There is (almost) no turgor in mature sweet cherries

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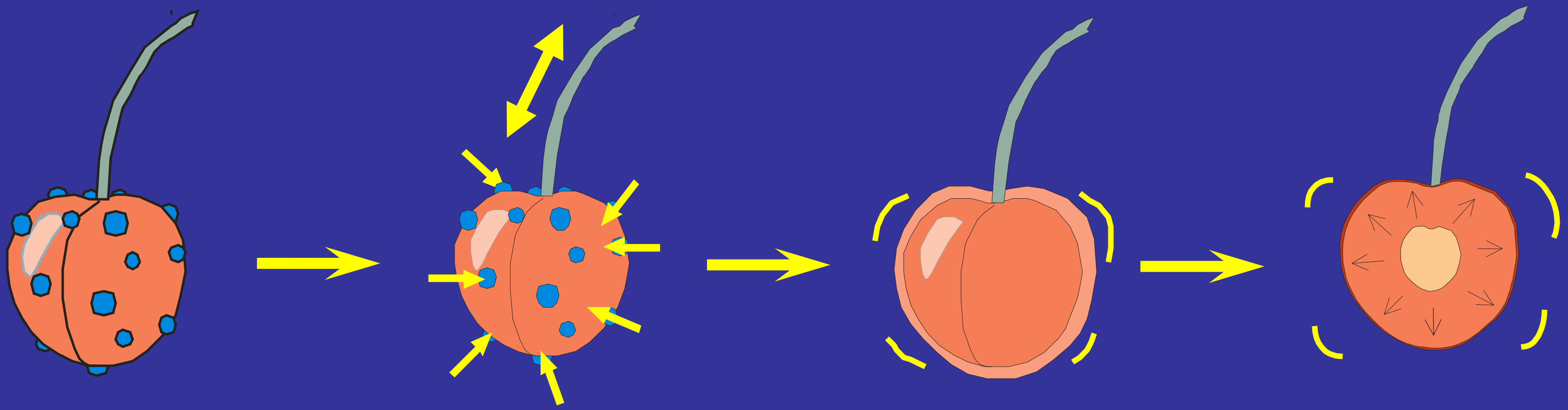
