



UNIVERSITÀ  
DEGLI STUDI DI TRIESTE



DIPARTIMENTO DI  
SCIENZE DELLA VITA

# Monitoring plant water status and rooting depth for precision irrigation in the vineyards of Classic Karst

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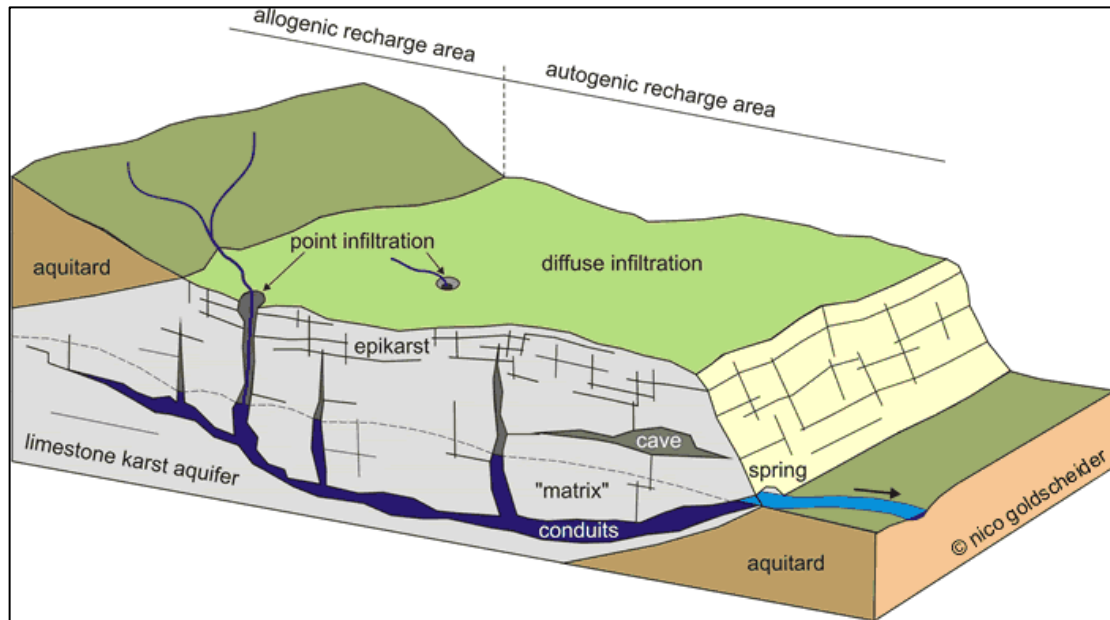
# Introduction

