



# Grapevine drought tolerance: tales from Bordeaux, ideotypes, and getting back to basics

*-Gregory Gambetta*



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INSTITUT DES SCIENCES  
DE LA VIGNE ET DU VIN  
BORDEAUX AQUITAINE



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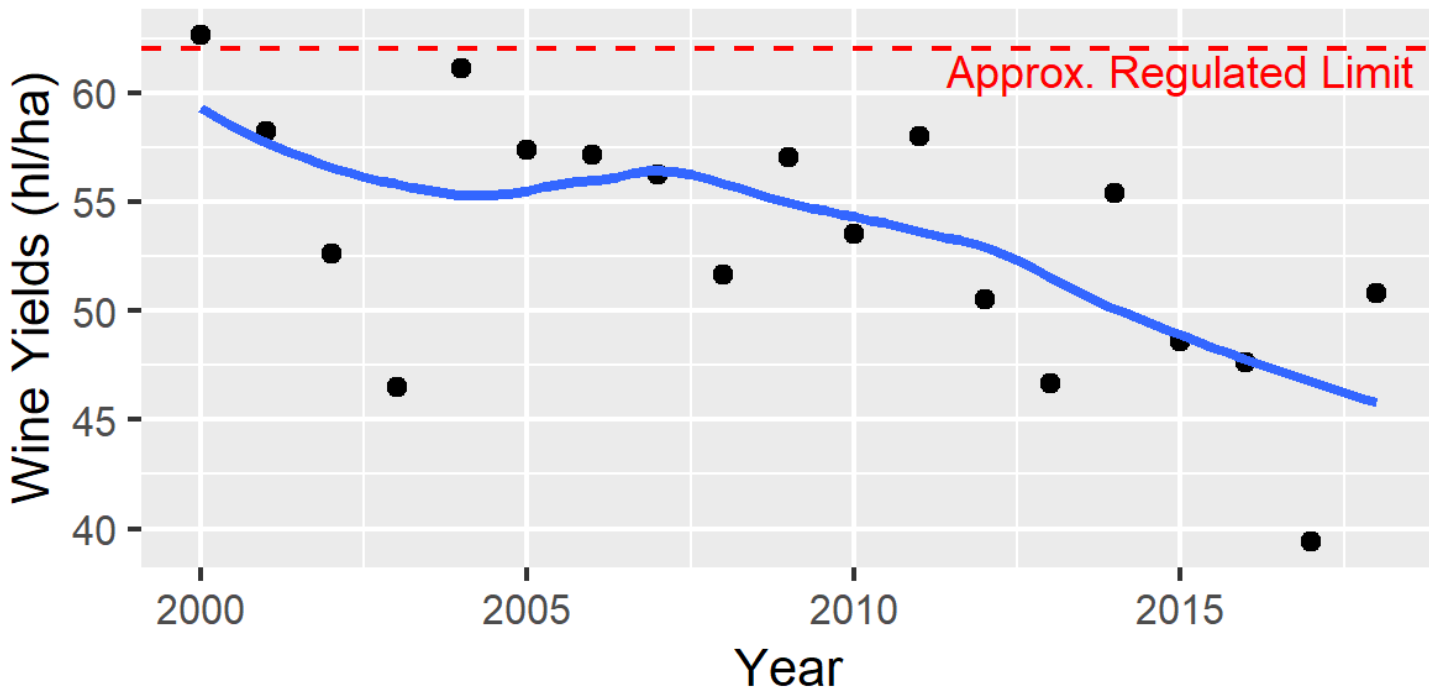


# Presentation Outline

- 1. European vineyard decline and the spectre of increasing water stress.**
2. Building a drought tolerant grapevine.
3. Practical implications & discussion question.

# Recent yield declines have growers worried

## France AOC/AOP Wine Yields 2000-2018



# This reality launched a huge investment

**PLAN NATIONAL  
DÉPÉRISSEMENT DU VIGNOBLE**



Launched in 2016 with an annual budget of over 2.5 million euros aimed at addressing the underlying causes of this decline.

