Grapes and irrigation:

Of myths and dogmas

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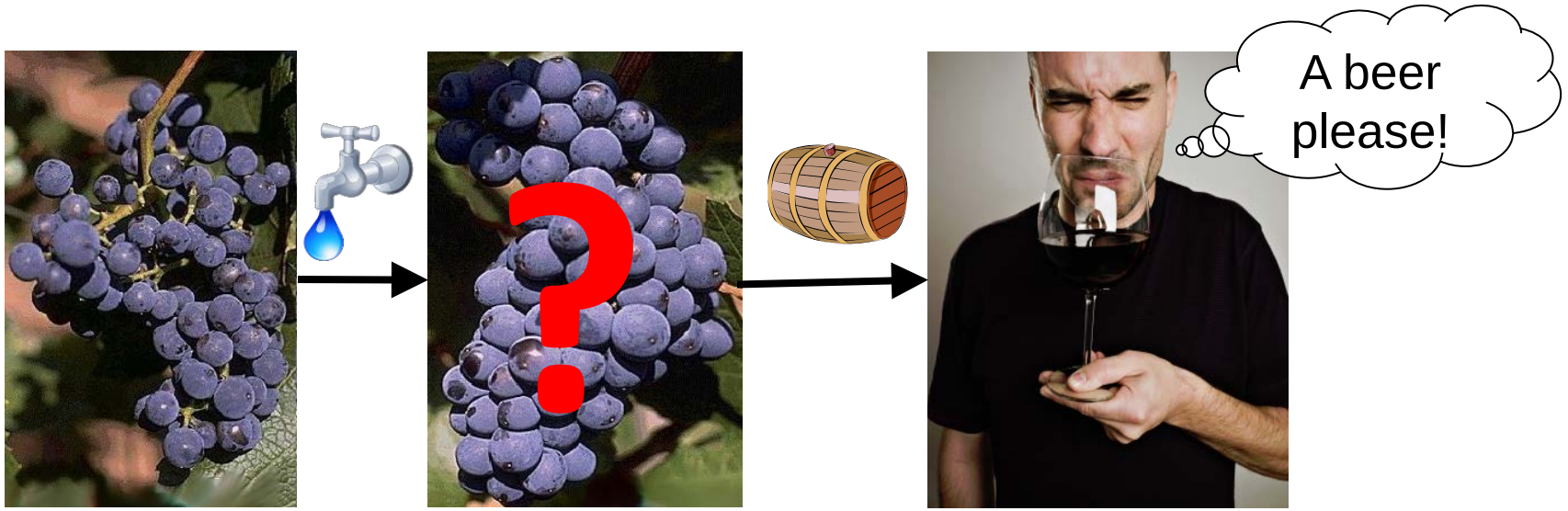
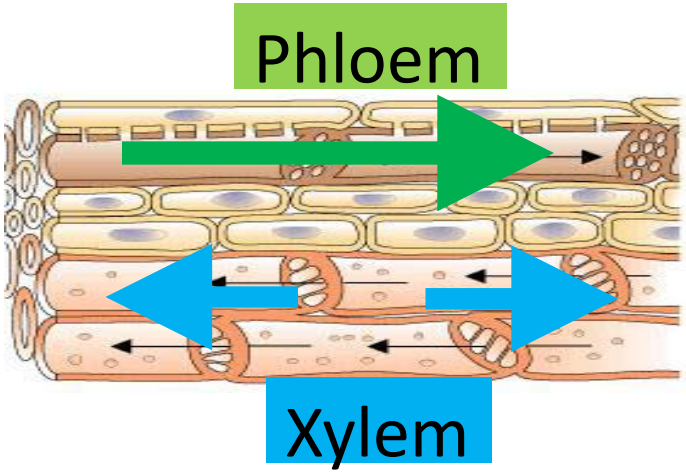
Late season irrigation = adding water to grapes and diluting wine