## *Viticulture and irrigation in the Karst*

drought 2012

↓  
scarcely developed irrigation

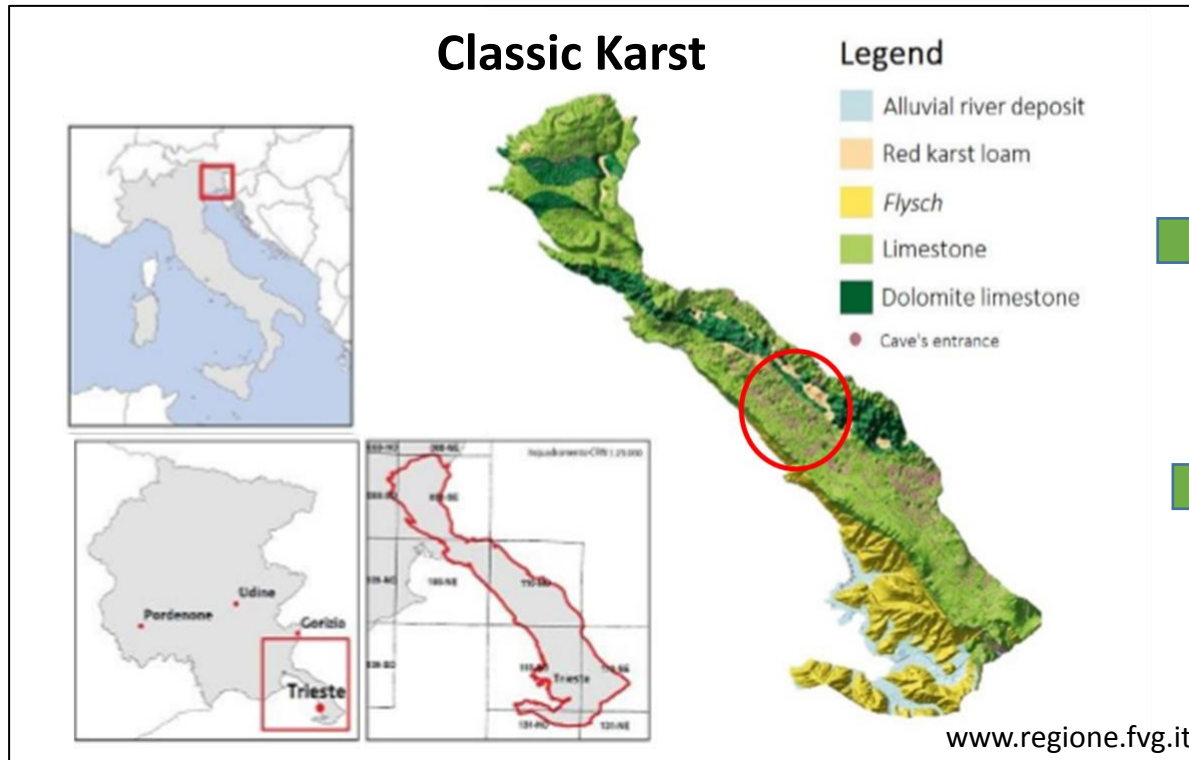
↓  
50% loss of wine production





# Materials and methods

- Water status
- Soil water availability
- Rooting depth



*Vitis vinifera* L. cv Malvasia istriana

**MV**: Mature Vineyard, 30 years old;

- Local red soil

**YV**: Young Vineyard, 4 years old:

- **YV**: rocky soil
- **YV**: local red soil

# Results



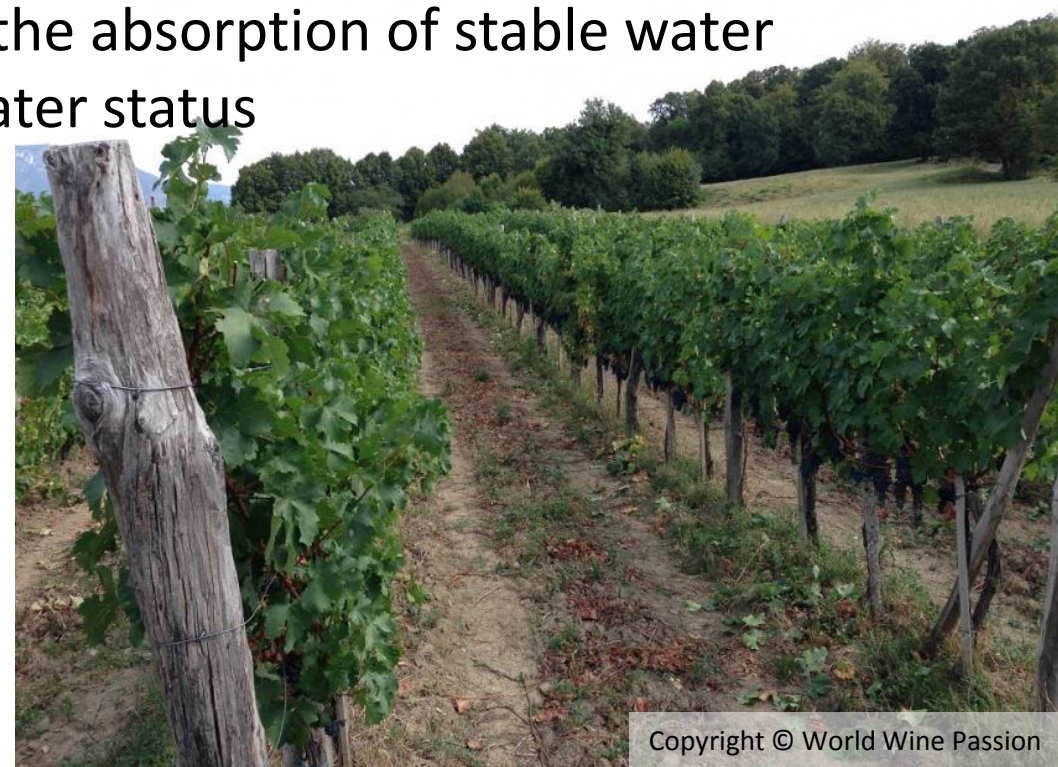
The estimation of soil water availability via soil sensors is not useful for irrigation management



During summer drought deep roots secure the absorption of stable water resources and relatively favourable plant water status

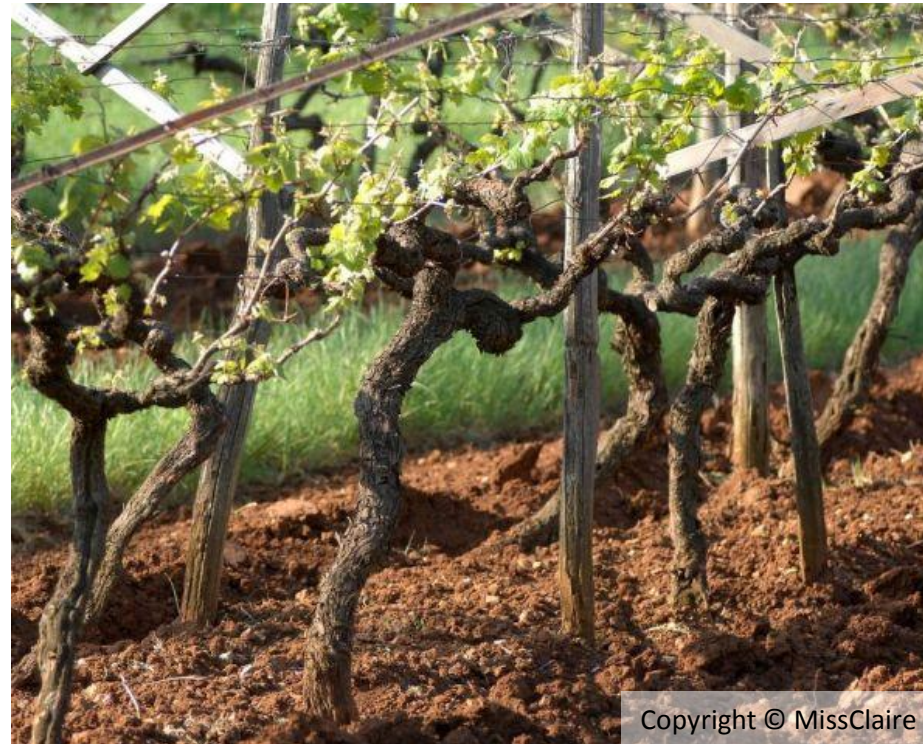


$\Psi_{pd}$  is a good proxy of drought stress intensity for the specific cultivar and site conditions