*What are the factors contributing to these declines?*

# Disease was the real focus at the start



## **Esca Disease**

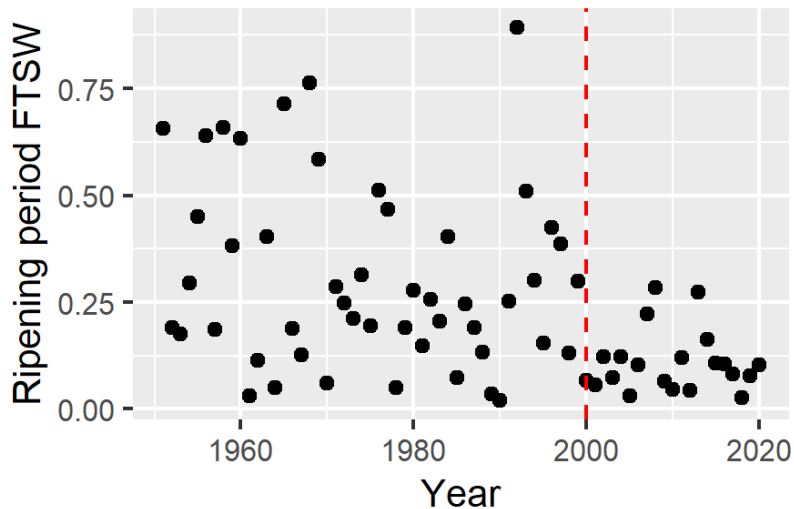
Photos courtesy of  
Giovanni Bortolami

*But disease is only part of the story*

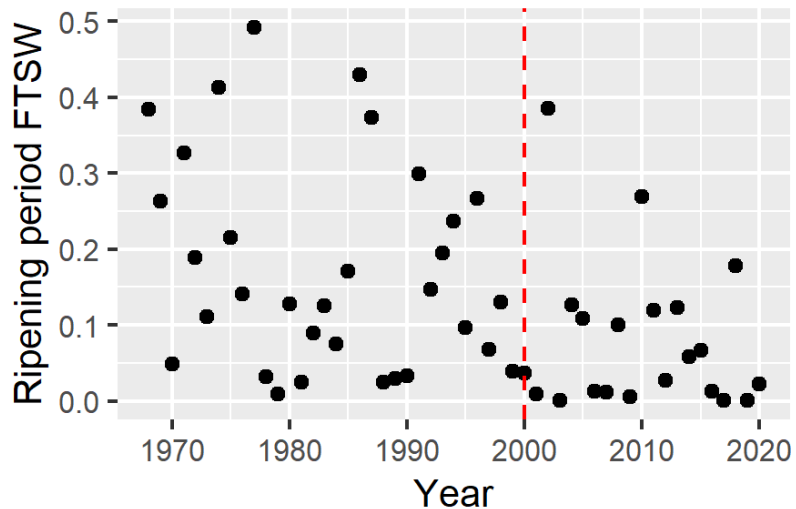
# Are the frequency of water deficits increasing?



