unibz
Fakultät für Naturwissenschaften und Technik
Facoltà di Scienze e Tecnologie
Faculty of Science and Technology

XII ORCHARD SYSTEMS 2021

Automatic irrigation scheduling in an apple orchard based on soil water potential thresholds continuously detected by digital tensiometers

Presented by: Ahmed Ben Abdelkader
With: Prof. Massimo Tagliavini
Dr. Martin Thalheimer
Dr. Marta Petrillo
Dr. Damiano Zanotelli

Email: Abenabdelkader@unibz.it

LAIMBURG
Versuchszentrum Laimburg
Centro di Sperimentazione Laimburg
Laimburg Research Centre

Project supported by ASSOMELA, the Italian Association of apple producers.

PROBLEM AND INTRODUCTION

High density apple orchard

Efficient irrigation scheduling

- **Automated low-cost system**
- **Testing 4 irrigation treatments**

T1: Control single drip line	▪ 2 drippers /tree ▪ Ψsoil threshold: -30 kPa.
T2: Partial root drying (PRD)	▪ 1 dripper /tree ▪ Ψsoil threshold: alternation between -30 and -60 kPa.
T3: Control double drip lines	▪ 4 drippers /tree ▪ Ψsoil threshold: -30 kPa.
T4: Regulated deficit irrigation (RDI)	▪ 4 drippers /tree ▪ Ψsoil threshold: -30 kPa at early season, and -60 kPa at late season.

Monitoring

Soil moisture: SW_Potential and SW_Content

Plant water status

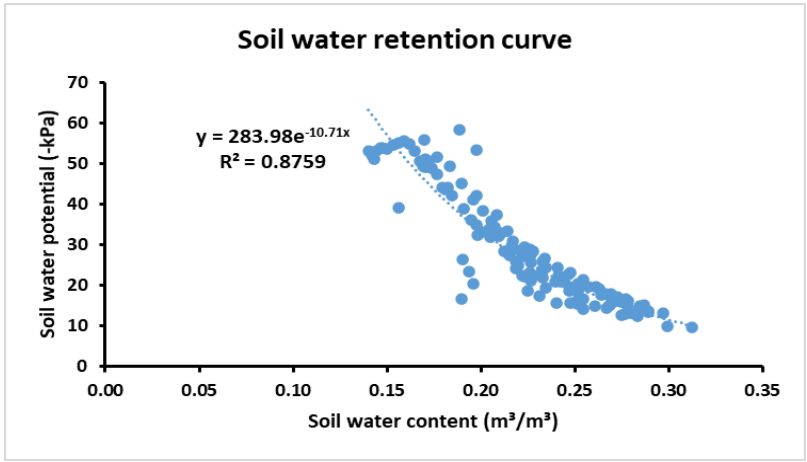
Fruit growth

Post harvest attributes

- To identify **efficient irrigation strategies** that reconcile water savings and optimal fruit production.
- To define **an appropriate soil water potential threshold (Ψ_{soil})** for automatic irrigation scheduling.

Material and Methods

- Apple orchard (cv.´Nicoter´/M9), 13 years old
- Sandy loam soil
- Planting spacing: 0.8m x 3m
- Irrigation rate 3 L/dripper
- Two summer seasons (2019 and 2020)

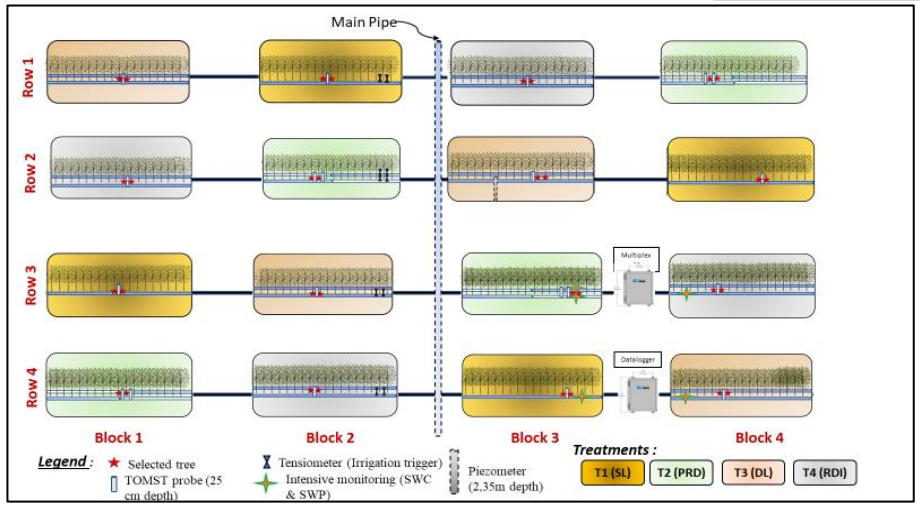


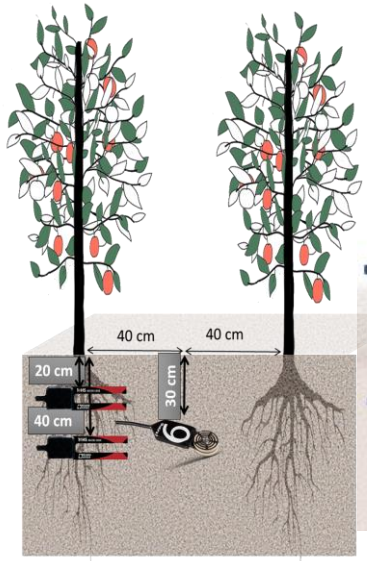
Soil water monitoring

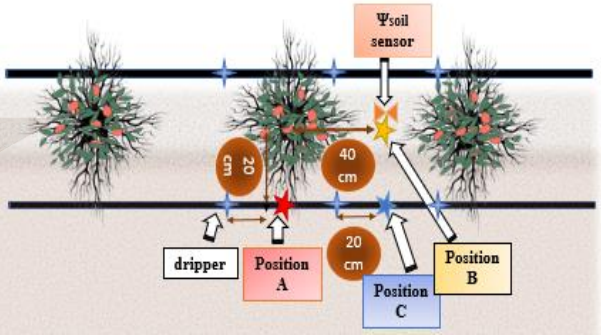
Electronic Tensiometer (Arduino system) triggers the irrigation

