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Hydraulic conductivity and vulnerability to embolism in grapevine
(cv. Chasselas)

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Environmental constraints and stress physiology

Valais, Switzerland

Drier summers
and important temperature amplitude
(IPCC Report 2007)

- Recurrent Water Stress
- Decline of photosynthetic rate
- Physiological disorders (cavitation, embolism, berry shrivel…)
- Incomplete grape ripeness
- Carbohydrate and nitrogen reserves in roots and woods?
- Cultivar sensibility?

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Experimental Station in Leytron (Switzerland)

Location:	**Leytron (Alpine valley, Valais)**
Cultivar:	**Chasselas (14/33-4)**
Rootstock:	**5 BB**
Plant density:	**5500 vines/ha**
Training system:	**Guyot simple (7 shoots/vine)**
Vines:	**15 years old**

Irrigation treatments:

- Drip-irrigation from bloom to veraison (9L/m^2/week)
- Drip-irrigation from veraison to harvest (9L/m^2/week)
- No irrigation
- No irrigation + plastic covered

4 split-plot randomised blocks of 12 vines each

Rainfall: 550 mm / year
Soils: stony soils,
low water holding capacity

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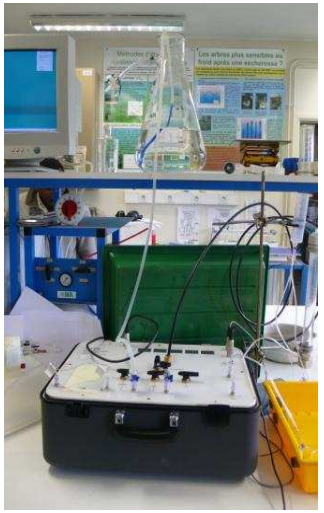
Measurements

- **Leaf gas-exchanges** (A, gs, E, R_d)
  Li-Cor 6400XP , Open-system

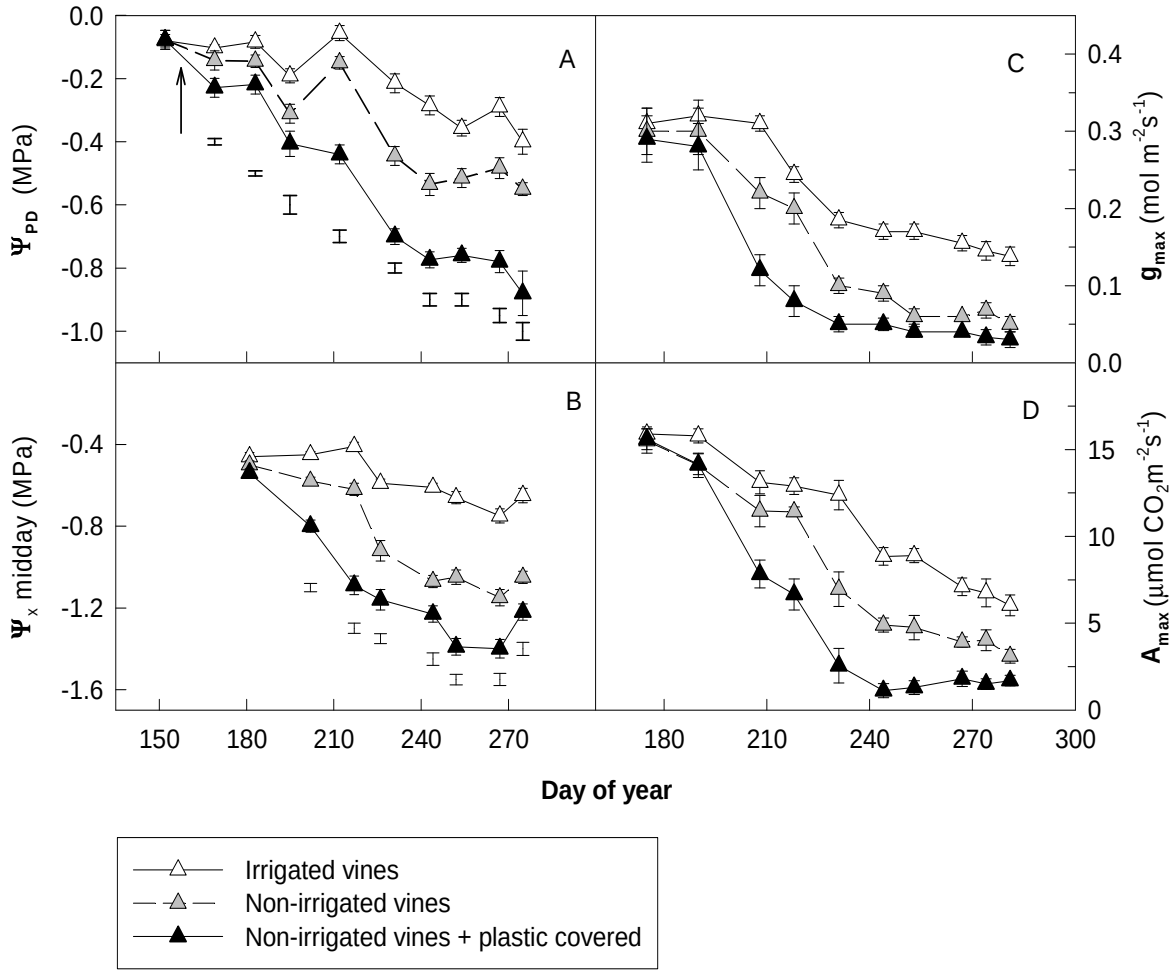
- **Plant Water Status**
  Leaf-Stem-Grape water potential (Ψ)
  Hydraulic conductance (K_h) (XYL'EM embolism meter)
  Stem Sap-flow (heat balance technique)
  C-isotopic discrimination (δC13) (berry sugars)