## Bordeaux



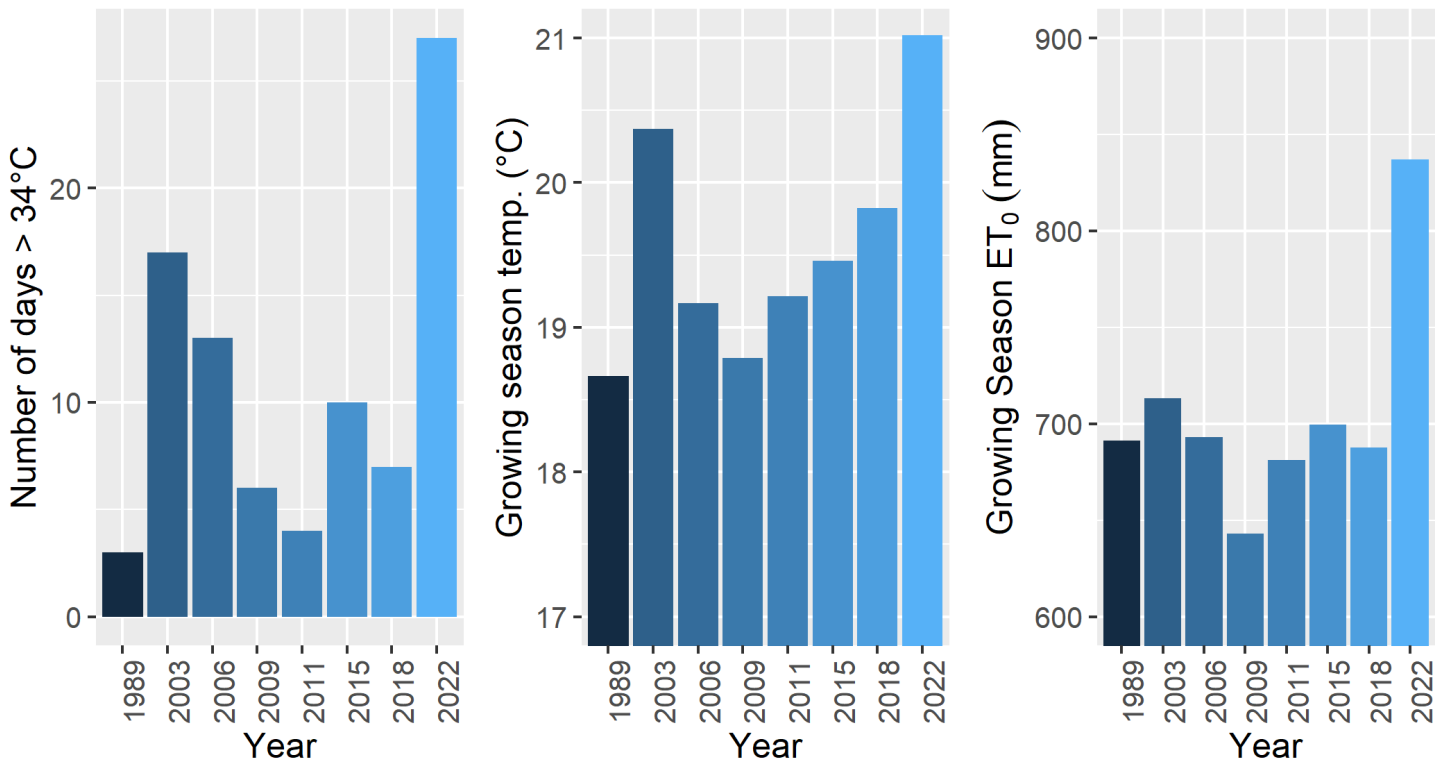
## Southern Rhône



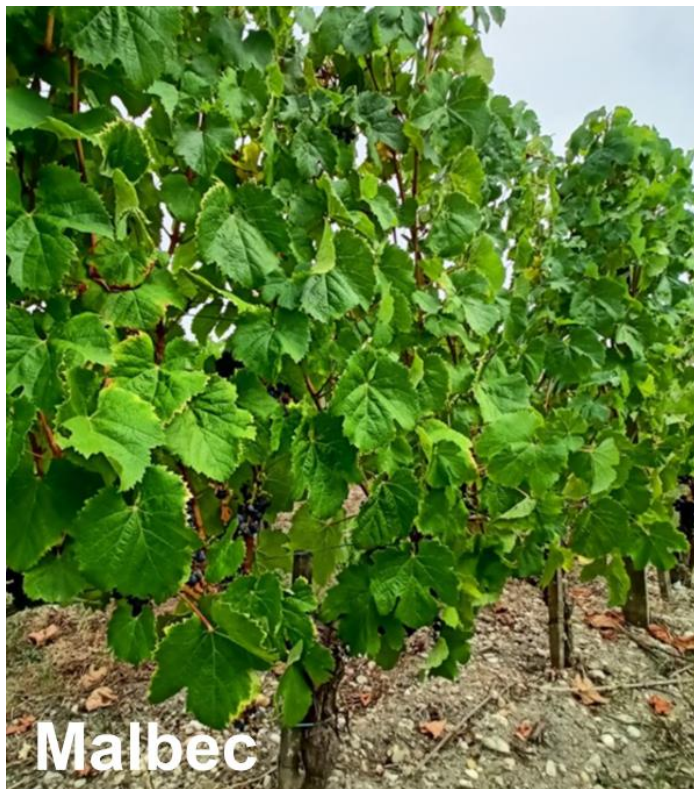
Gambetta et al unpublished data

# Recent hot and dry vintages are worrying

Climate metric comparisons across selected hot Bordeaux vintages



**And some have been extreme**



**Malbec**



**Syrah**





# Conclusions

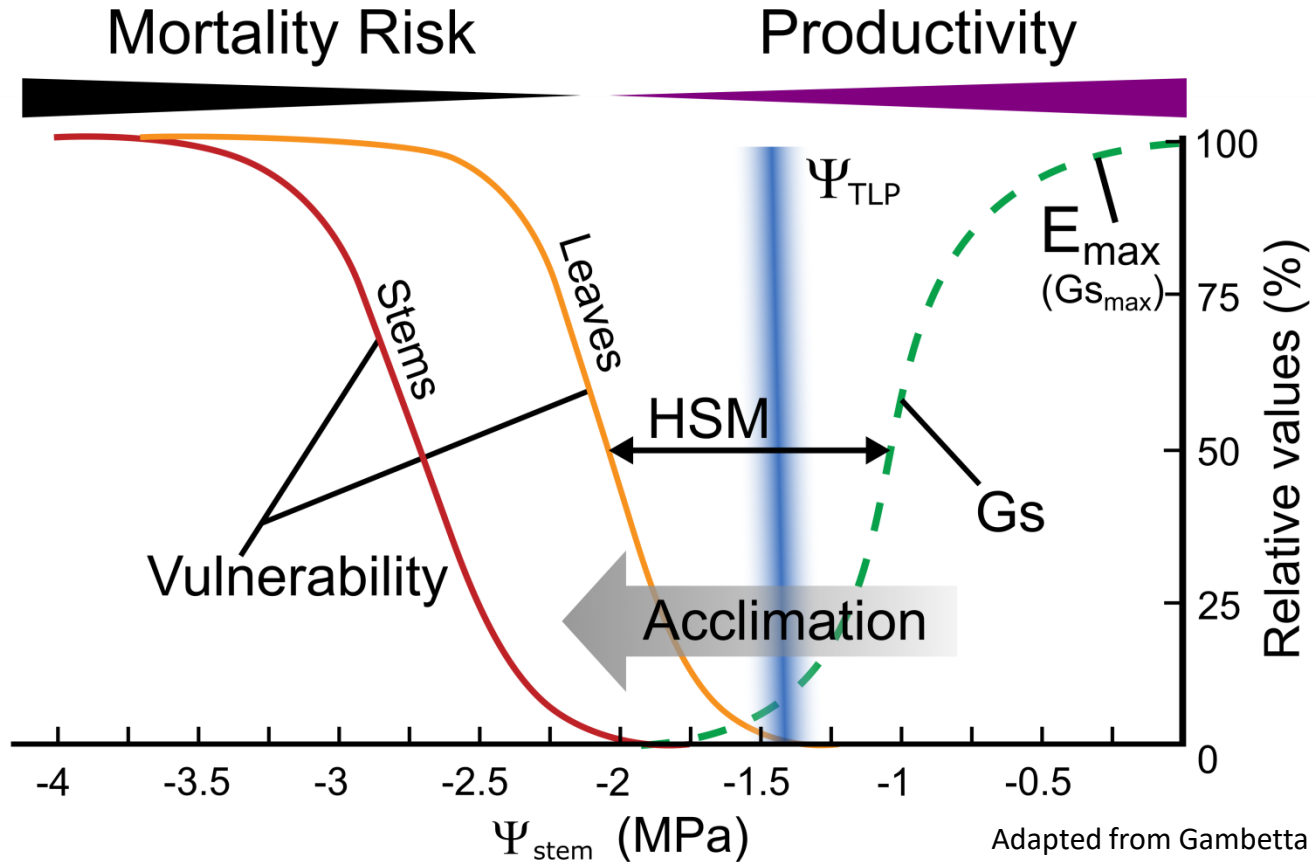
- In dry farmed regions water status can be largely unknown.
- Since yield declines are incremental water stress impacts on yield remain unquantified year to year.
- This raises the spectre of water deficits, carry-over effects