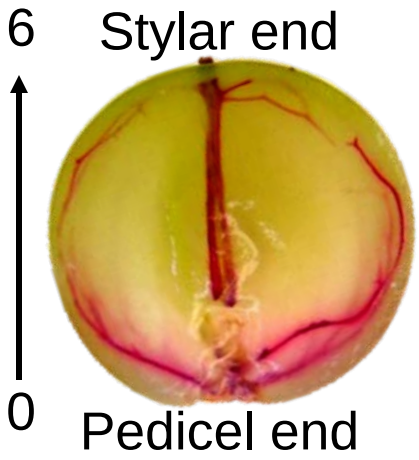
Ins and outs of water

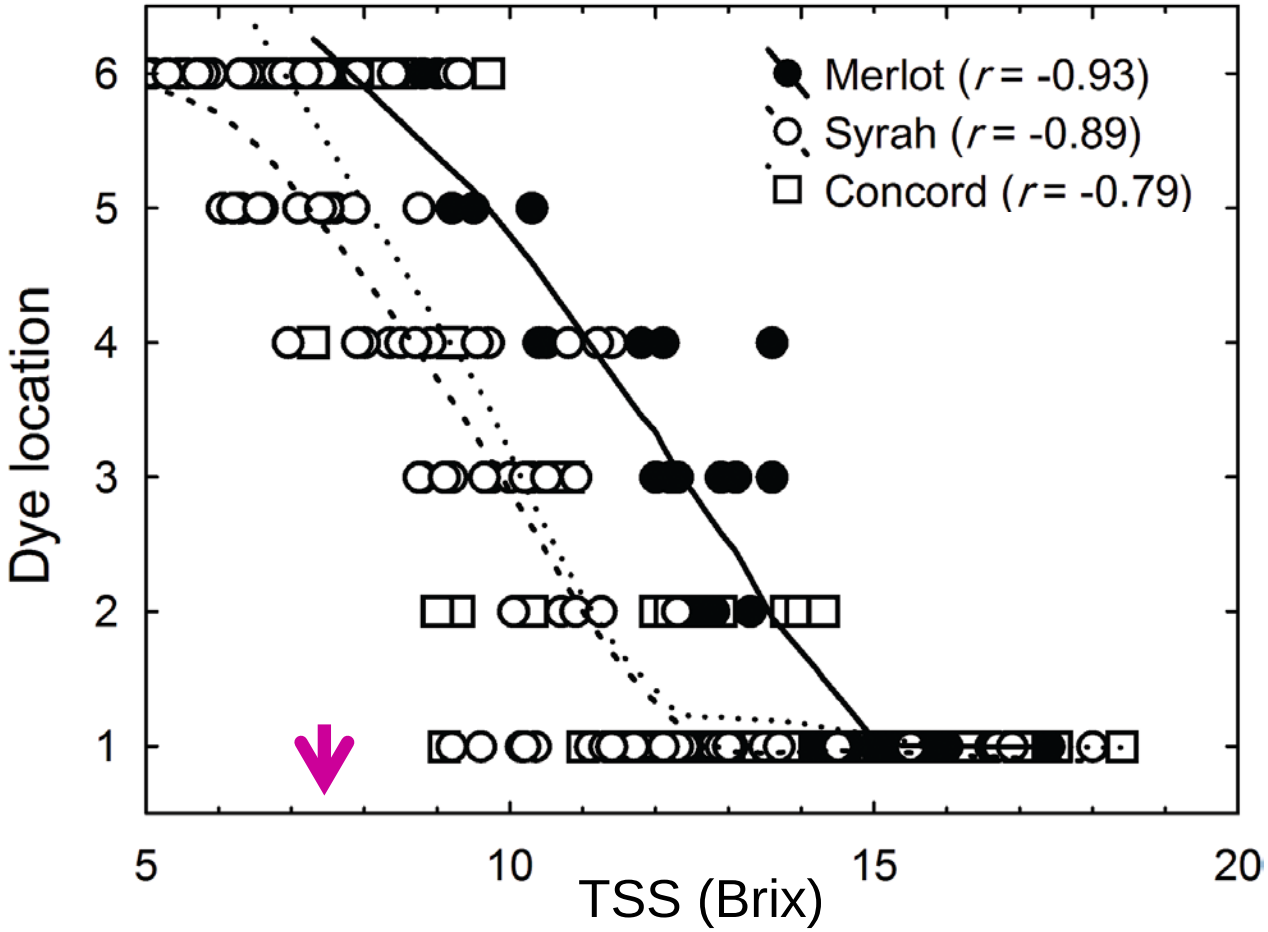


- Phloem: sugar and water; source-sink; one direction
- Xylem: mostly water; hydraulic pressure gradient;
- Berry size = water ins – water outs

