

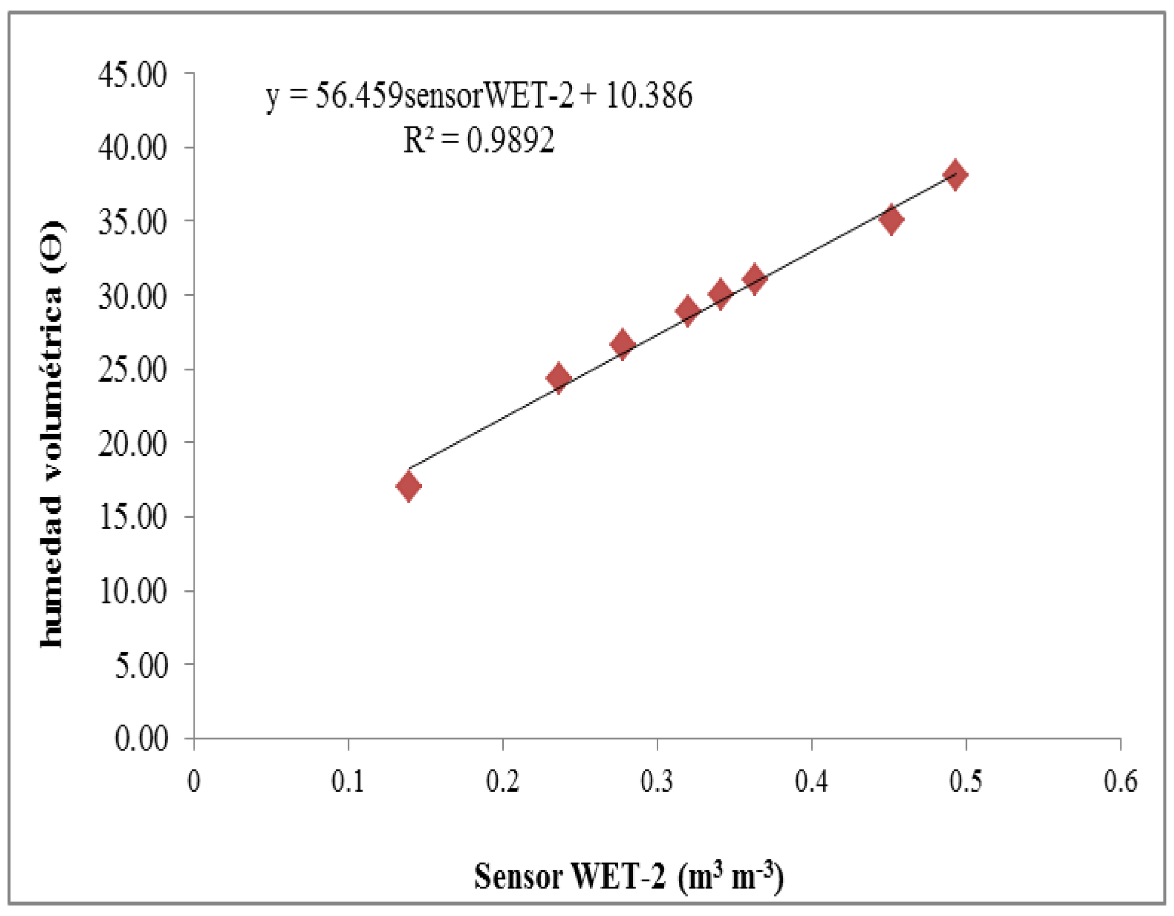

Fig. 4: Calibration curve with correction factor of a WET-2 moisture sensor of humidity in a Pallexerolls soil.

RESULTS

The figure 3, shows the relationship between the θ determined in the laboratory and measured with the WET-2 sensor (m3 m-3), with a low coefficient of determination (R2=0.6481). Probably, due to factors such as soil compaction and air spaces in the pots. However, was possible to find a correction factor for the readings through calculations between the maximum, medium and minimum values to find a common factor based on the speed of water infiltration into the soil. This factor has been obtained through experience (author 2), so the figure 4 shown the C.C with the correction factor applied. A high linear relationship is observed (R2=0.9892) between of the humidity values that ranged between 0.493, 0.363 and 0.139 m3 m-3. Pecan et al., 2022, found similar results with calibration of sensors based on dielectric properties in disturbed clay loam soils. They reported a significant statistical dependence between the calibration coefficients and the clay content, as well as higher measurement errors when the manufacturer calibration was used. This suggests specific calibration according to the characteristics of the soil under study.

CONCLUSION

We concluded that with the C.C of WET-2 sensor specific with the founded correction factor to the characteristics of the soil under study, it was effective for programming and monitoring irrigation of ryegrass crops.

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