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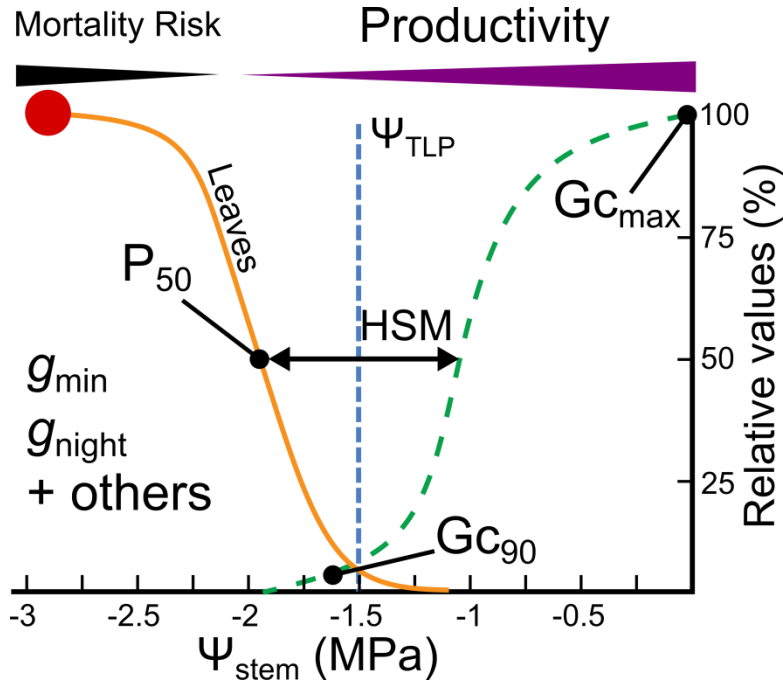
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# Building a drought tolerant grapevine



Adapted from Gambetta et al, 2020

# Building a drought tolerant grapevine



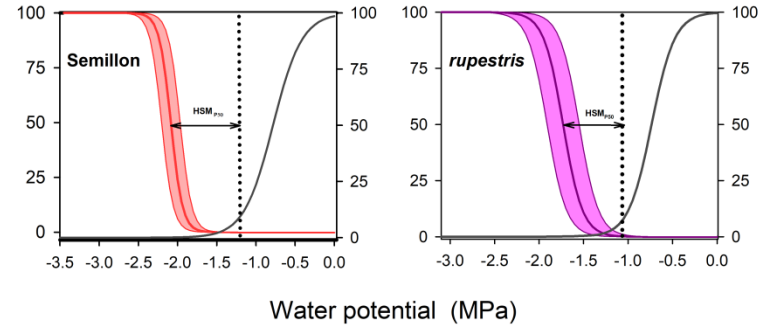
*Traits integration...*

## *V. vinifera*

- Grenache
- Syrah
- Semillon
- Vidadillo (Spain)
- Yiannoudi (Cyprus)

## Other species

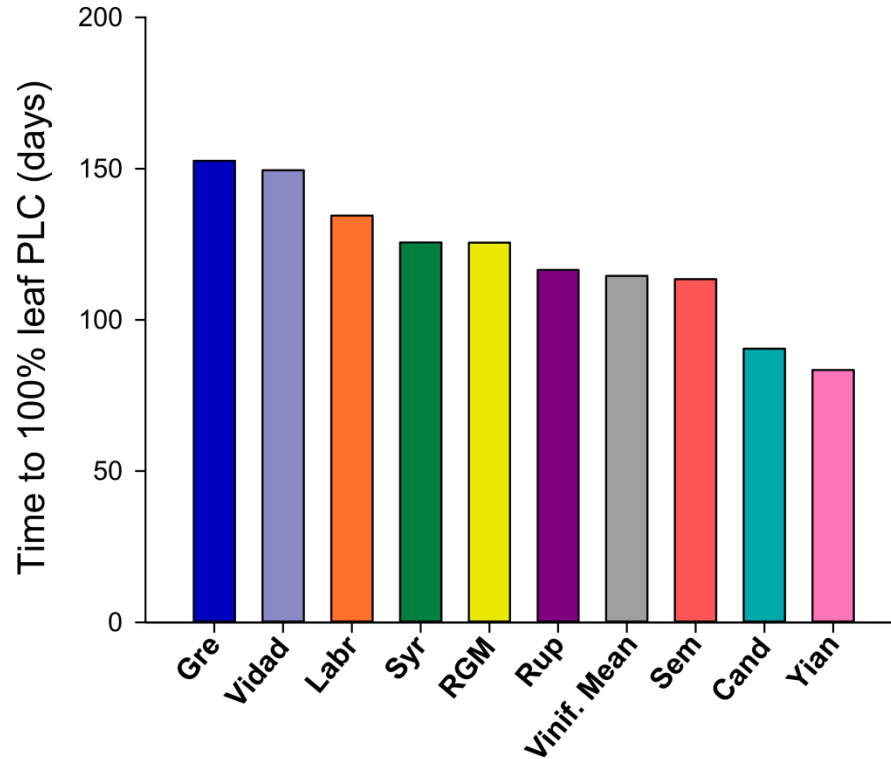
- V. candicans*
- V. labrusca*
- V. riparia* (RGM)
- V. rupestris*