- Growth, Yield, C/N reserves (roots, trunks, canes)
- Wine quality (polyphenols, anthocyanins, aroma) sensoric (7 cultivars)



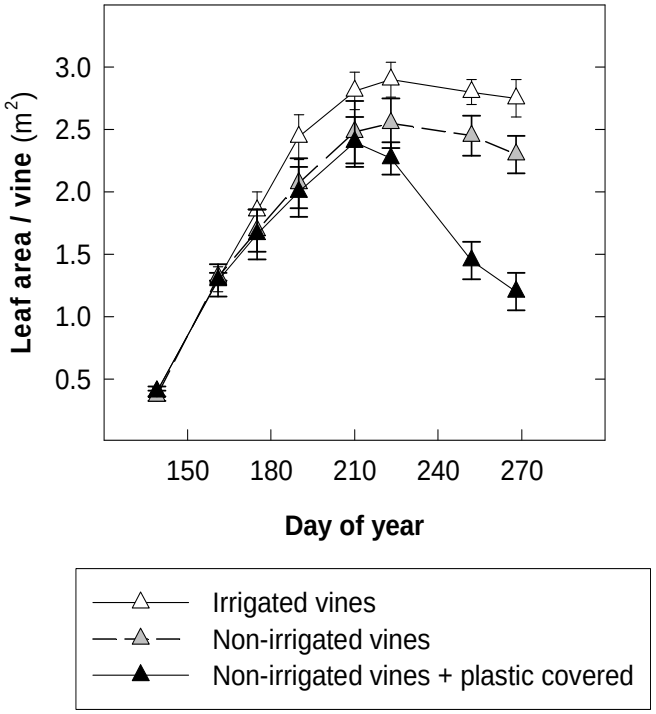
Changes in predawn water potential (Ψ_{PD}), stem water potential (Ψ_x), maximum stomatal conductance (g_{max}) and in maximum photosynthetic rate (A_{max})