See you at the interactive screen

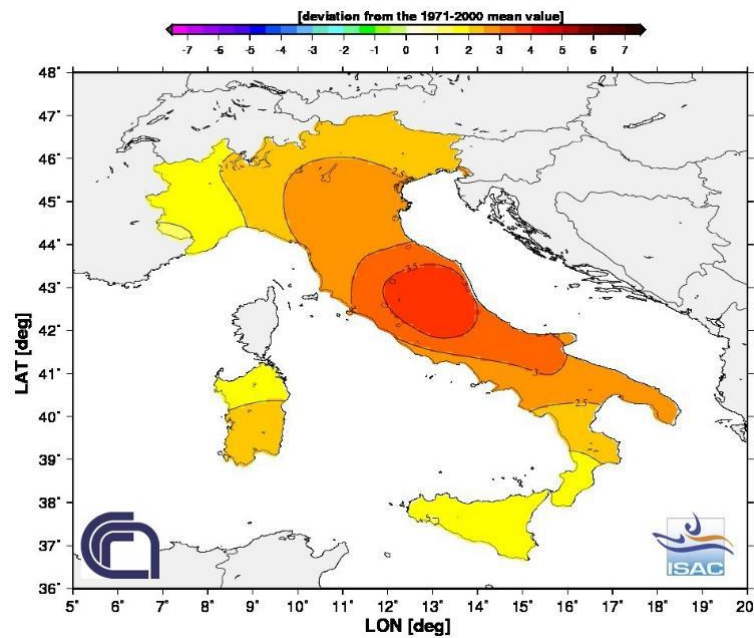


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# Introduction

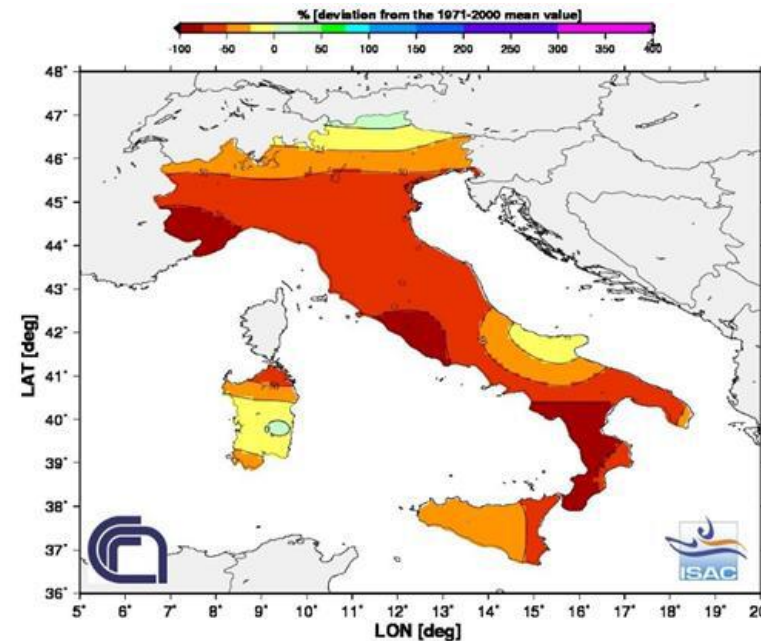
## *Viticulture and climate change*

- Summer 2012 in Italy



Anomaly:  $+2.32^{\circ}\text{C}$  (relative to 1971-2000 mean)

2<sup>nd</sup> warmest (from 1800)



Anomaly:  $-48\%$  (relative to 1971-2000 mean)

11<sup>th</sup> driest (from 1800)



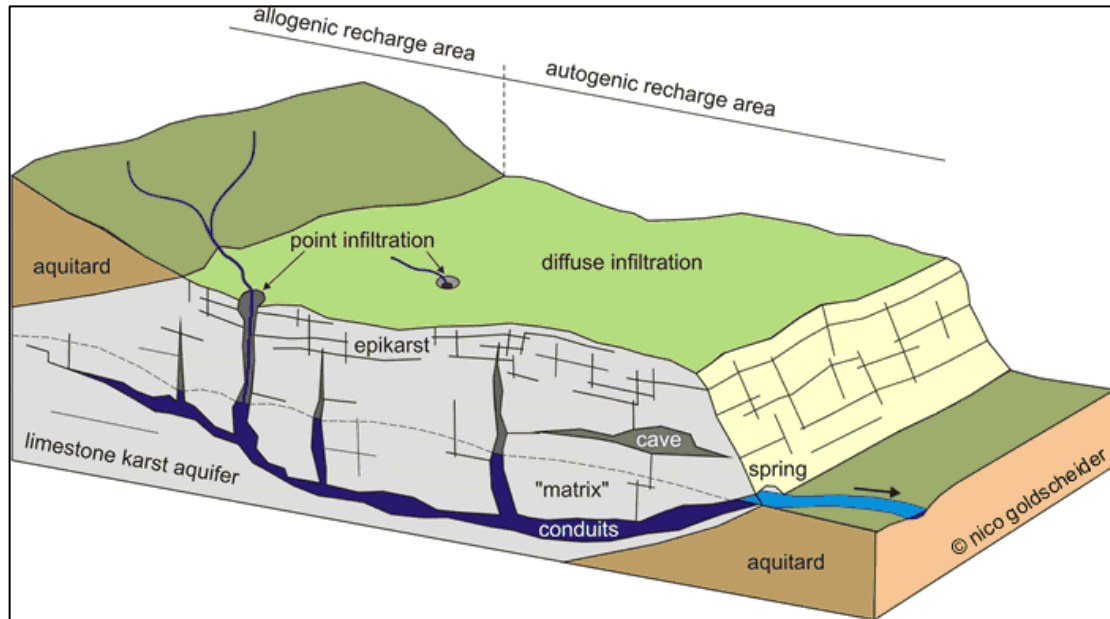
# Introduction

## *Viticulture and irrigation in the Karst*

drought 2012

↓  
scarcely developed irrigation

↓  
50% loss of wine production



# Aims of the study



monitoring of **plant water status** through measurements of **leaf** physiological parameters and **soil** water availability to identify the best strategy for the evaluation of **plant water stress as a tool to schedule supplemental irrigation** in karstic areas



estimating grapevine **rooting depth** through water isotopic composition analysis