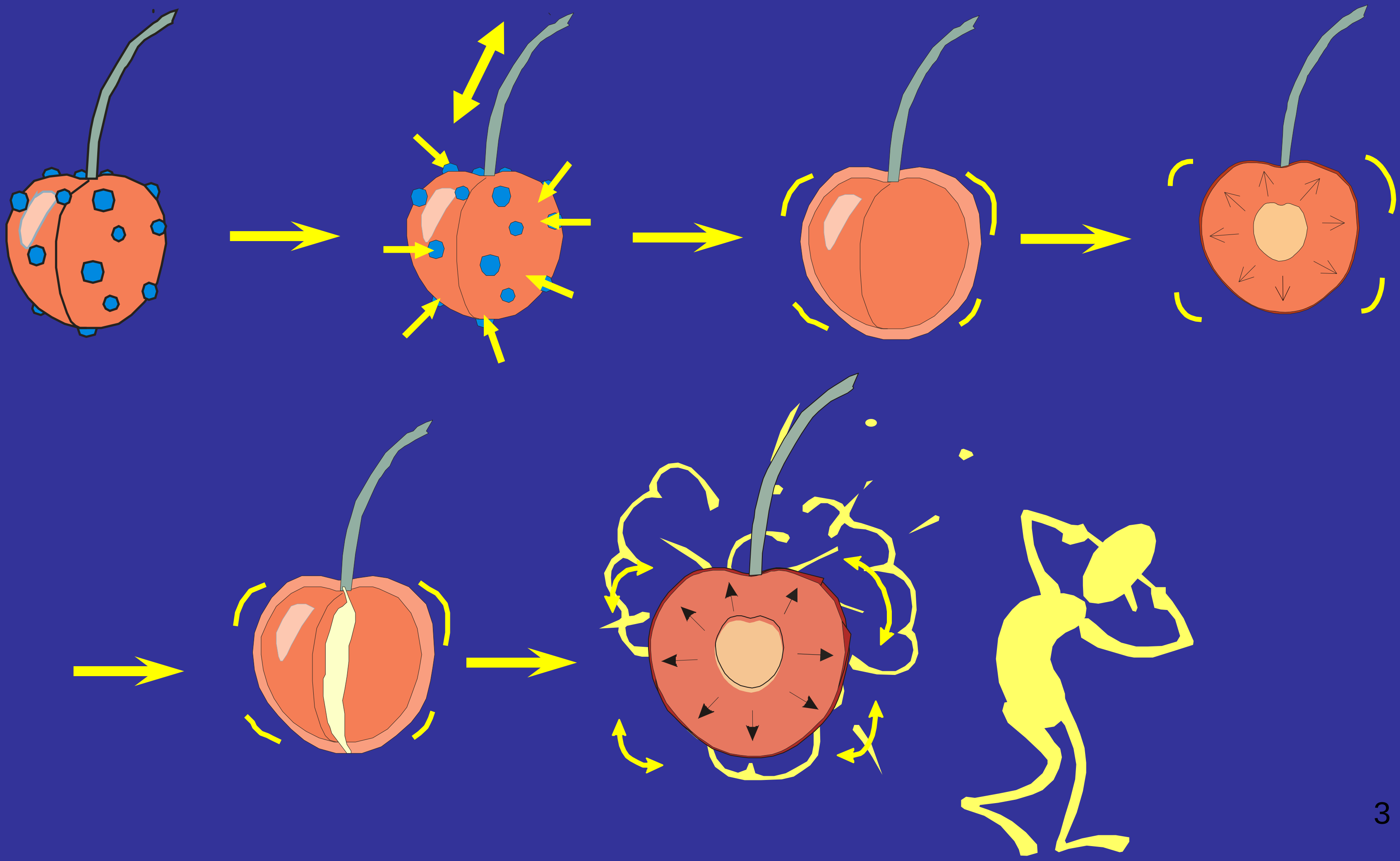
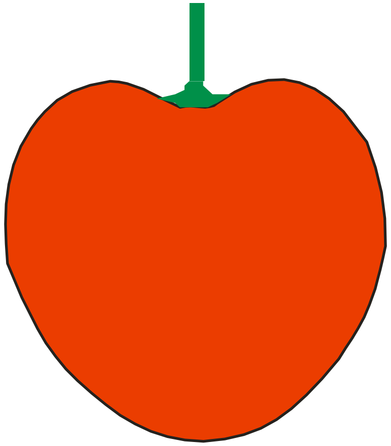
Text books
Rain induced strain cracking