Chasselas, Leytron 2009



Leaf area per vine during the season

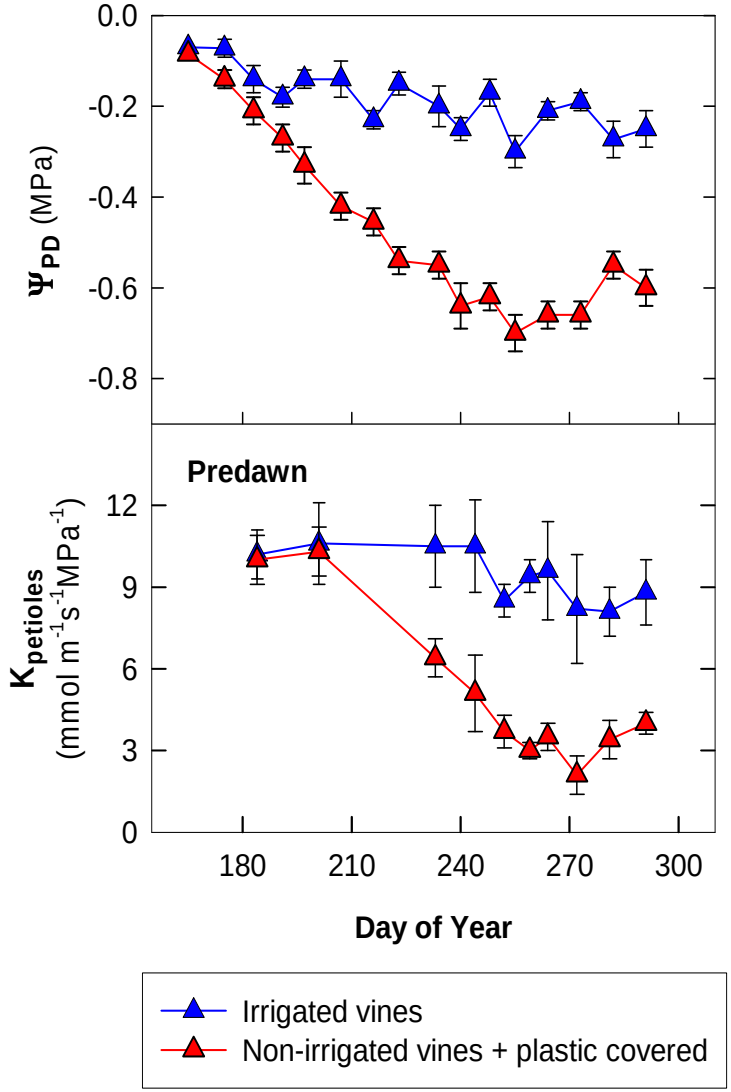
Chasselas, Leytron 2009



Non-irrigated vines and plastic covered in September 2009

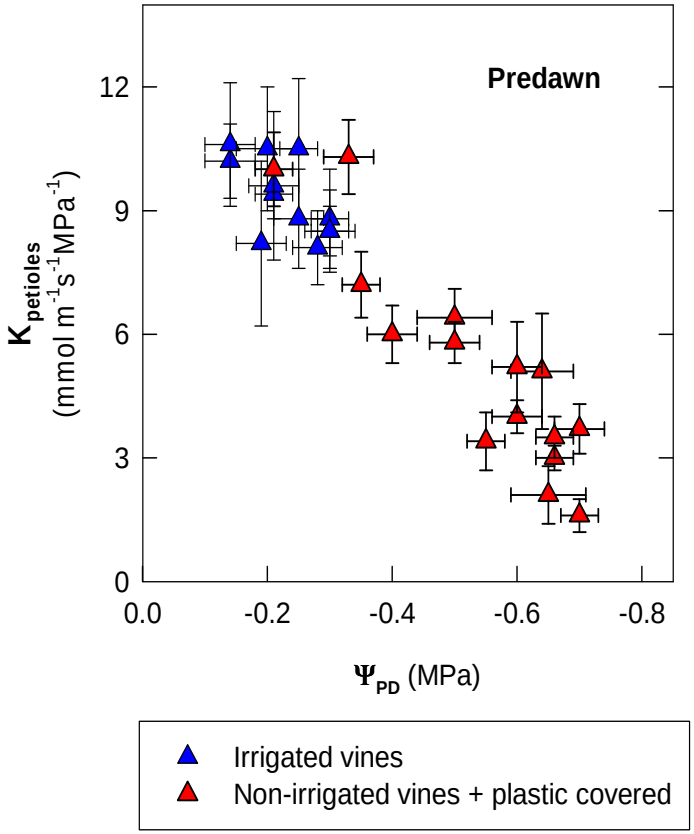
Changes in predawn water potential (Ψ_{PD}) and petiole hydraulic conductance ($K_{petioles}$) measured at predawn during the season 2010