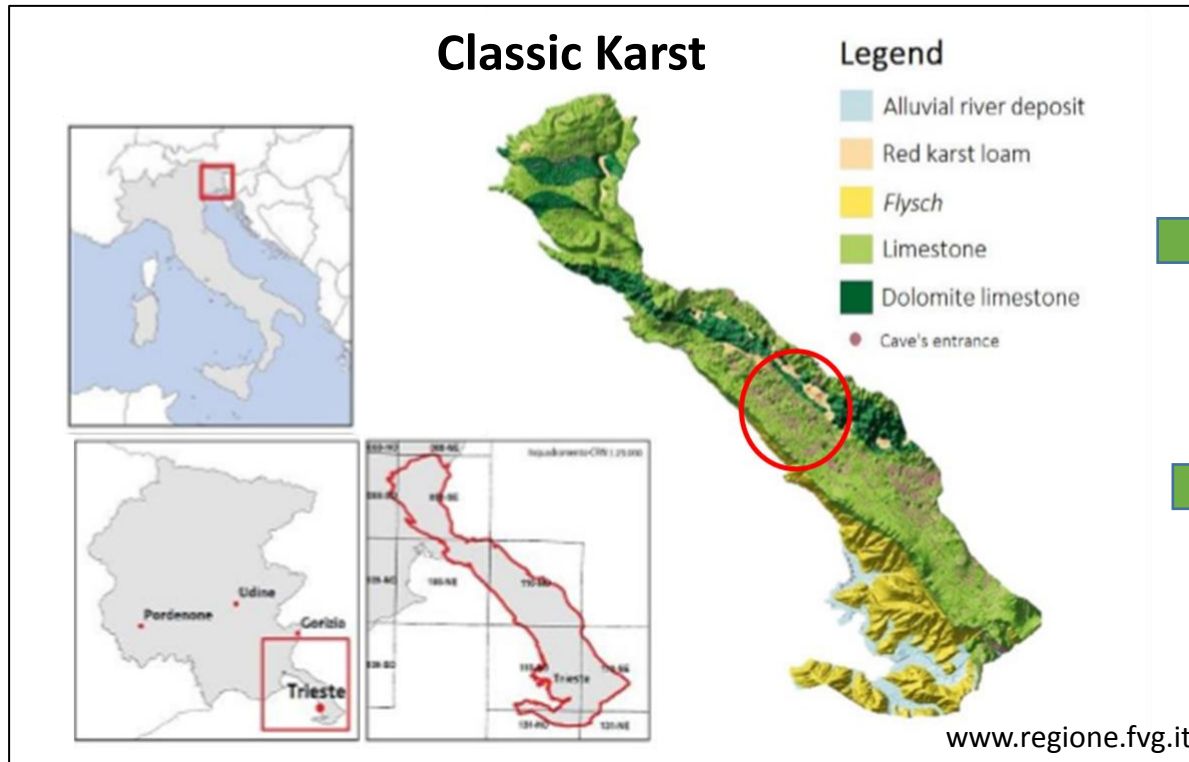


**SUSTAINABLE WATER USE    AVOID YIELD LOSSES    IMPROVE WINE QUALITY**



# Materials and methods

## *Vitis vinifera* L. cv Malvasia istriana



**MV: Mature Vineyard, 30 years old;**

- Local red soil

**YV: Young Vineyard, 4 years old:**

- YV: rocky soil
- YV: local red soil

# Materials and methods

- Climatic data: air temperature and humidity, vapour pressure deficit, rainfall

- Soil water potential



- Pre-dawn ( $\Psi_{pd}$ ) and midday water potential ( $\Psi_{min}$ )



- Leaf conductance to water vapour ( $g_L$ )

