

Preliminary results on the validation of automated measurements of stem water potential with microtensiometers in coffee plants

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Introduction

- Coffee is **one of the most relevant crops worldwide** and is a traded commodity globally
- Until recently, **irrigation in coffee** was used to face droughts but has now become a **strategy to improve productivity**
- Plant water potential** may be used to monitor real-time plant water status for irrigation scheduling purposes and to assess deficit irrigation practices

Objectives

- perform automated measurements of **stem water potential (Ψ_{stem})** with non-destructive, continuous measurements, using microtensiometers in coffee plants, replacing the discrete measurements of the pressure chamber
- validate the use of microtensiometers in coffee plants for the first time**

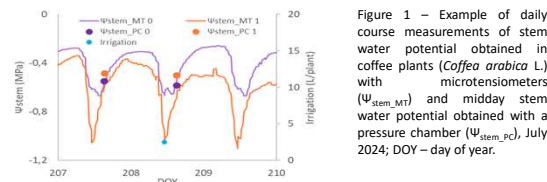
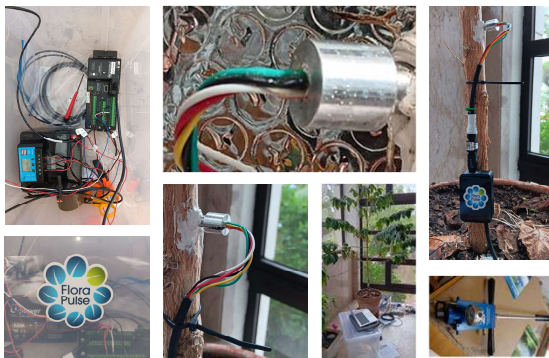


Figure 1 – Example of daily course measurements of stem water potential obtained in coffee plants (*Coffea arabica* L.) with microtensiometers ($\Psi_{\text{stem_MT}}$) and midday stem water potential obtained with a pressure chamber ($\Psi_{\text{stem_PC}}$), July 2024, DOY – day of year.

Materials & Methods The experimental work took place in indoor conditions during the summer of 2024 (DOY 163-253) at the University of Lisbon, Portugal. Two **microtensiometers** (SDI-12 probes, FloraPulse, Davis, CA, USA, www.florapulse.com) were installed, each one in the stem of a *Coffea arabica* L. potted plant. Microtensiometers' data ($\Psi_{\text{stem_MT}}$) were obtained every 20 min, and stored at a datalogger (CR1000, Campbell Scientific, Inc., Utah, USA). A **pressure chamber** (Pump-up Chamber, PMS Instrument Company, Albany, Oregon, USA) was used for to obtain midday Ψ_{stem} ($\Psi_{\text{stem_PC}}$), (13:00-15:00 h, GMT+1) during July, using a sample of three leaves per plant, from shaded areas of the plant, and covered with aluminum foil for at least 30 minutes before the measurements were made.

Results

When considering all the datasets, the maximum absolute values registered for $\Psi_{\text{stem_MT}}$ were **-0.1 and -0.2 MPa**, for both plants, respectively, while the minimum $\Psi_{\text{stem_MT}}$ were **-2.1 and -1.6 MPa** (Fig. 1 and 2). Contrary to the findings of other authors, with different plant species, our results don't show an offset for midday values, between $\Psi_{\text{stem_MT}}$ and $\Psi_{\text{stem_PC}}$, indicating adequacy to follow prompt hydrological behaviour of the plant. A good agreement was found between midday microtensiometer results and $\Psi_{\text{stem_PC}}$. The coefficients of determination (R^2) were equal to **0.86 and 0.78** for plant 0 and plant 1, respectively (Fig. 3). MSE was close to zero for both situations (0,004 and 0,036, for plant 0 and 1, respectively) indicating a good accuracy.

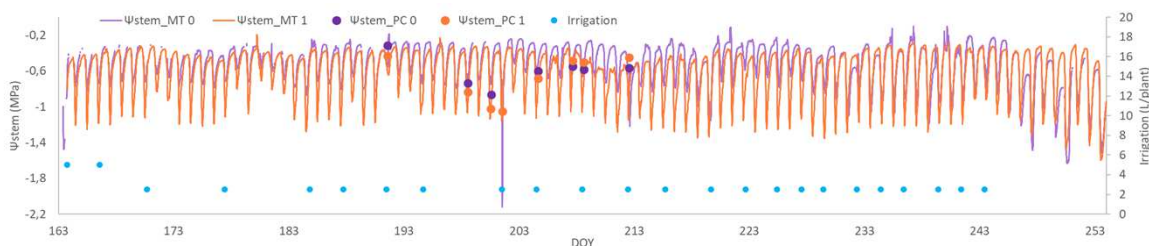


Figure 2 - Midday stem water potential obtained with microtensiometers ($\Psi_{\text{stem_MT}}$) and a pressure chamber ($\Psi_{\text{stem_PC}}$) in two coffee plants (*Coffea arabica* L.), June to September 2024; 0 and 1-numbering of the plants; DOY – day of year.

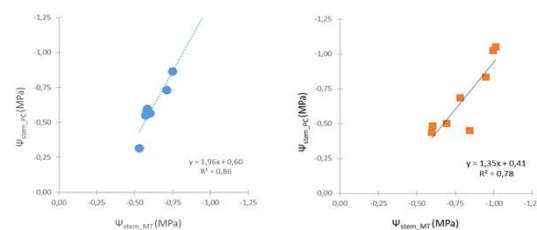


Figure 3 - Relationship between midday stem water potential obtained with microtensiometers ($\Psi_{\text{stem_MT}}$) and a pressure chamber ($\Psi_{\text{stem_PC}}$), July 2024 (left – plant 0, right – plant 1).

Conclusions

A **good agreement** was obtained between measurements of midday stem water potential obtained with microtensiometers and a pressure chamber in coffee plants. These preliminary results indicate that microtensiometers are a promising tool to monitor real-time, midday stem water potential in coffee, useful in irrigation scheduling protocols.

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