CALIBRATION AND EVALUATION OF A CAPACITANCE PROBE IN AGRICULTURAL SOILS IN NORTHEAST BRAZIL

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INTRODUCTION

Soil water content (SWC) is an important parameter for irrigation management. Among the indirect methods to determine SWC, the main techniques based on the dielectric constant of the soil are Frequency Domain Reflectometry (FDR), Time Domain Reflectometry (TDR) and Time Domain Transmissivity (TDT) (Silva et al., 2019).

Among the downhole FDR sensors, Diviner 2000® capacitance probe (Sentek Pty Ltd., Australia) responds to change in the apparent soil dielectric permittivity, whose values are strongly influenced by SWC. Furthermore, the Diviner probe can be used at different depths of a soil profile, which is an advantage over other soil moisture sensors (Ventrella et al., 2008). The resonant frequency detected by the sensor in the soil (F_s) is scaled to a value SF ranging between 0 and 1 on the basis of the readings obtained after placing the access tube in air (F_a) and water (F_w):

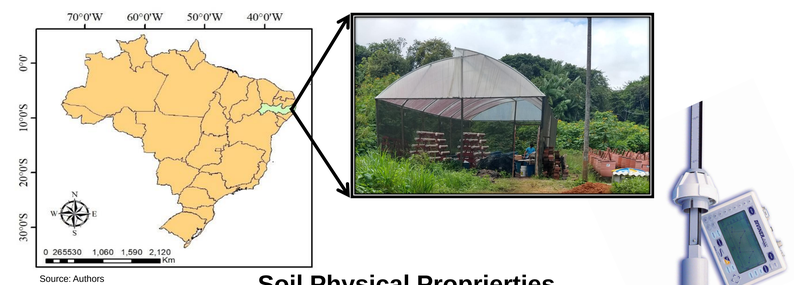
$$SF = \frac{F_a - F_s}{F_a - F_w}$$

However, these electronic sensors need site-specific calibration to increase the accuracy of the measurements, which can be carried out in field or in laboratory (Sentek, 2011).

OBJECTIVES

Assessing the performance of the Diviner 2000® calibration equation proposed by the manufacturer and calibrating the probe for two agricultural soils representatives of the northeast of Brazil.

MATERIALS AND METHODS



Source: Authors

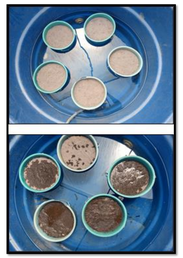
Soil Physical Proprierties

Textural Class	Particle Size Analysis			Bulk density
	Sand	Silt	Clay	
	---------- g kg^{-1} ----------			g cm^{-3}
Sandy clay loam	0.66	0.10	0.24	1.54
Sandy	0.96	0.02	0.02	1.50

The equations proposed were based on relation between the SWC values determined by gravimetry in laboratory and the indirect readings of Diviner, in m^3 m^{-3}, which were used as correction factor of manufacter's calibration equation.

MATERIALS AND METHODS

Source: http://www.barcelonareview.com/67/s_kw.html



Photos: Authors

The knowledge of measured SWC (SWC_{Lab}) allowed identifying the equations to correct the SWC estimated by Diviner 2000 readings (SWC_{Div}).

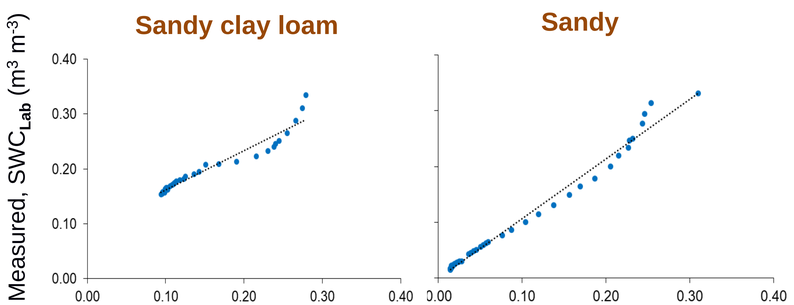
The accuracy associated to the equation proposed by the manufacurer and by the calibration equation was evaluated by the Mean Error (ME).

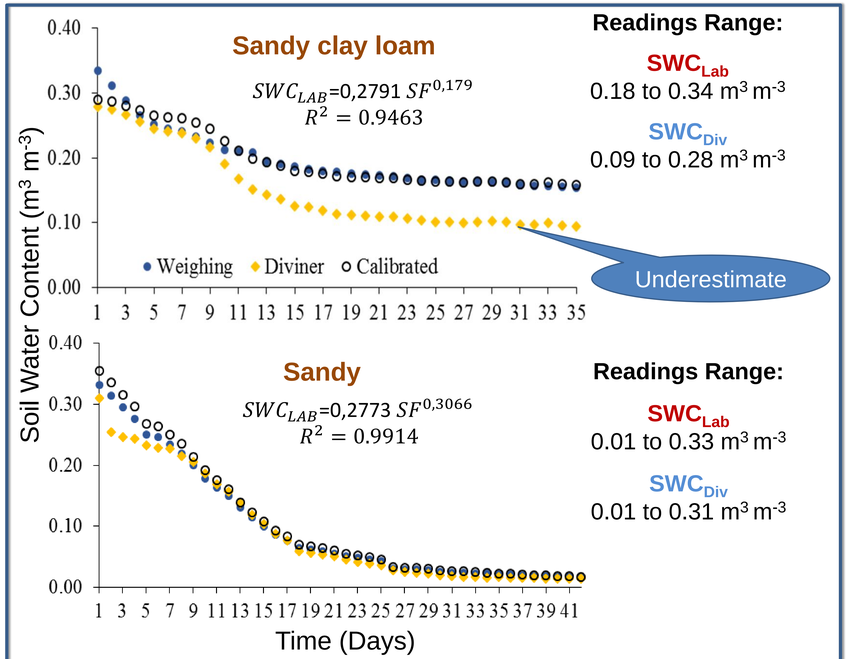
RESULTS

Equations to correct SWC estimated by the Diviner 2000 readings (SWC_{Div})

Sandy clay loam: $SWC_{Lab} = 0.7117\ SWC_{Div} + 0.091$ $R^2 = 0.9314$

Sandy: $SWC_{Lab} = 1.0707\ SWC_{Div}$ $R^2 = 0.9857$





Readings Range:

SWC_{Lab} 0.18 to 0.34 m^3 m^{-3}

SWC_{Div} 0.09 to 0.28 m^3 m^{-3}

Readings Range:

SWC_{Lab} 0.01 to 0.33 m^3 m^{-3}

SWC_{Div} 0.01 to 0.31 m^3 m^{-3}

Soil	Mean Error (ME)	
	Before calibration	After calibration
Sandy clay loam	**- 0.05**	**0.00**
Sandy	**- 0.01**	**0.01**

CONCLUSIONS

- ✓ The Diviner 2000 probe can be **successfully** used to **support irrigation management** in irrigated areas with **soils similar** to those **investigated** because it is **easy to operate** and allows fairly **accurate estimations** of **SWC.**
- ✓ The **manufacture's equation** slightly **underestimated** SWC, in **sandy clay loam soil**.
- ✓ The results confirmed the **suitability** of the manufacturer's equation in **sandy soils**.

REFERENCES

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