Chasselas, Leytron



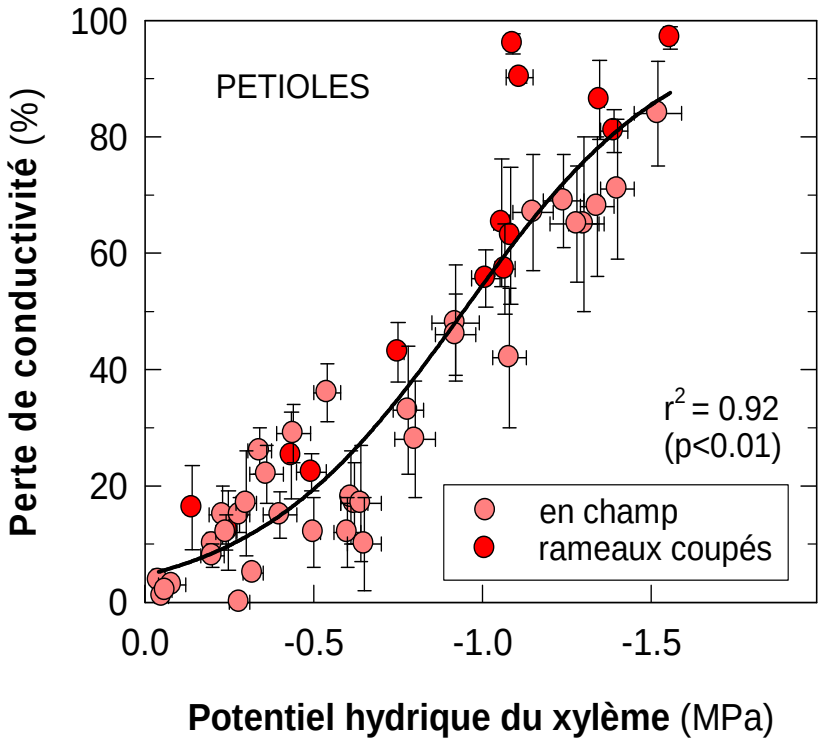
Relationship between predawn water potential (Ψ_{PD}) and petiole hydraulic conductance ($K_{petioles}$) measured at predawn