*Genetic diversity...*



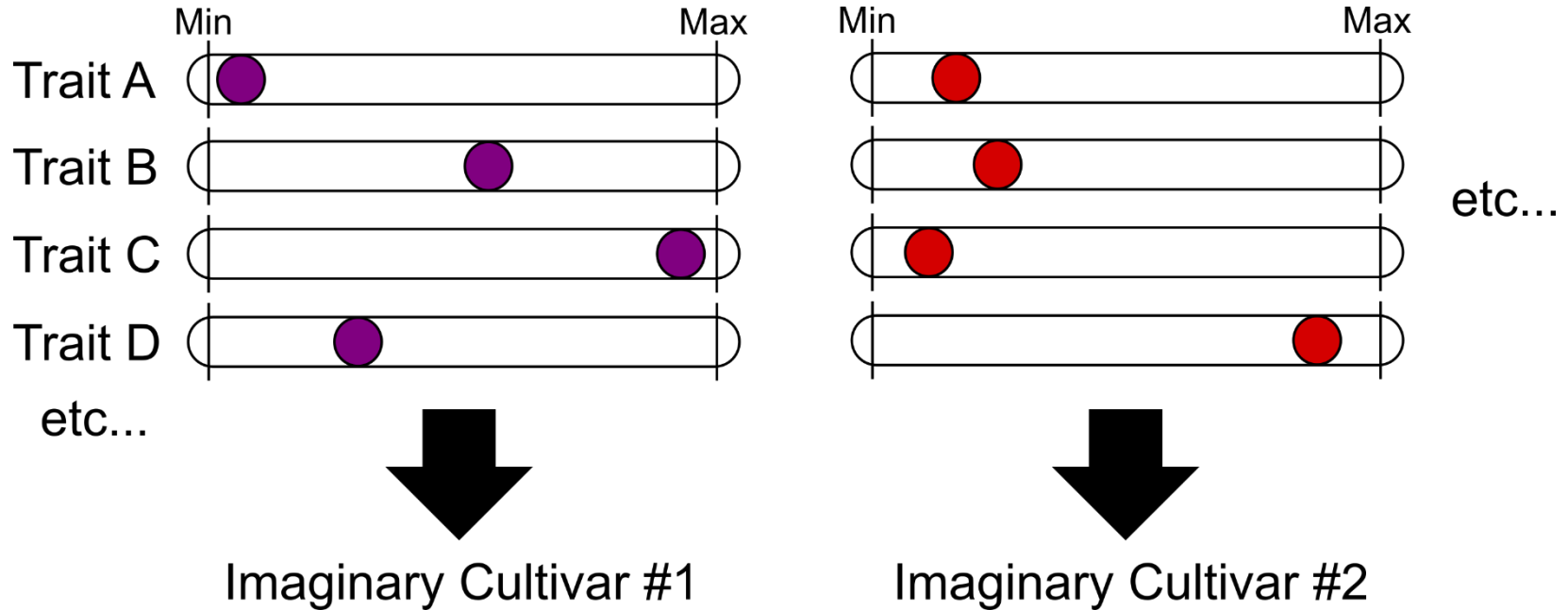
# Building a drought tolerant grapevine



Dayer et al, 2022

*Different trait combinations expand performance*

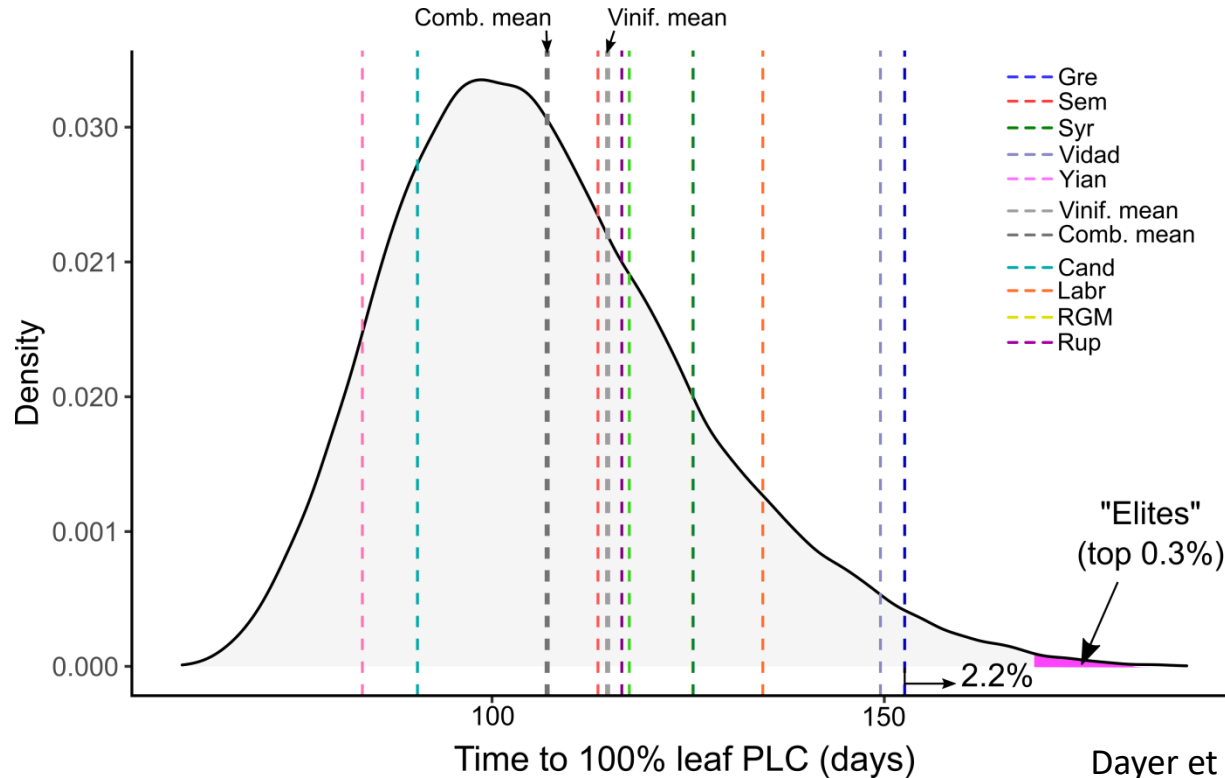
# Creating “model-assisted” ideotypes



*Now imagine we made 50,000 of these imaginary cultivars*

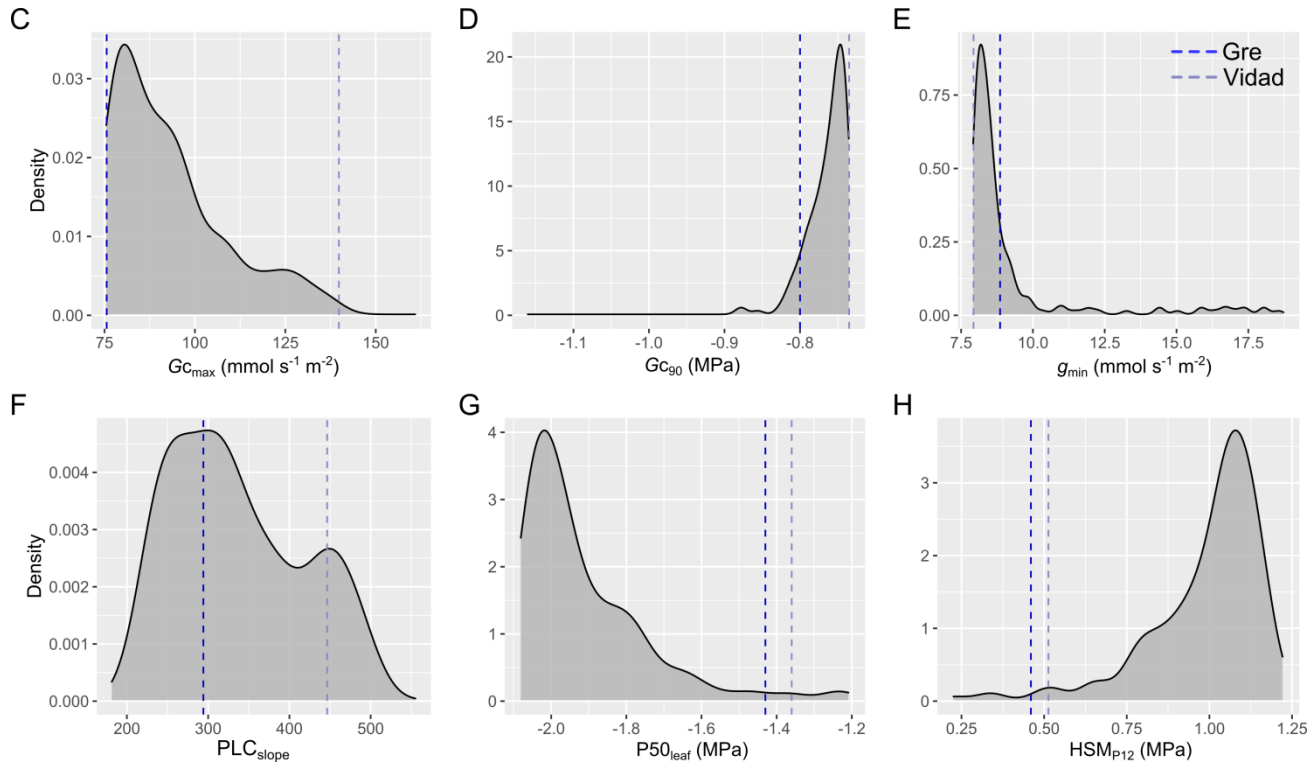


# Creating “model-assisted” ideotypes



*Different trait combinations expand performance*

# Exploring “Elite” ideotype traits



Dayer et al, 2022

*The full range trait diversity can be Elite, except  $Gc_{90}$  and  $Gc_{max}$*





