SIMULATING FUTURE DROUGHT SCENARIOS TO ASSESS CLIMATE CHANGE IMPACTS ON VINEYARD ECOSYSTEMS IN YVORNE, SWITZERLAND

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INTRODUCTION

Drought events can strongly impact grapevine and berry physiology and subsequent wine quality, as widely demonstrated in controlled experiments.

However, the potential **impacts of summer drought on the whole vineyard ecosystem**, combining vegetation, soil and its microbiome, remain poorly explored, especially in cooler climate regions and under field conditions.

To fill this gap, we set up a 3-year **multidisciplinary drought simulation experiment** in a Chasselas vineyard in Yvorne, Switzerland.

View of one of the four setups installed in the vineyard. © S. Fantasia

METHODOLOGY

Four rainout shelters were installed in April 2024 to exclude natural rainfall. Under these shelters, **three distinct water supply** regimes are applied, via centralized irrigation:

1) **Control**: a control regime reproducing the past 20-year average local rainfall;
2) **Moderate to severe stress**: a moderate to severe water deficit, based on RCP 8.5 projections for 2085;
3) **Severe stress**: a severe water deficit, with water supply reduced to 50% of the 2085 projections.

An additional external plot was established outside each shelter to monitor external conditions.

Grapevine physiology, **berry composition**, **wine quality**, **plant species composition**, **soil properties** and **soil microbial diversity** are monitored throughout the 2024-2026 growing seasons.

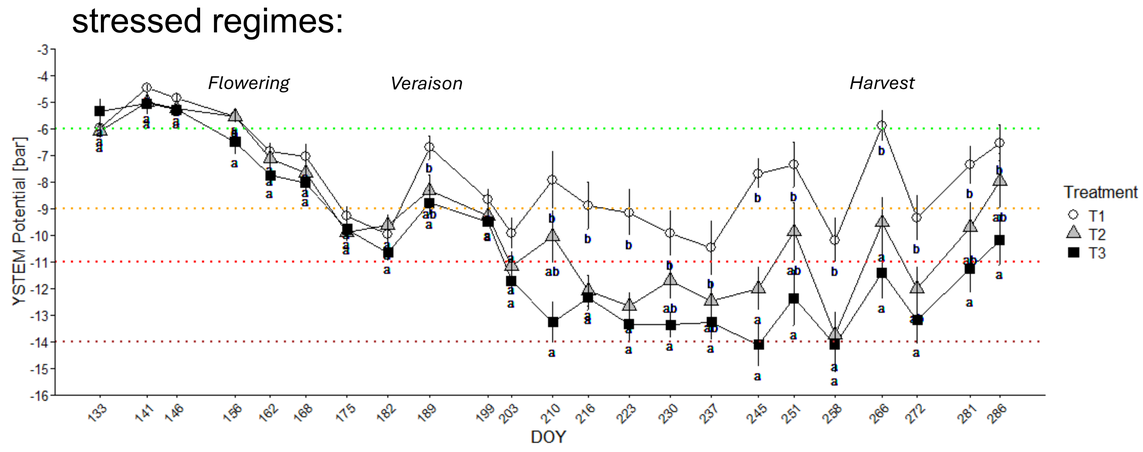
Below and aboveground **temperature and humidity** are continuously recorded at various heights and depths.

Control **Moderate to severe** **Severe**

Vines, grapes and soil cover from the different regimes (September 2024). © S. Fantasia

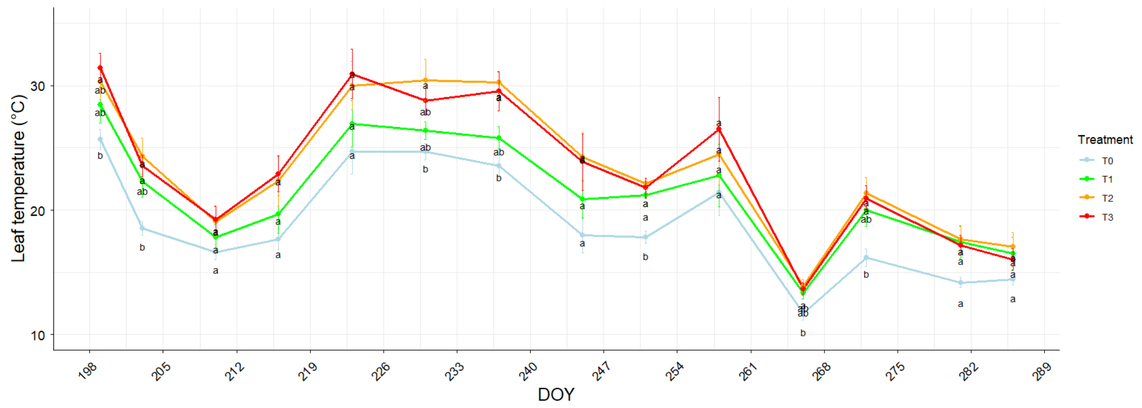
PRELIMINARY RESULTS AND DISCUSSION

- Stress treatments (T2, T3) diverged from the control from veraison onwards, with **no consistent water potential differences** between stressed regimes:



Seasonal evolution of midday stem water potential, measured in 2025 (p>0.05).
T1: Control; T2: Moderate to severe stress; T3: Severe stress.
Dashed lines represent different water potential levels.

- Leaf temperature was ~2°C higher for the two stressed regimes, indicating **reduced transpiration**:



Average leaf temperature, measured in 2025 (p>0.05).
T0: External conditions; T1: Control; T2: Moderate to severe stress; T3: Severe stress.

- Drought stress **advanced phenology, reduced canopy growth, vigour, berry weight, yield, sugar per berry and malic acid**.
- **Yeast assimilable nitrogen was higher in stressed regimes**, likely due to a concentration effect and reduced nitrogen competition.
- Wines produced from stressed regimes in 2024 had **full body and lower freshness**, with **honey and cooked fruit aromas.**

CONCLUSIONS AND PERSPECTIVES

- **Drought stress affects vineyard ecosystem,** with no significant differences between the two stressed regimes.
- This experiment provides an **integrative, field-scale platform** to disentangle coupled responses of grapevine, soil and associated vegetation.
- These shelters represent a **powerful tool for drought research**, potentially enabling more robust predictions of vineyard responses under future climate scenarios and supporting the development of targeted adaptation strategies.

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