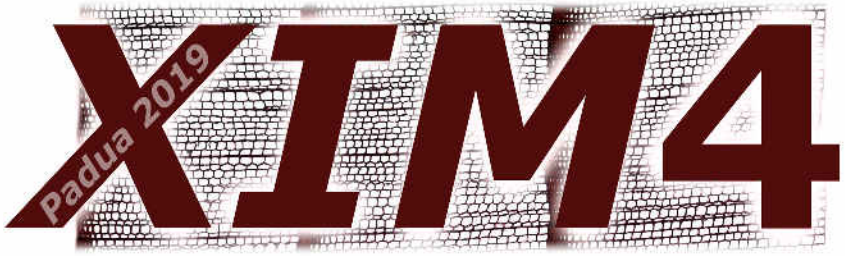
TESAF DEPARTMENT OF LAND, ENVIRONMENT, AGRICULTURE AND FORESTRY

DAFNAE Department of Agronomy, Food, Natural resources, Animals and Environment

INRA SCIENCE & IMPACT

UNIVERSITÀ DEGLI STUDI DI PADOVA

# Fourth Xylem International Meeting




# BOOK OF ABSTRACTS

New Phytologist

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### Investigation of non-structural carbohydrates and xylem anatomy in petiole of grapevine varieties during water limitation and after re-irrigation

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Water shortage (WS) during growing of *Vitis vinifera* L. can limit shoot growth and affect yield and fruit quality, as well as allocation of carbon reserves into perennial organs for the upcoming years. Varietal anatomical differences, such as specific mean xylem vessel diameter in petiole, are expected to influence water transport in canes facing water limitation. Several authors have also evidenced that non-structural carbohydrates (NSC) of adjacent living parenchyma are involved in the repair mechanism of embolized vessels. In this work, we evaluated NSC level and xylem anatomy in petiole of Cabernet Sauvignon and Syrah varieties, subjected to WS and subsequent water refilling in the summer of 2017. The anatomical analysis highlighted that Syrah had high frequency of classes of large vessels, and that the xylem differentiation of vascular bundles was also affected by WS. Moreover, petiole NSC content was significantly influenced by WS and recovery, supporting the hypothesis that starch mobilization was associated to an elevated concentration in soluble NSC. This effect was determinant for Cabernet Sauvignon, whose stress response seemed to be based mainly on NSC metabolism. Finally, Syrah, differently to Cabernet Sauvignon, sustained the WS-induced increase in soluble NSC of petiole also 18 h after re-watering.

*Key message*: Petiole anatomy and NSC were compared in different grapevine varieties during water stress and after re-irrigation. The cultivar with the higher frequency in large vessels could maintain higher soluble NSC for recovery.

## *SESSION 5: PHYSIOLOGICAL RESPONSES TO THE ENVIRONMENT*

### Effects of mosses with contrasting functional traits on shrub growth and xylem anatomy under different precipitation regimes at the tundra

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In the Arctic tundra, bryophytes are the dominant growth form covering the soil surface of shrub communities. They can exert physical and chemical effects on the community through their capacity to retain moisture, their allelopathic compounds or the introduction of nutrients into the system. The study of the interaction between shrubs and bryophytes is essential to understand the functioning of these communities, which are expanding in the tundra due to global change. In this study, we collected *Betula nana* ramets growing on moss carpets dominated by the species *Hylocomium splendens*, *Pleurozium schreberi* or *Sphagnum* spp., which differ in their growth habit and the density of their carpets. We sampled three ramets per site in eight locations near Abisko, Sweden. Half of the sites correspond to low precipitation areas (571-755 mm) and the other half to high precipitation (811-1155 mm). We prepared microscopic sections of the shrubs stem base and measured growth rings and xylem anatomical parameters (vessel lumen area, vessel density and grouping, and theoretical hydraulic conductivity). Preliminary results indicate shrub growth differences depending on the dominating moss species. We discuss the importance of moss traits combined with the precipitation regime for the performance of tundra shrubs in the context of a changing climate.

*Key message*: Moss species with contrasting functional traits related to their growth habit differ in their influence on shrub performance at the tundra.physiology.

# Investigation of non-structural carbohydrates and anatomy in petiole of grapevine varieties during water limitation and after re-irrigation

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## Introduction

Recent studies confirm that xylem anatomy together with non structural carbohydrates (NSC) play crucial roles in sustaining grapevine under strong water deficit [1-2]. Indeed NSC are supposed to be involved in refilling mechanism of embolized vessel [3].