# Conclusions

- Drought tolerance cannot be related to any one single trait (but a few seem to be very important).
- Drought tolerance is about integrating multiple traits and having a more nuanced and complete understanding of a behavior.
- Some existing varieties seem to have quite tolerant (and rare) trait combinations.



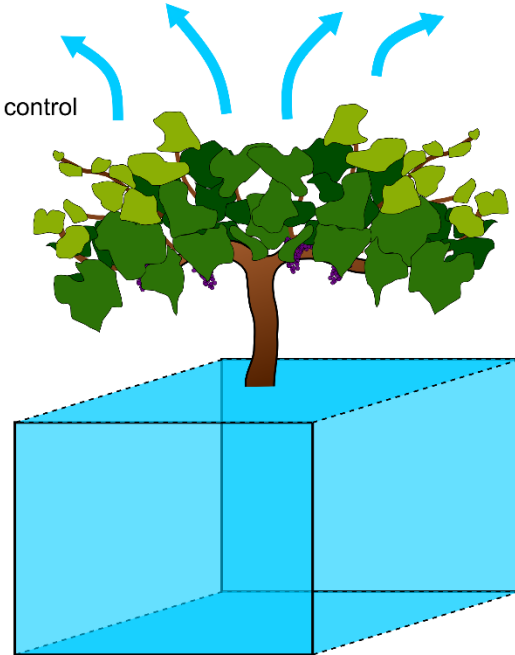
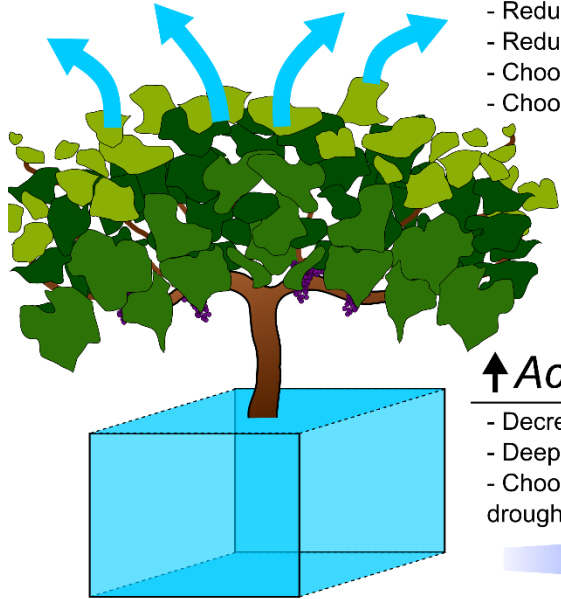
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# Simple principles for the drought tolerant vineyard