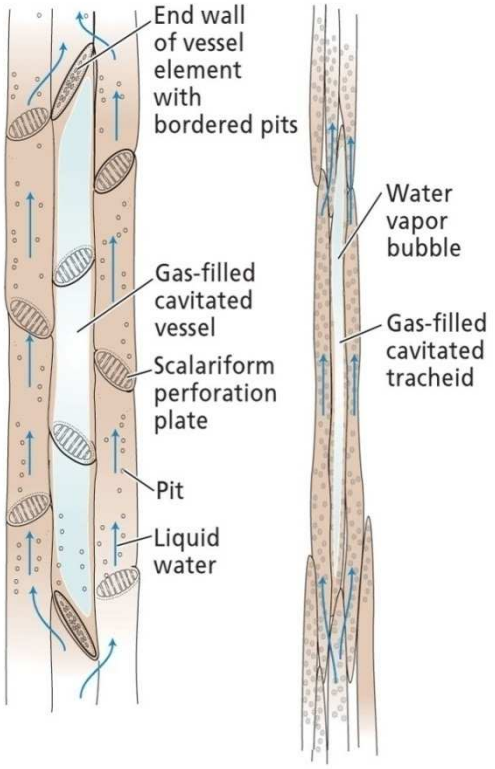
Chasselas, Leytron 2009-2010



Vulnerability to cavitation
PLC (percent loss of conductivity)