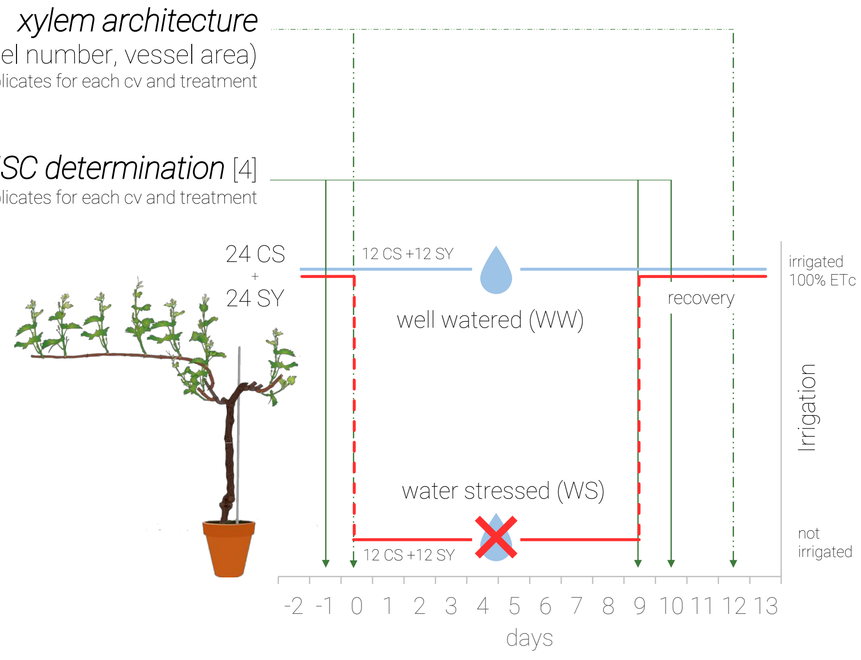
In this view, the present study aimed at investigating the impact of a short and severe water deficit on two grapevine cultivars with different hydraulic behavior, namely Cabernet Sauvignon (CS - isohydric) and Syrah (SY - near anisohydric). In particular, we looked at the effect of drought on:

i) xylem differentiation within vascular bundles of leaf petioles, before and after stress;
ii) pattern of glucose, maltose, sucrose and starch during water deficit and after recovery.

## Experimental plan

*Petiole xylem architecture*
(vessel number, vessel area)
3 replicates for each cv and treatment

*NSC determination* [4]
3 replicates for each cv and treatment



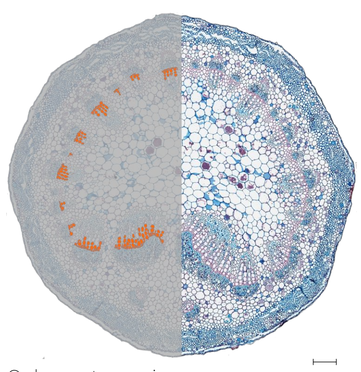

## What's hot?

| Non structural carbohydrates | CS | | SY | |
|---|---|---|---|---|
| | starch | maltose | starch | maltose |
| before stress | ● ↓ | ⬢ ↓ | ⬢ ↓ | ⬢ ↓ |
| during stress | ● ↓ | ⬢ ↓ | ● ↓ | ⬢ ↓ |
| after recovery | ● | ● | ● | ⬢ |

| Xylem architecture *more frequent vessel size class | CS | | SY | |
|---|---|---|---|---|
| | WW | WS | WW | WS |
| before stress | ● ↓ | ● ↓ | ⬤ ↓ | ⬤ ↓ |
| after stress | ● | ● | ⬤ | ⬤ |