## ↓ *Transpiration (E)*

- Reducing canopy size
- Reducing exposed leaf area
- Choosing varieties with lower  $E_{max}$
- Choosing varieties with tighter stomatal control

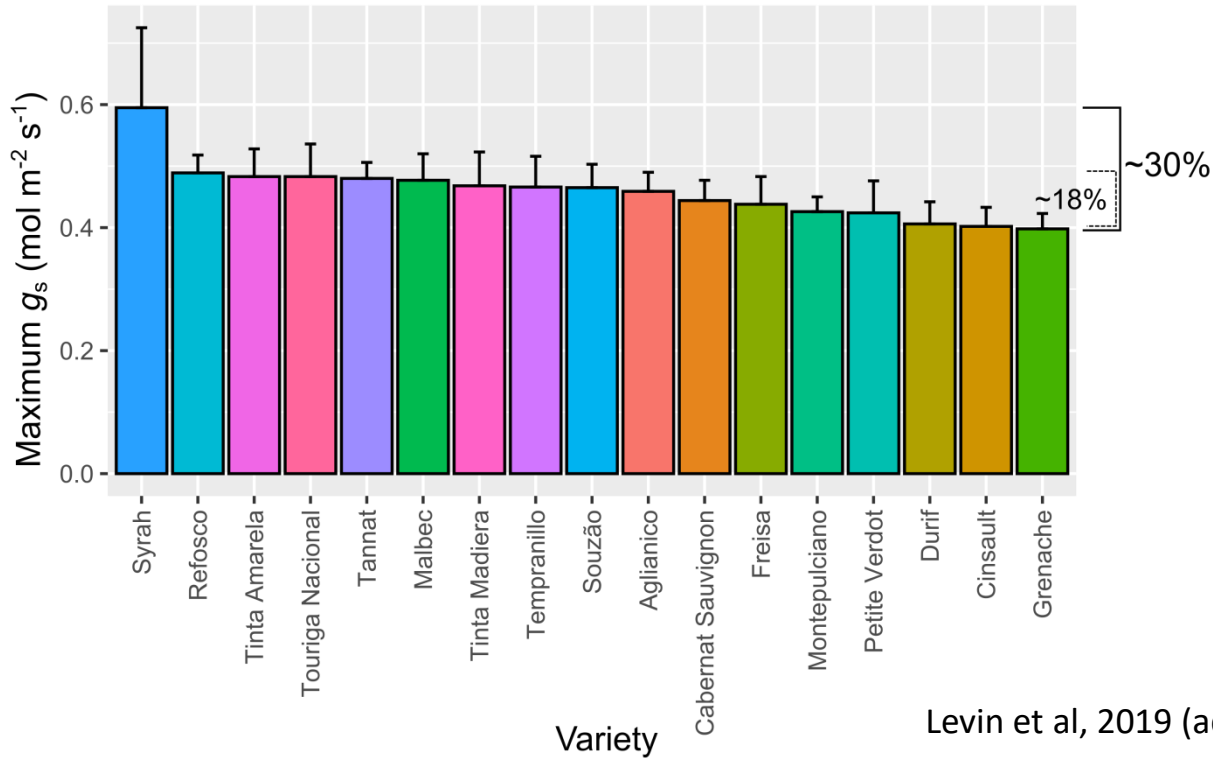


## ↑ *Access to Soil Water*

- Decreasing vineyard density
- Deep soil preparation
- Choosing high vigor & drought tolerant rootstocks