TMS-4 Tomst probe (Soil water content)

Experimental design

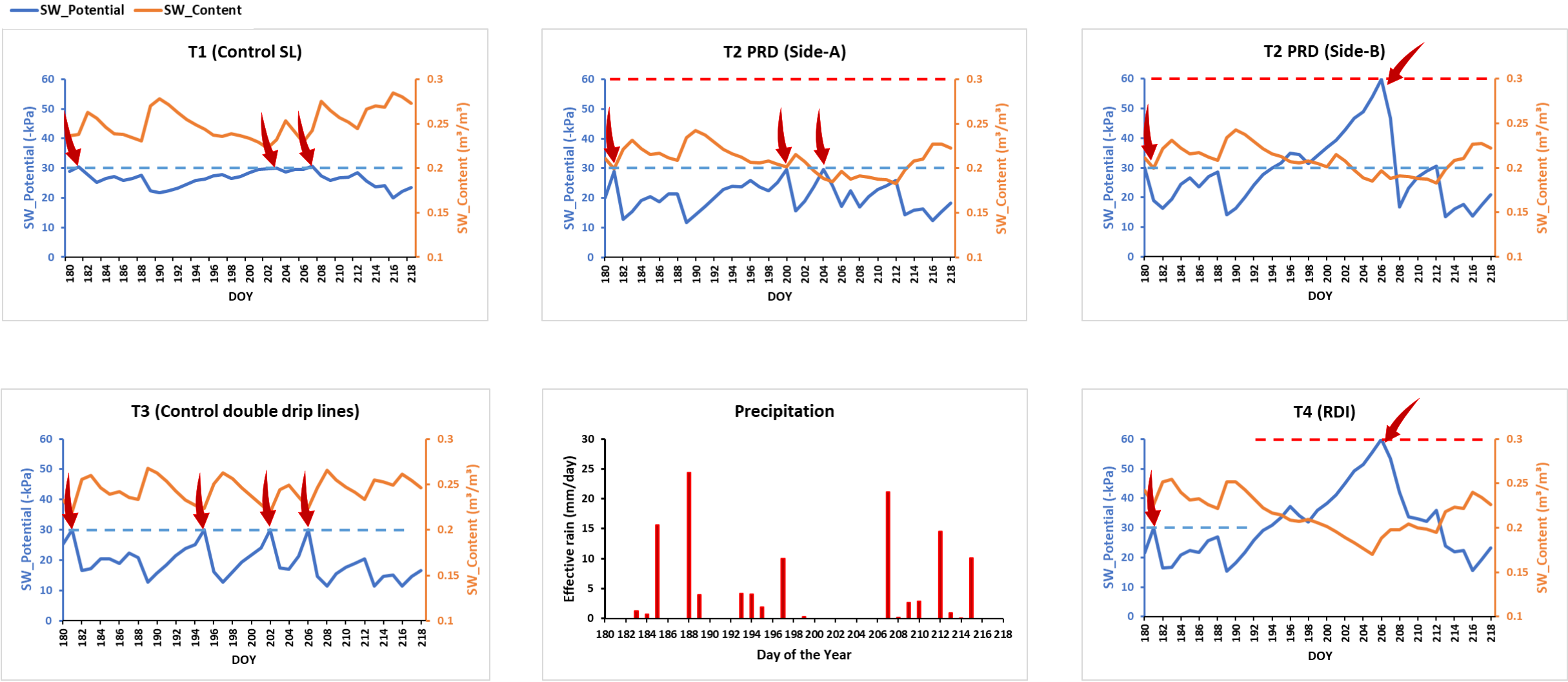






Soil moisture monitoring at different positions (Intensive monitoring)

Soil moisture results



Irrigation Supply

Ψ_{soil} Threshold (-30kPa)

Ψ_{soil} Threshold (-60kPa)

Discussion and Conclusions

- ✓ In both seasons (2019 and 2020), summer was rather rainy: 230mm and 300mm respectively, therefore only slight soil moisture differences among irrigation treatments were recorded.
- ✓ No effects on gas exchange and Ψ_{stem}, fruit growth, yield and fruit quality.
- ✓ Soil water content increased in the upper soil layer by 2 to 5% with irrigation, while at 40 cm depth it was affected only when 4 drippers per tree were present.
- ✓ PRD and RDI ➔ Saving water (up to 72% and 68% respectively) when compared to control without compromising fruit quality and yield.

Conclusions

- ❖ **Irrigation management by the use of tensiometers** was successful; tensiometers had a fast and reliable response to the changes in soil water availability and allowed to keep Ψ_{soil} in the desired range.
- ❖ **Lowering the Ψ_{soil} threshold for triggering irrigation from -30 to -60** kPa using either **RDI** or **PRD** (wetting only half of the root apparatus) could allow water saving without affecting growth, gas exchanges and fruit quality.

Next step: performances need to be tested under drier conditions: We intend to use a ground cover to prevent the rain infiltration during next season.