- Isotopic composition of Xylem sap, Deep soil water, Rainfall

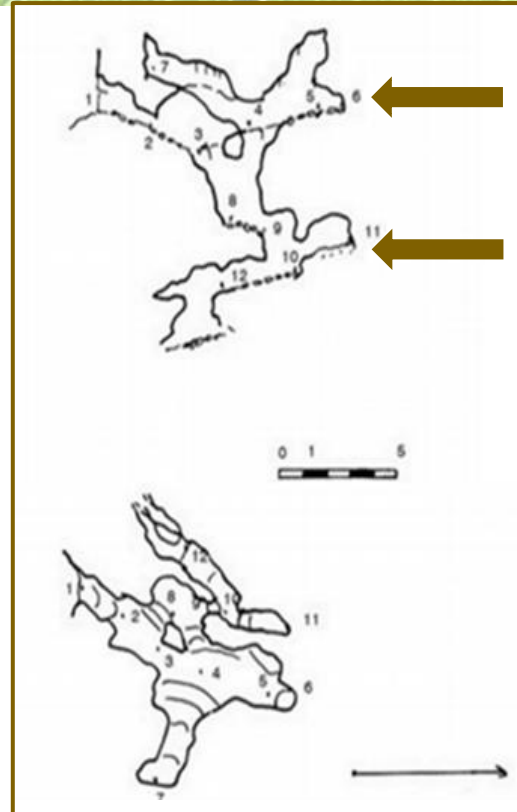




# Materials and methods

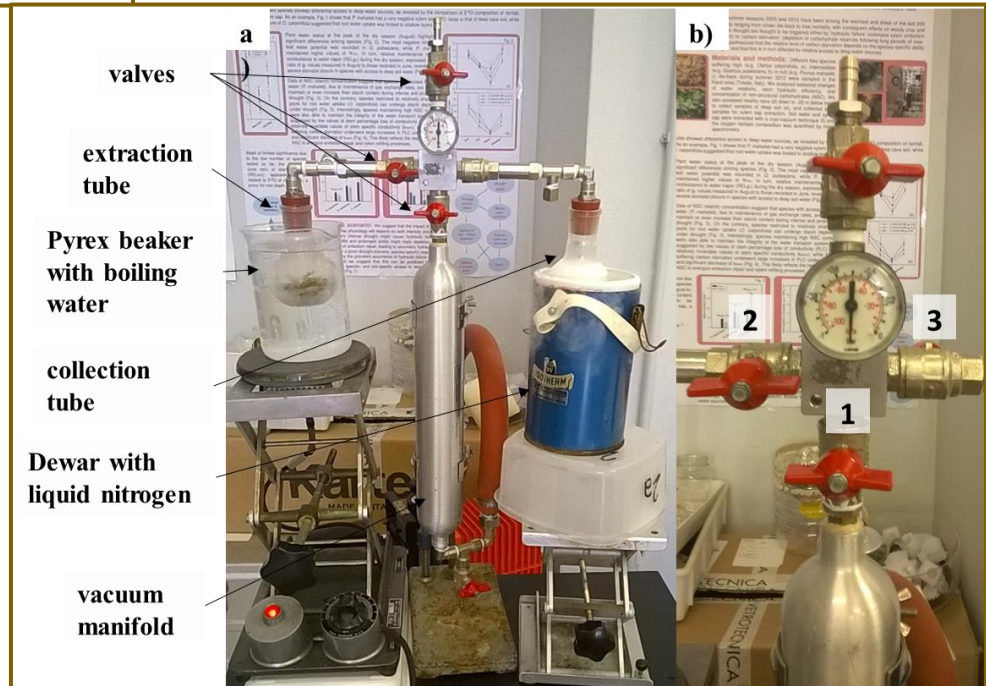