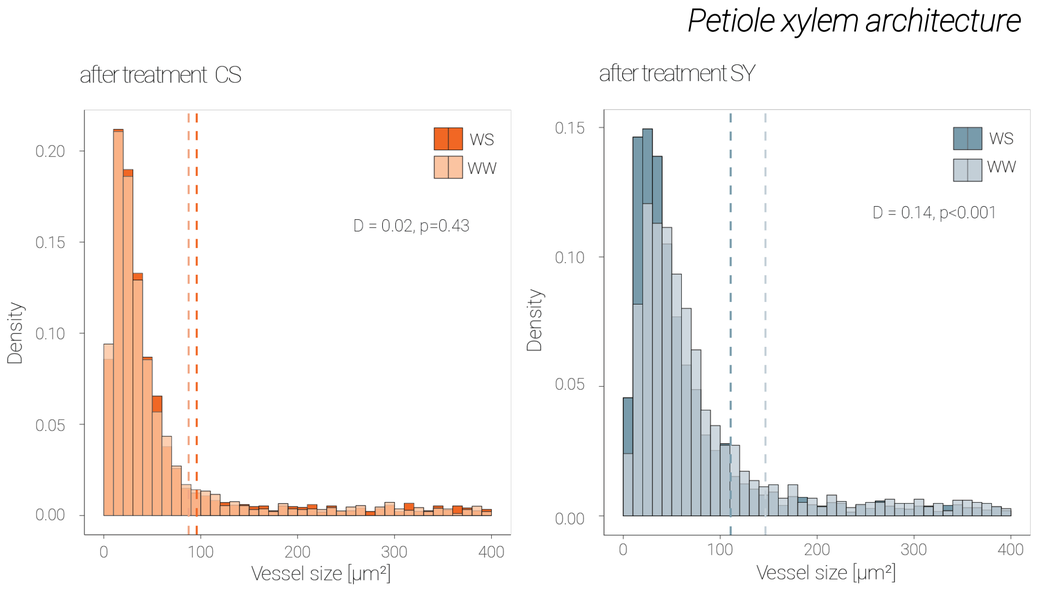
## Results

*Petiole xylem architecture*

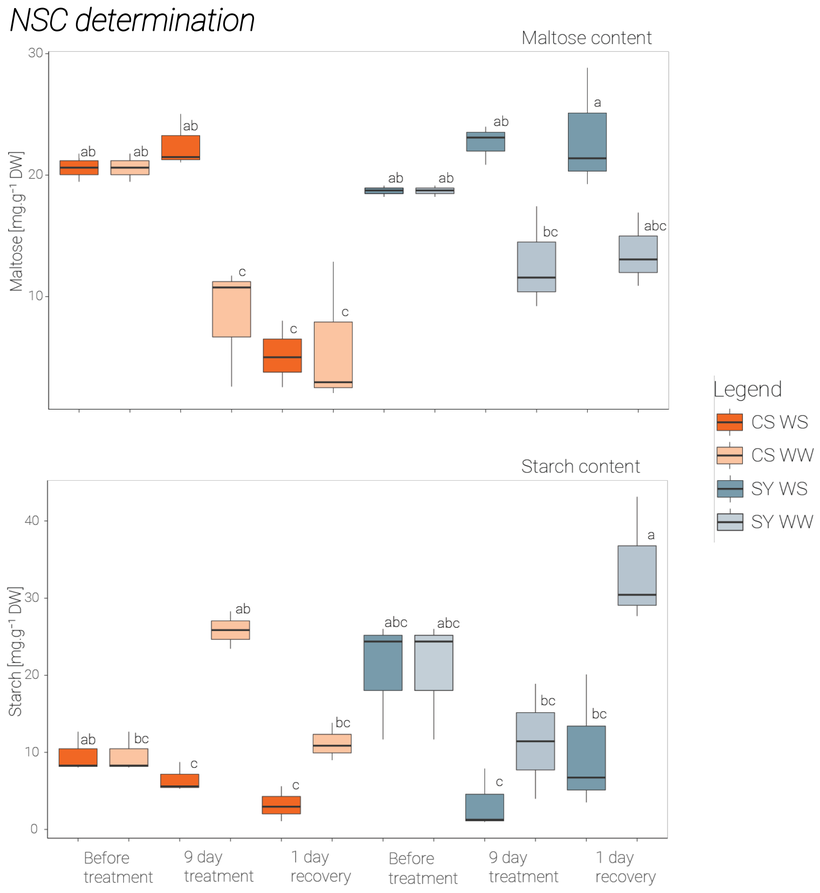


Cabernet sauvignon
6 µm section – alcian blue safranin
200 µm

Both before and after the treatment, the difference in the frequency of xylem dimensional classes between CS and SY was statistically significant, with CS having petioles with smaller vessel size compared to SY (not shown).
The comparison of dimensional vessel classes was considered in both stressed (WS) and well watered (WW) vines. Different patterns were observed: while in CS the petioles vessel size distribution was similar in WW and WS plants, the distribution in SY was significantly affected by the treatment, as in WW vines a greater number of larger vessels was observed.



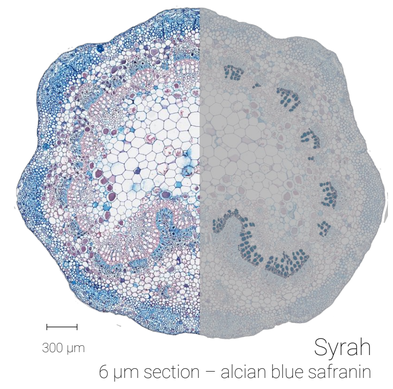

*NSC determination*




**Maltose** was significantly affected by all experimental factors (treatment, time, variety) and their interaction. WS treatment determined a significantly higher concentration of maltose in petioles in both the varieties respect to control. However, after re-watering, the two cultivars showed an opposite trend: maltose level in CS dropped at the same values of control, while in SY its values remained high.
The same pattern was also observed for **sucrose**.

**Starch** showed differences in response to both treatment and variety and to their interaction with time. In WS vines, the concentration of starch in petioles was significantly lower than in the control. In both WW and WS vines, SY showed a higher quantity of starch respect to CS.

**Glucose** concentration in petiole resulted to be significantly affected only by time and variety.



300 µm
Syrah
6 µm section – alcian blue safranin

[1] Hochberg, U. et al. (2014) Functional plant biology, 42: 357-365 [2] Falchi, R. et al. (2019) BIO Web of Conferences, 13 [3] Nardini et al. (2011) Plant Science 180: 604-611 [4] Quentin, A.G. et al. (2015) Tree Physiology, 35: 1146 - 1165

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