At veraison: xylem inflow ↓

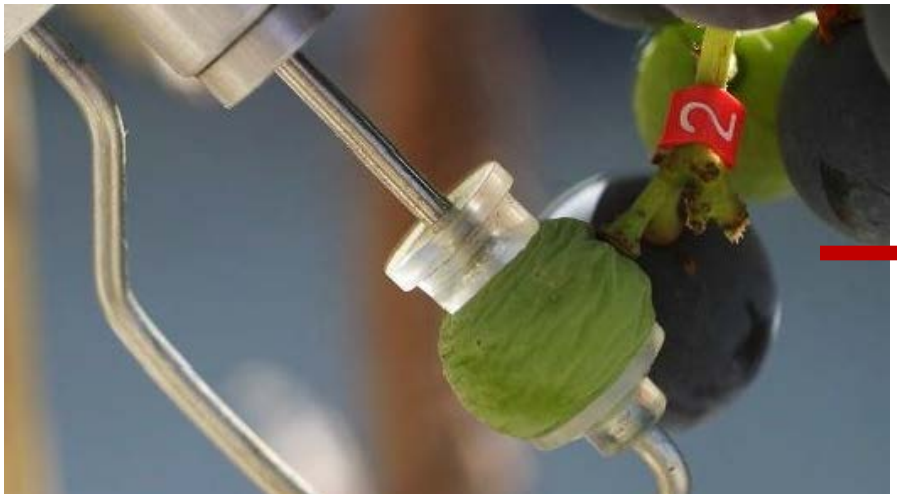
Unripe berry (<7 Brix)





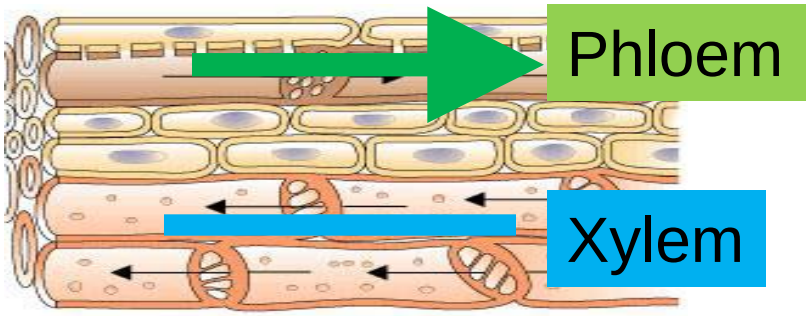
(Zhang & Keller, 2017)

At veraison: phloem inflow ↑



Pre-veraison water stress; berry shrank

Water stress continued into ripening, berry resumed expansion; WHY?



Increase in phloem inflow w/ rapid sugar accumulation
→ Berry growth resumed despite water stress

(Pictures courtesy of D. Romero; Keller et al., 2015)

Buffering effect of phloem inflow

- To estimate phloem inflow:

Inputs: rates of berry growth, transpiration, respiration, and sugar accumulation, and sugar concentration of pedicel phloem sap