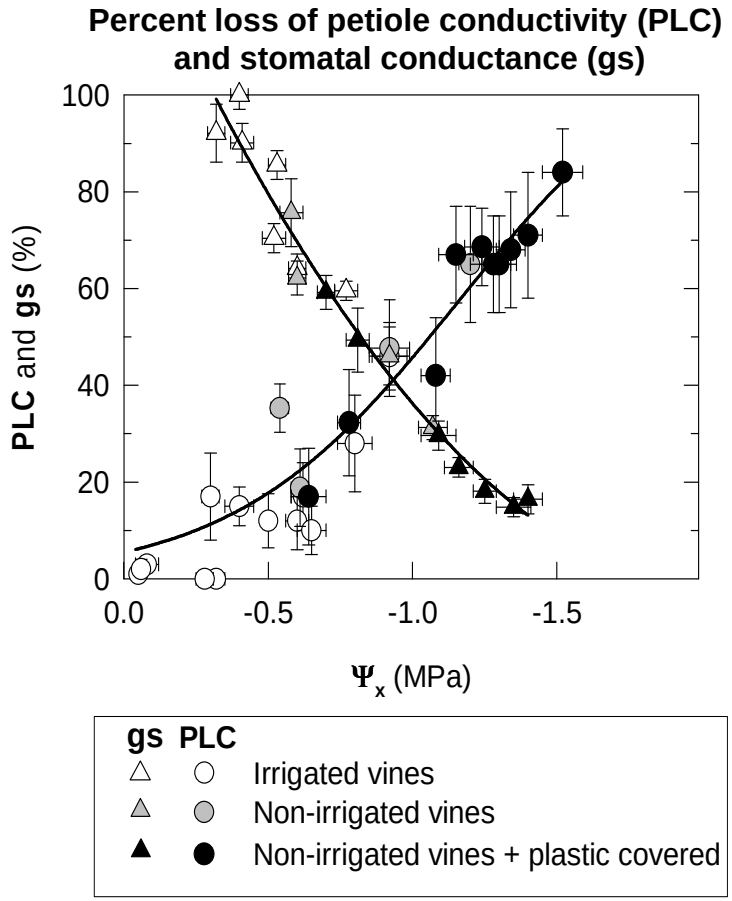
Chasselas, Pully and Leytron 2009





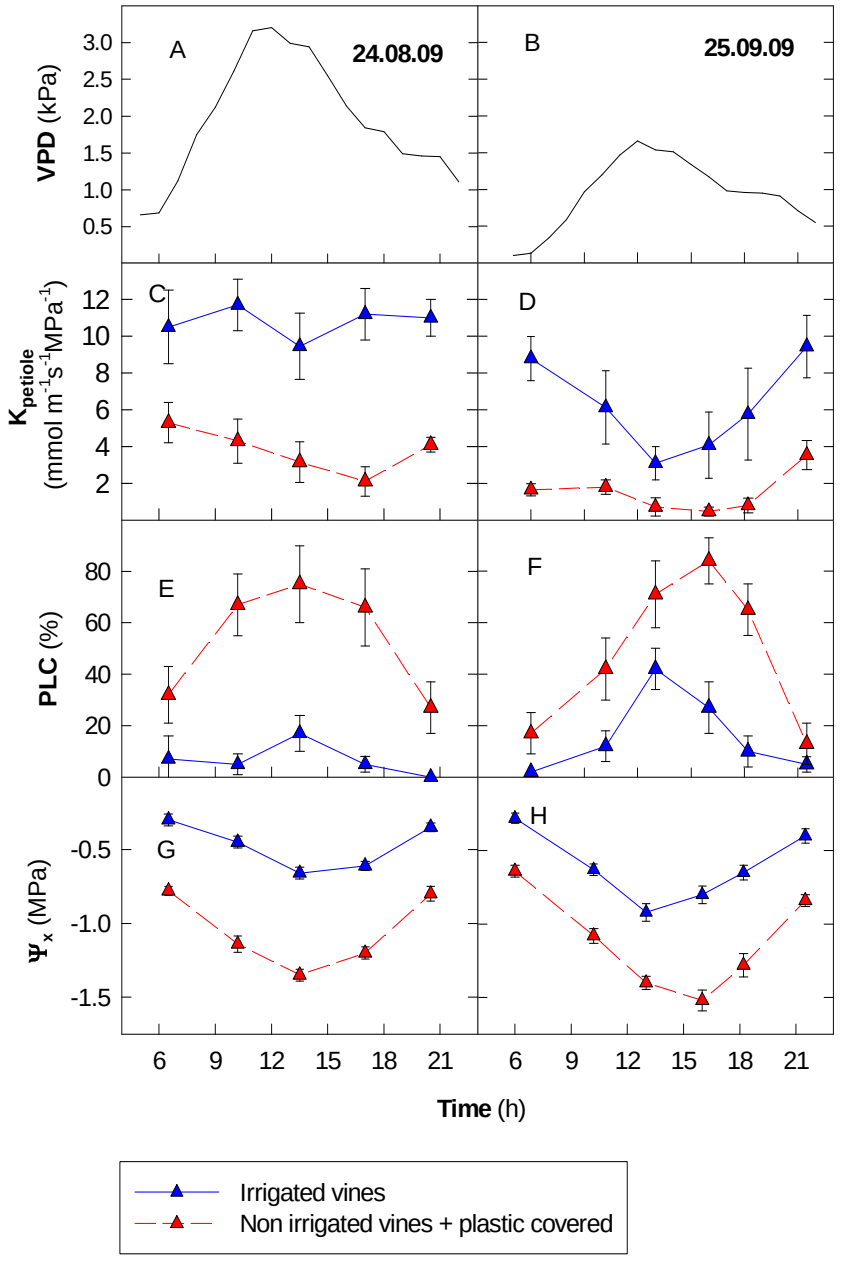
Hydraulic conductivity and stomatal behaviour in grapevine

Chasselas, Leytron 2009



Diurnal courses of VPD, petiole hydraulic conductance ($K_{petioles}$), vulnerability to petioles cavitation (PLC) and stem water potential (Ψ_x)