## *Isotopic composition analysis*

- ***Vitis* Branches**
- **Rainfall**
- **Cave soil**



- 9 m

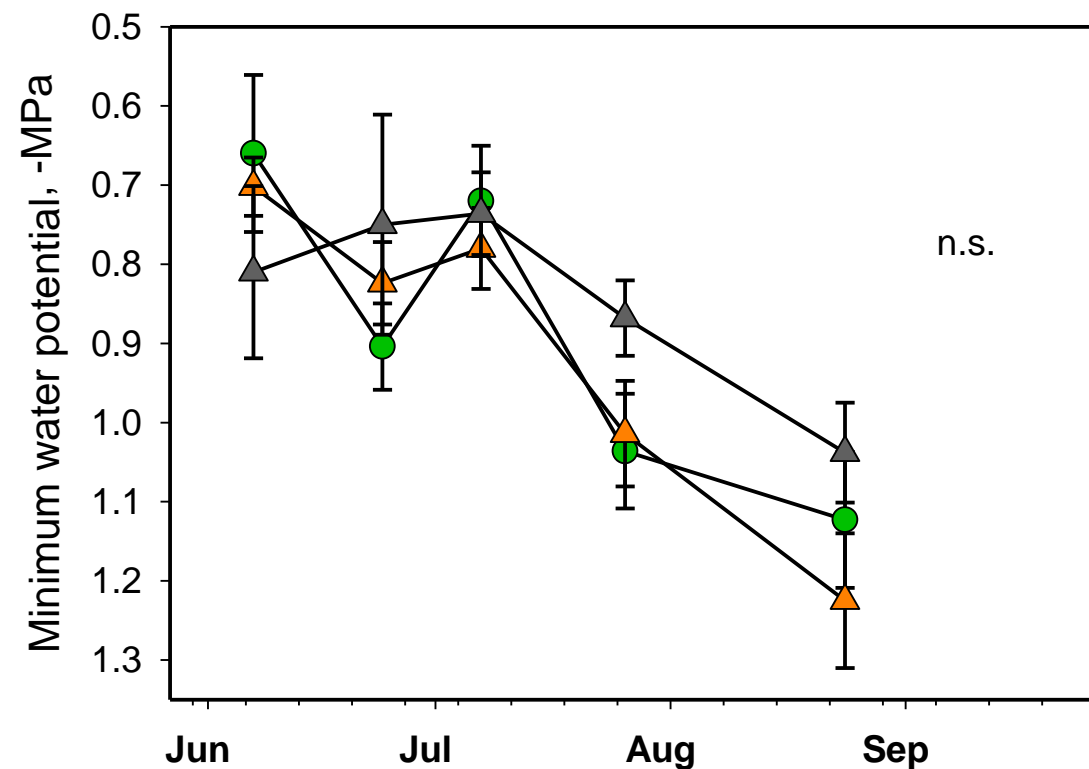
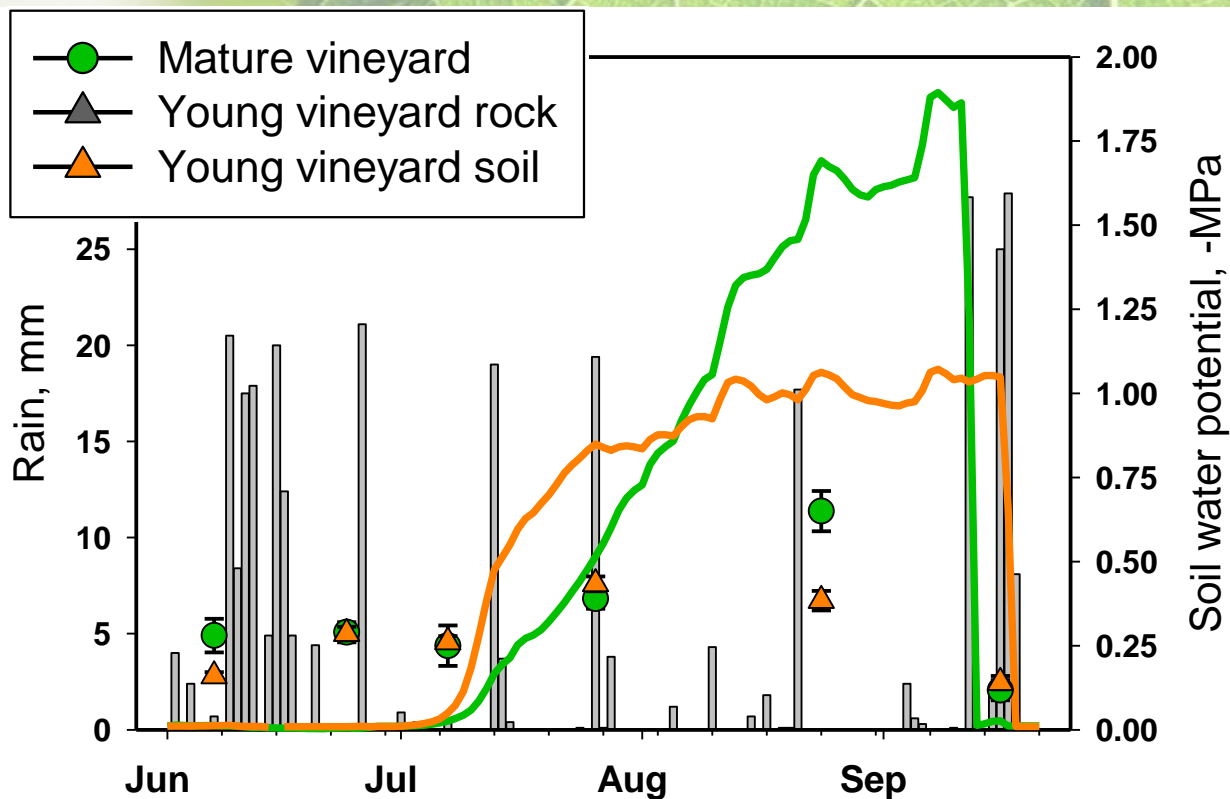
- 15 m