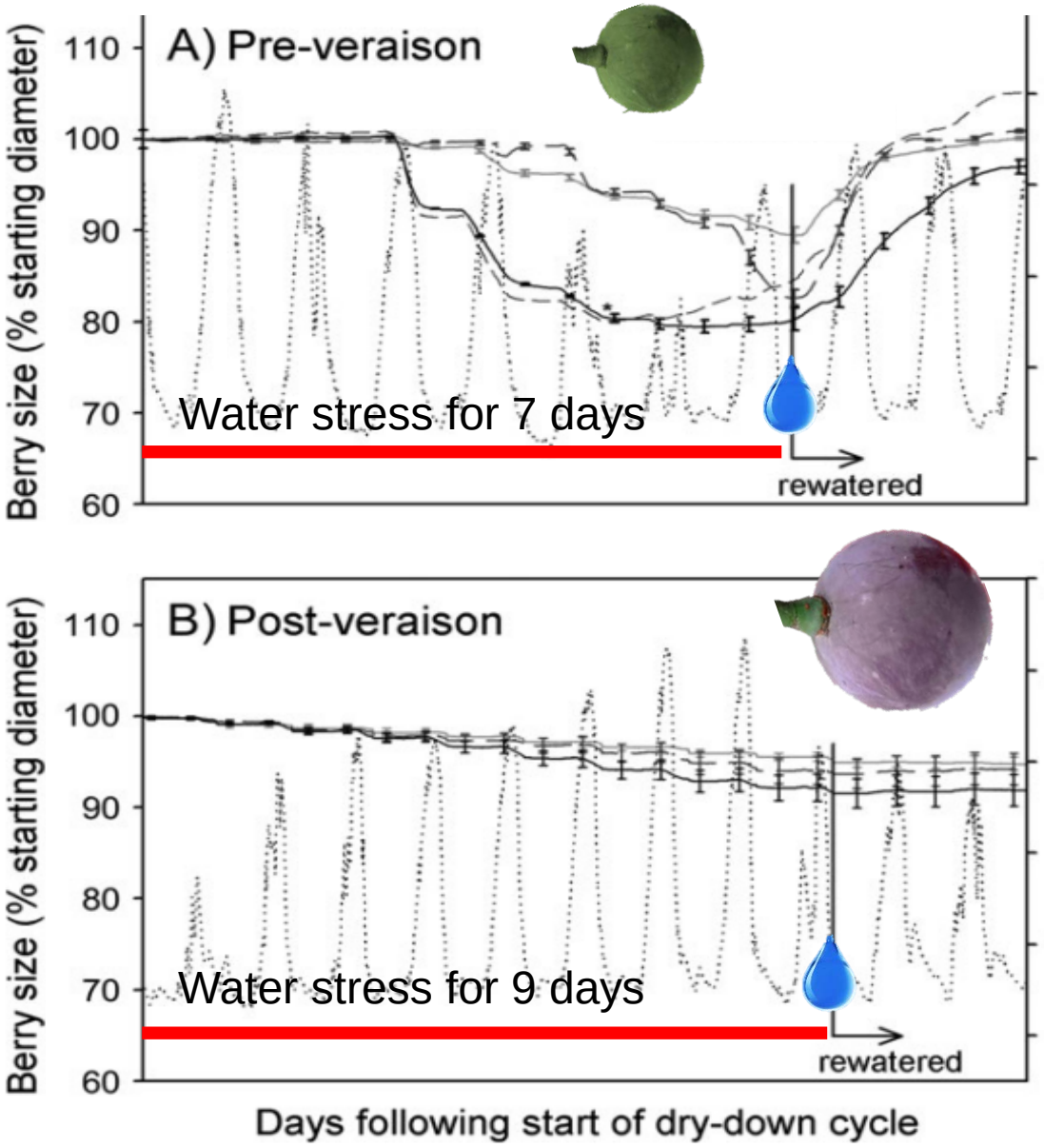
→ $Water_{phloem} > Water_{berry\ growth} + Water_{berry\ transpiration}$

→ Phloem-derived water is in surplus during ripening

→ Buffers berries from changes in xylem water supply

(Zhang & Keller, 2017)