Chasselas, Leytron, 24/08 and 25/09/2009



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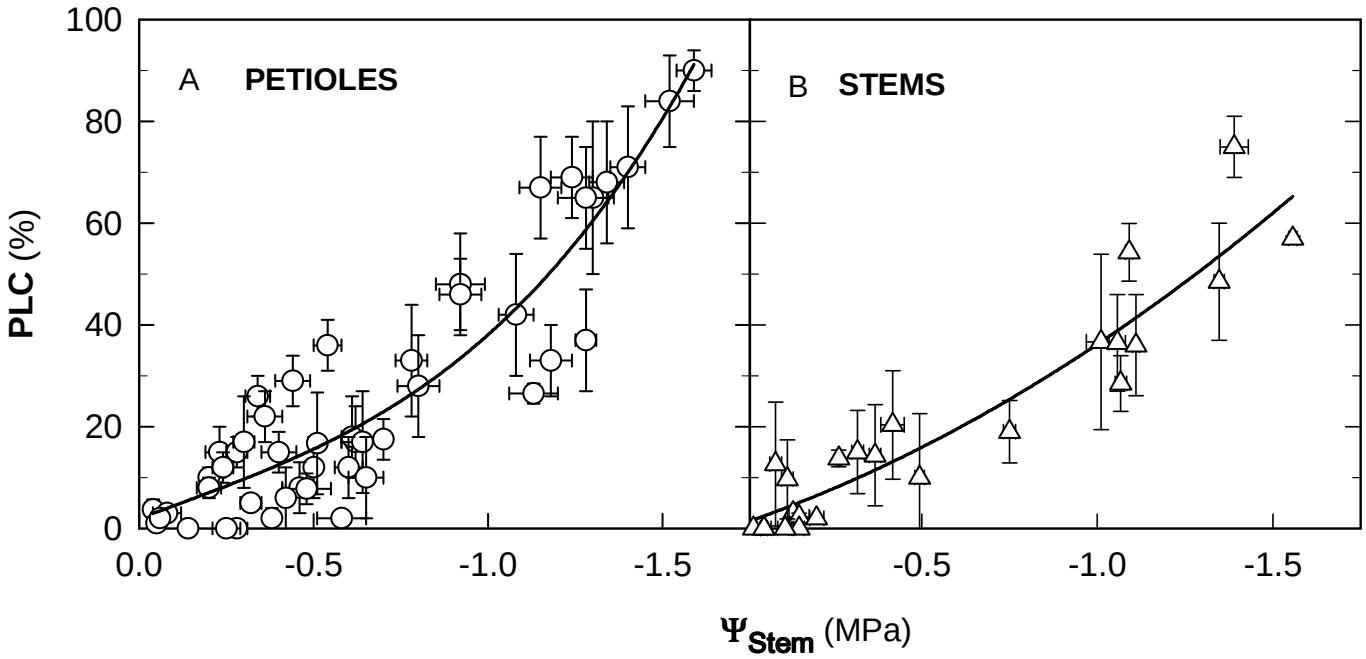
Vulnerability to cavitation
PLC (percent loss of conductivity) in petioles and stems

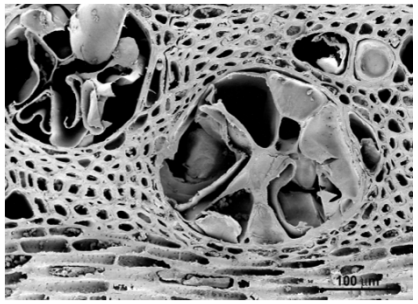
Chasselas, Pully and Leytron 2009-2010



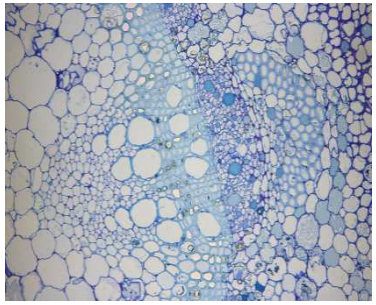
Perspectives about stress grapevine physiology:

Improve the knowledge about water and carbon transfer within the plant during water restriction and manifestation of physiological disorders:

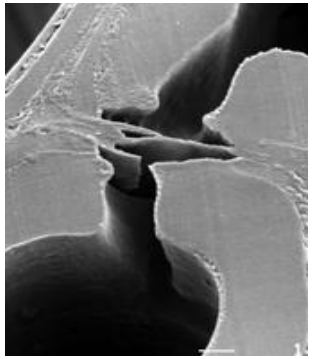
vascular anatomy and histology,
hydraulic conductivity and cavitation “fatigue” during the season
water and sugar translocation in berries



Tyloses in grapevine vessels
Chasselas (K. Gindro, ACW)



Petiole anatomy (irrigated vines)
Chasselas (K. Gindro, ACW)



Jansen et al., 2011

Thank you for your attention

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