**Cryogenic vacuum distillation**  
**-> Isotope ratio mass spectrometry**

# Results

## *Water status at drought progression*



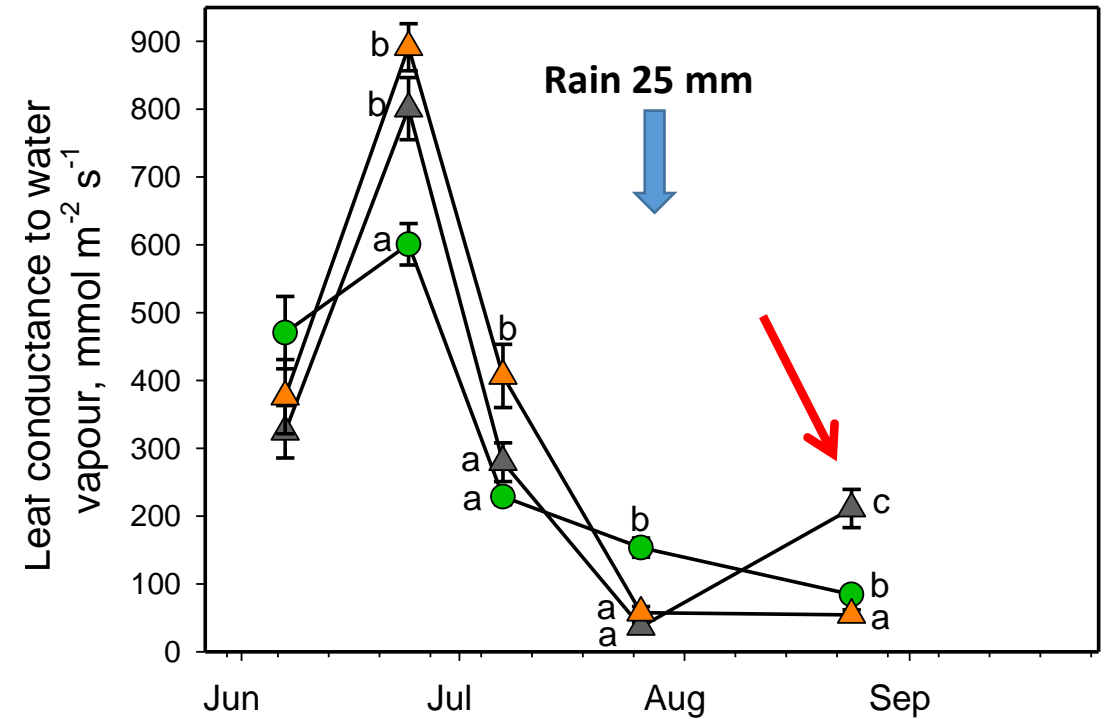
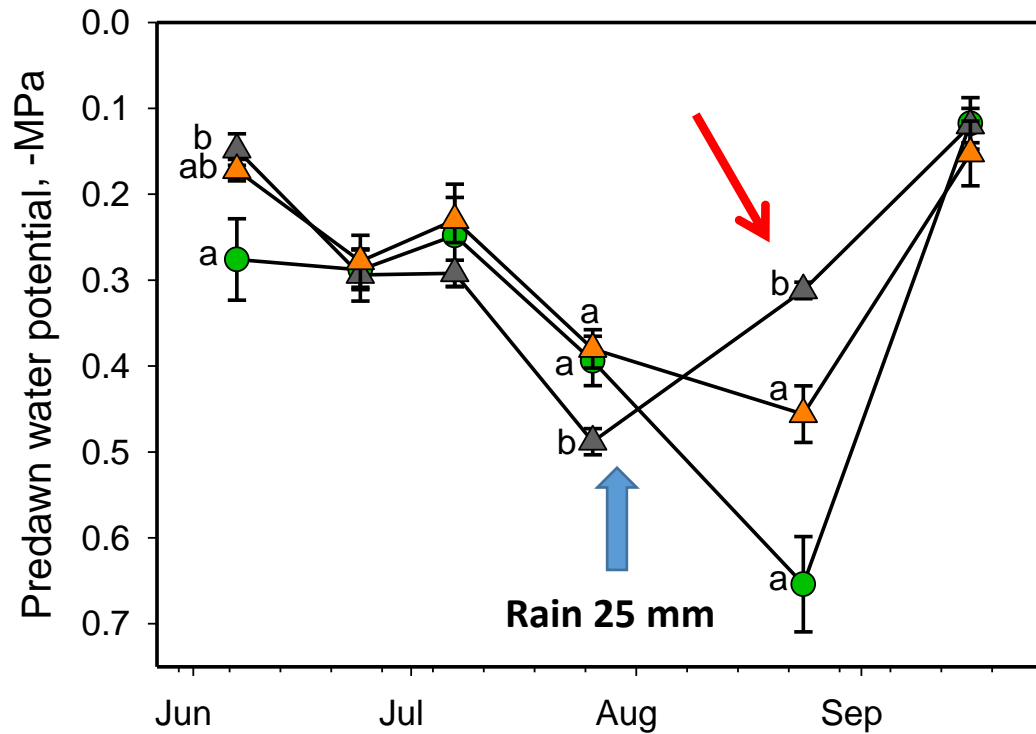
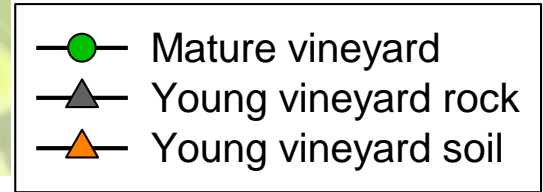
➡  $\Psi_{\text{soil}}$  gradually decreased as summer progressed dropping below -1.5 MPa, but plant water status never reached critical values ( $\Psi_{\text{pd}} > -0.60$  MPa,  $\Psi_{\text{min}} > -1.2$  MPa)