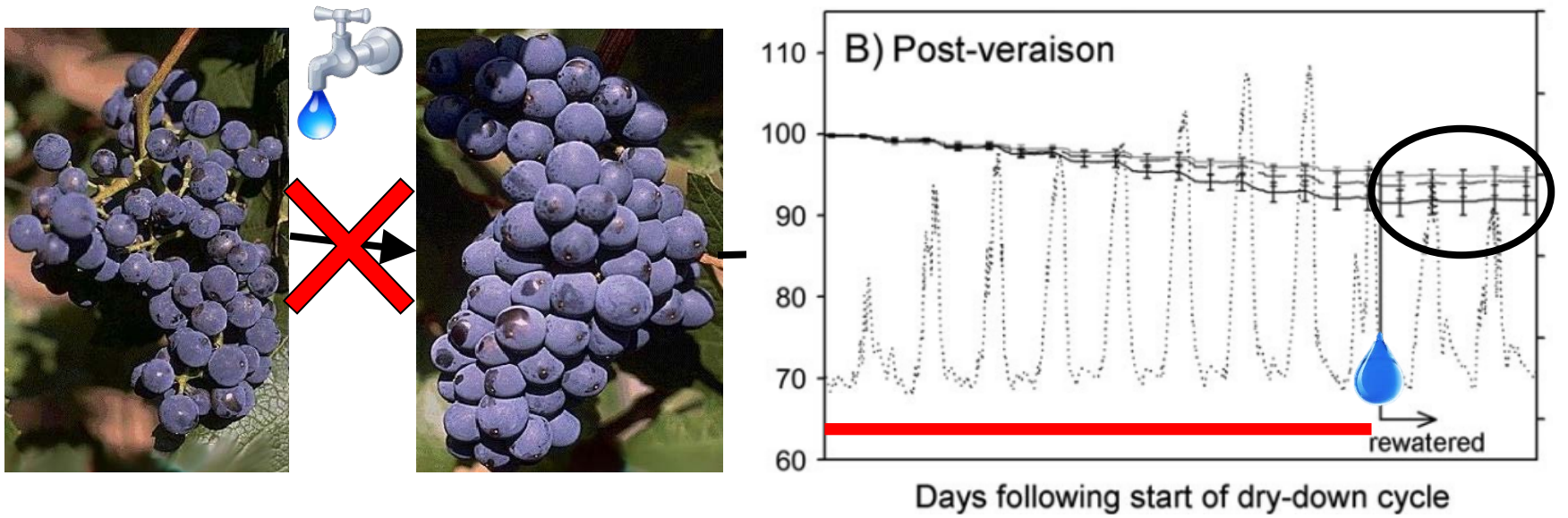
Response to xylem water supply



(Keller et al., 2006)

- Soil water availability affects xylem flow
- Before veraison, berries are sensitive to water stress and re-watering.
- After veraison, berries become insensitive to changes in xylem water supply.

Late season irrigation doesn't dilute berry sugar



- Irrigation close to harvest: reduce/stop the previous decrease in berry size
- ↗ leaf photosynthesis and therefore sugar import; benefit ripening

Berry weight loss from dehydration after ripening

- Berries reach maximum sugar content around 24 Brix
- Afterwards, no more increase in sugar content
- Further increase in Brix is due to dehydration
- 5% yield reduction for each °Brix increase
- ~10% weight loss before dehydration is visible

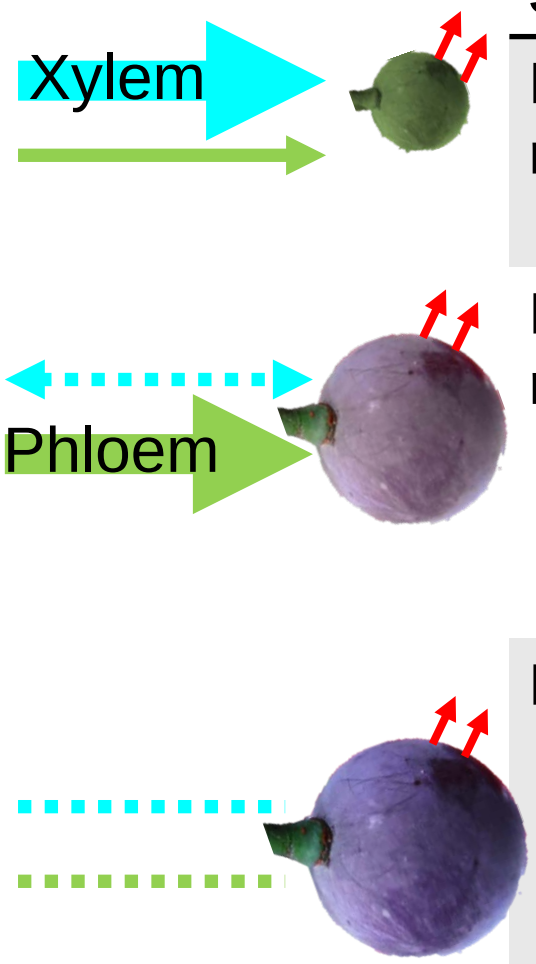
- Too much water stress before harvest → reduce yield and potentially profits for the grower

The “Goldilocks” irrigation principle:

not too little (avoid over stress before harvest)

not too much (avoid any new canopy growth)

From berries to vineyards



Stage	Physiology	Practice
Before ripening	Main water supply: xylem	Best time to control berry size by deficit irrigation
During ripening	Main water supply: phloem; rapid sugar accu.; berry size insensitive to soil water	Adequate irrigation for photosynthesis
Ripe	No more phloem inflow and sugar accu.; weight loss due to dehydration	Adequate irrigation to avoid excess dehydration or new canopy growth

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Reference:

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Thank you!