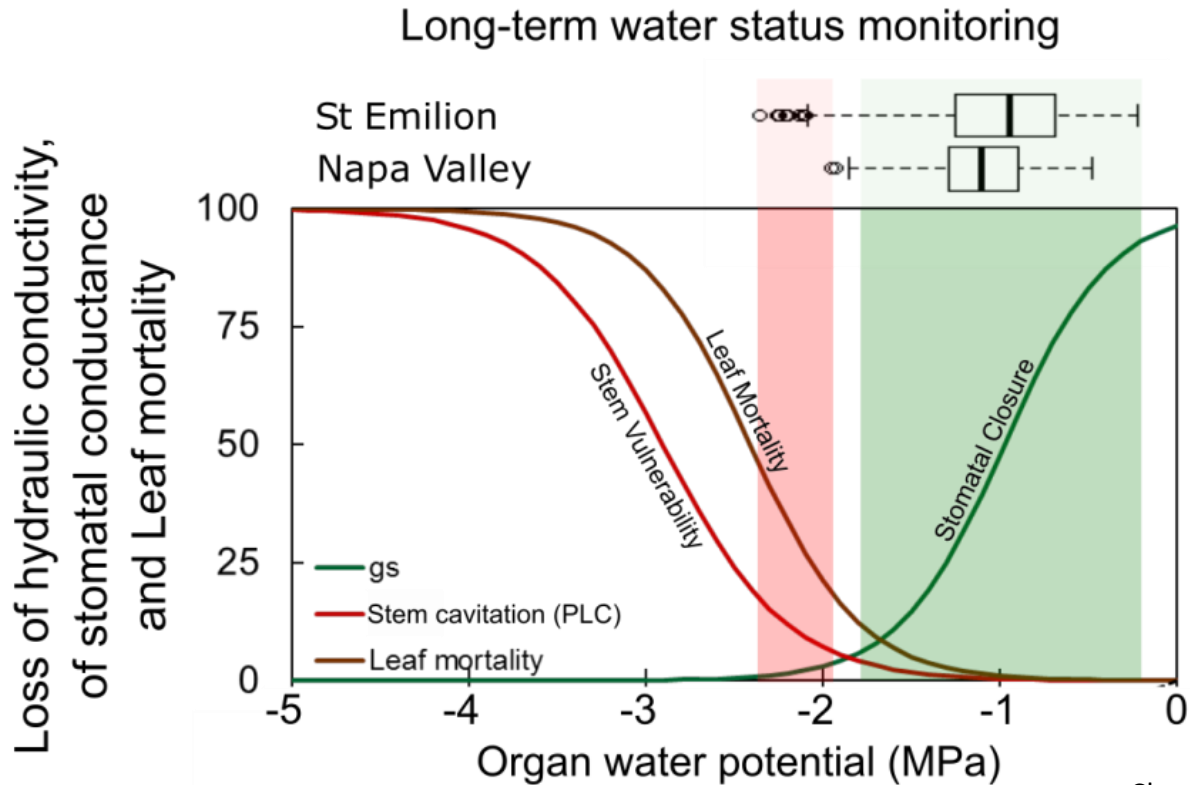
*Drought Tolerance*

# Variation between genotypes is significant



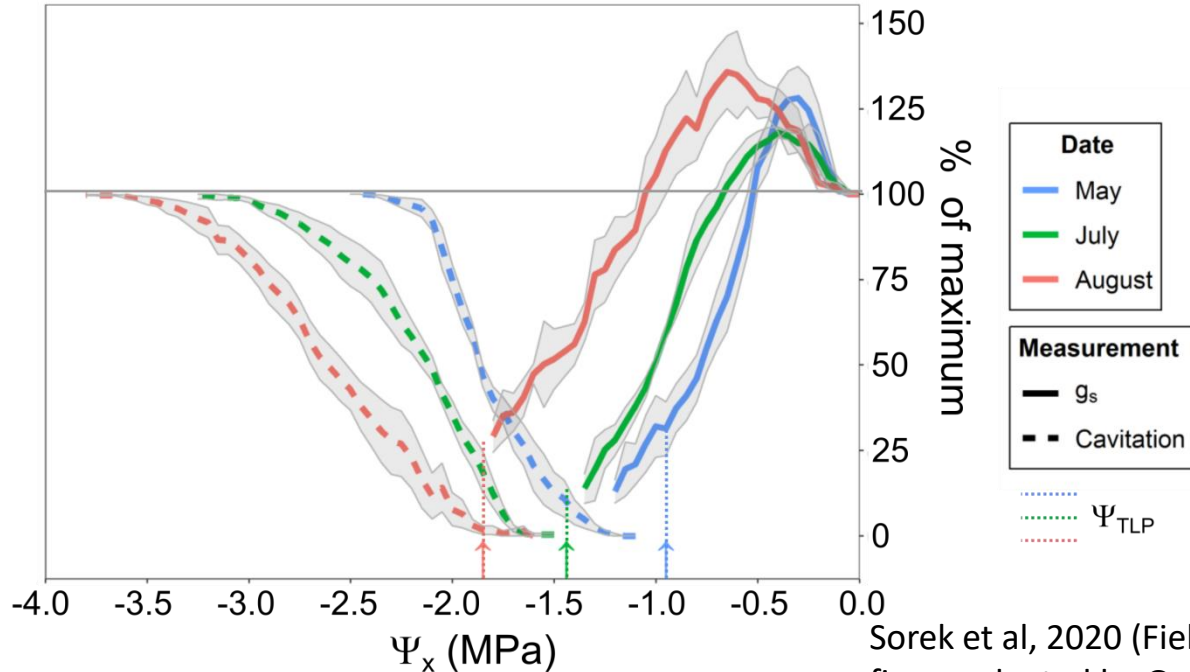
Field grown vines in a common garden

# How far can I push vine water stress without damaging vines for current and future vintages?



# Increased tolerance through the season

Here  $g_s$ , turgor loss point ( $\Psi_{TLP}$ ), and leaf vulnerability



Sorek et al, 2020 (Field grown Cab. Sauv.;  
figure adapted by Gambetta)

*And this is mostly developmental and not stress induced*

# Avoiding carry-over effects

## Managing water deficit preveraison

| Budbreak   | Flowering & Set   | Veraison |
|--|---|----------|
| <p>Water deficits during this time can inhibit shoot and leaf growth and thus should be avoided to promote a healthy canopy, flowering, and set.</p> | <p>Moderate water deficits (<math>\Psi_1 \geq -1.3</math> MPa) can control berry size and will likely not impact yield the following year. <b>More severe water deficits can potentially reduce yield the following year.</b></p> |          |

Levin et al, 2020

*Avoid severe pre-veraison water deficits*





# Conclusions

- Seasonal changes in drought tolerance thresholds are huge and allow vines to tolerate more negative water potentials as the season progresses.
- So when matters and in general we want to avoid severe pre-veraison water deficits because they can have negative consequences on yield in following seasons



# Conclusions (cont.)

- When it comes to a more drought tolerant vineyard rely on simple sound principles. AKA: Don't over think it!
- Generally we want to decrease transpirational demand and increase the available water to the vine.
- This means decreasing exposed leaf area or choosing varieties with more conservative stomatal behavior while maximizing rooting volume through decreased planting density and drought tolerant rootstocks.



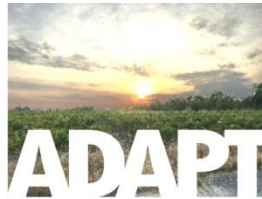


# Thank you and questions

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