➡ Plants have access to stable water resources



# Results

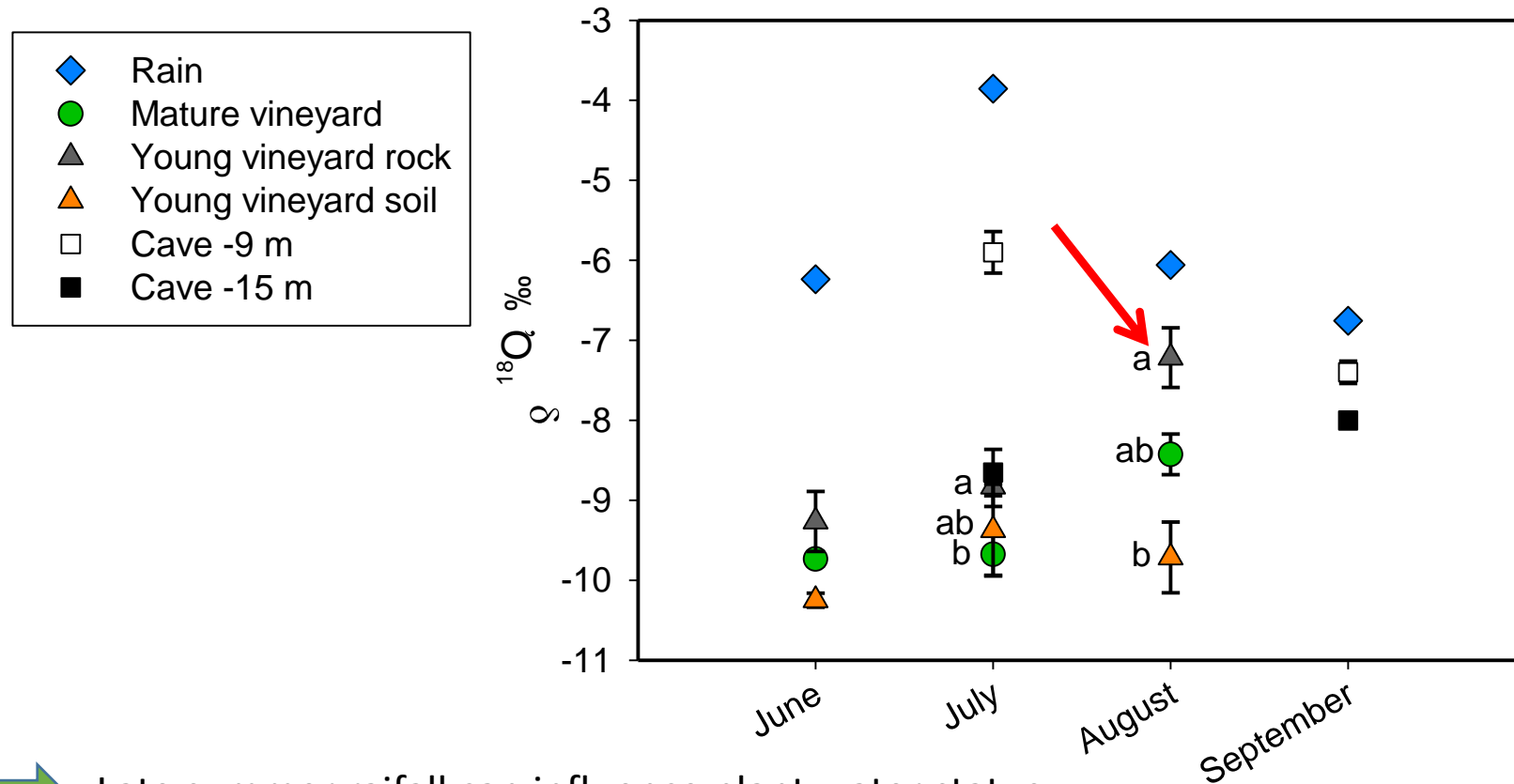
## *Mature vs Young vineyard*



- ➡ Significant stomatal closure in summer: isohydric behavior improve the drought tolerance of plants
- ➡ More favorable water status in YV with rocky soils: loose rocks facilitate water infiltration to the rooting zone

# Results

## *Isotopic composition analysis*



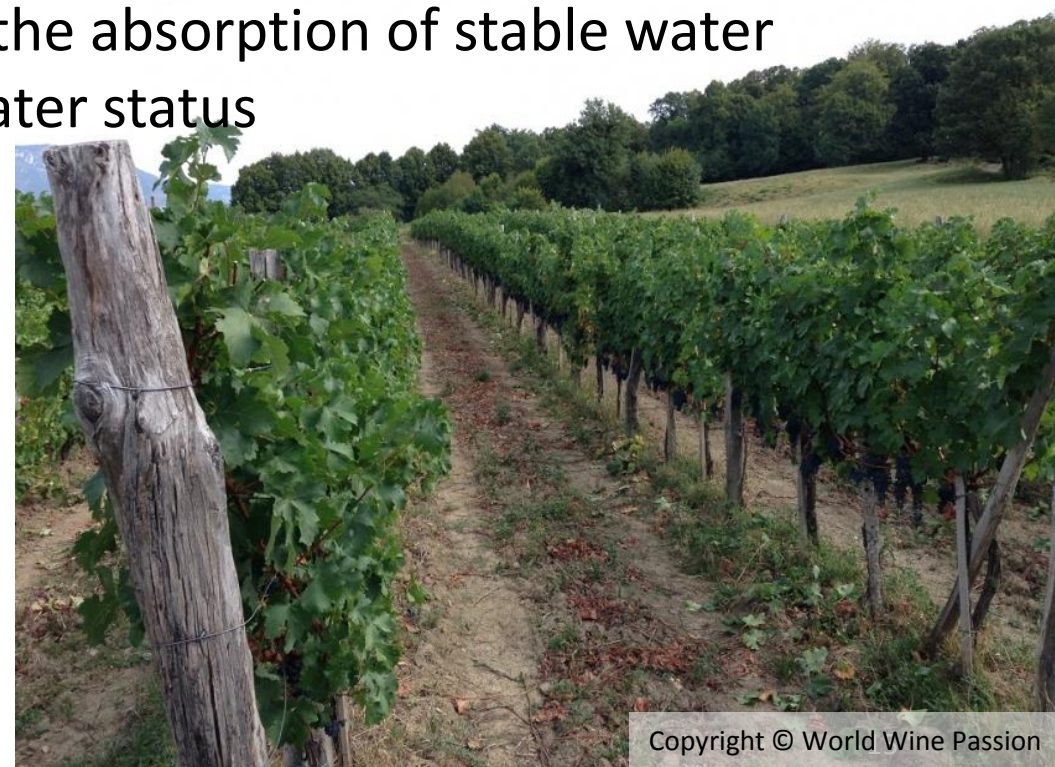
➡ Late summer rainfall can influence plant water status

➡ Xylem sap  $\delta^{18}\text{O}$  of all plants was more similar to that of cave soil water at -15 m than that of rainfall



# Take home message...

- ✓ The estimation of soil water availability via soil sensors is not useful for irrigation management
- ✓ During summer drought deep roots secure the absorption of stable water resources and relatively favourable plant water status
- ✓  $\Psi_{pd}$  is a good proxy of drought stress intensity for the specific cultivar and site conditions





# Conclusions

The general favourable water status of plants suggests that a moderate amount of rainfall in late spring/early summer may guarantee the maintenance of a moderate water stress during the growing season, and allow the plants to thrive during July and August avoiding the risk for severe water stress, even in case of little or no rainfall.

Supplemental irrigation could be applied i) in Spring to recharge underground water stores, ii) during summer, if water is allowed to penetrate below the shallow soil layer, moisturizing the rooting zone.



Thank you



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