Text books
Rain induced strain cracking

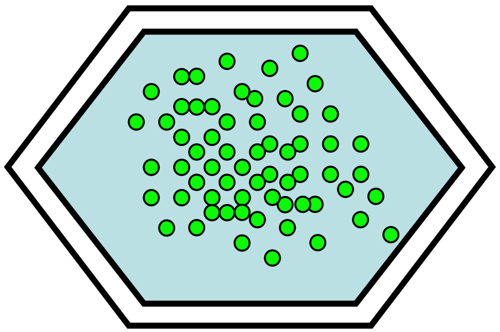


Water potential



$$\Psi^{fruit} = \Psi_{\pi} + \Psi_{P}^{fruit}$$

(−) (−) (+)



$$\Psi^{cell} = \Psi_{\pi} + \Psi_{P}^{cell}$$

(−) (−) (+)

Example:

$$\Psi_{\pi} = -RT\sum C$$

$$\Psi_{\pi} = -3.5MPa = -35bar$$

If $\Psi^{cell} = -0.1MPa = -1bar$

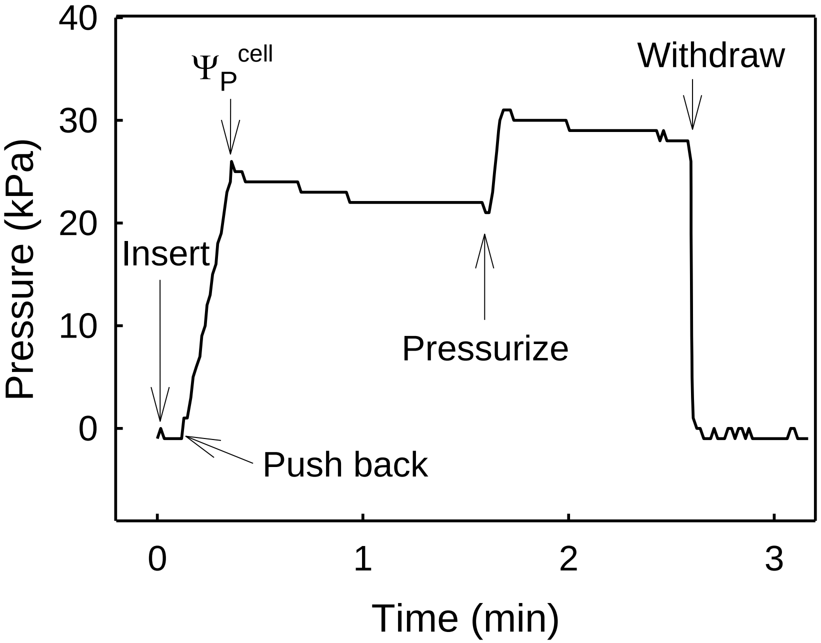
$$\Psi_{P} = 34bar$$

Objectives:

- adopt techniques for measuring Ψ_P^{fruit} and Ψ_P^{cell}
- study effect of water transport on Ψ_P^{fruit}

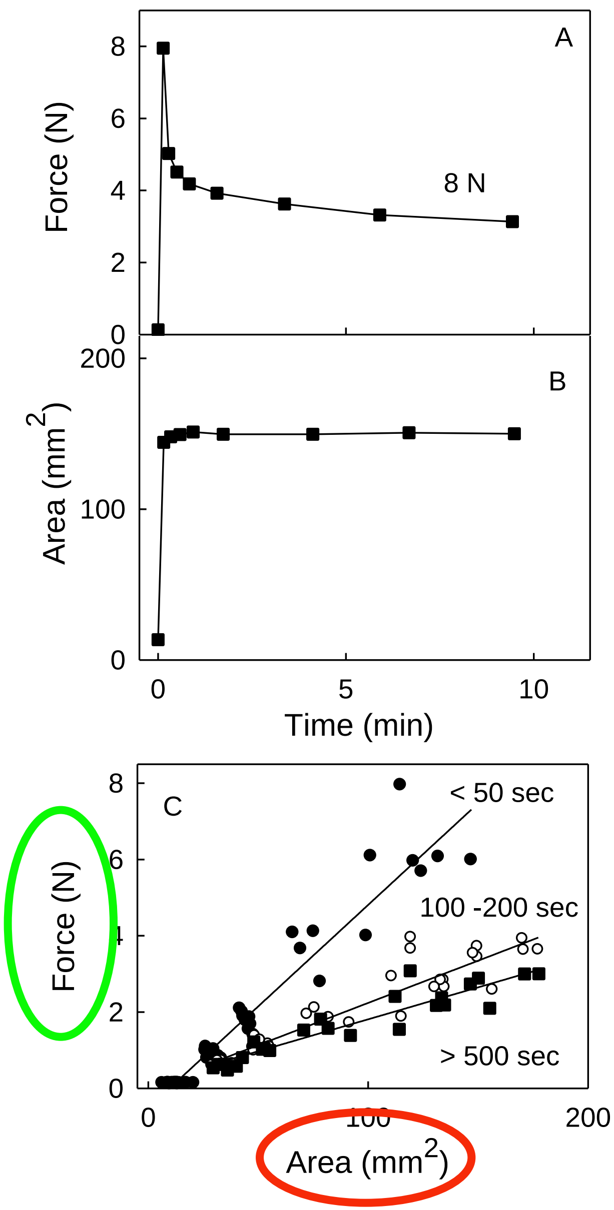
Cell pressure probe for quantifying cell turgor

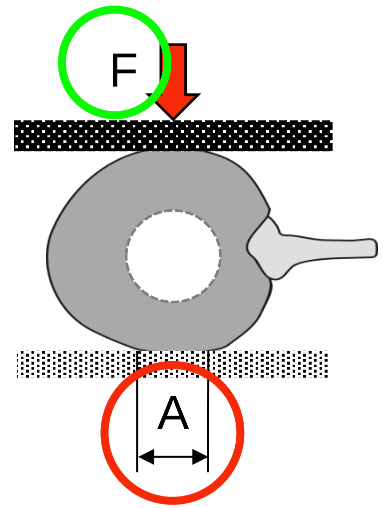
Fruit



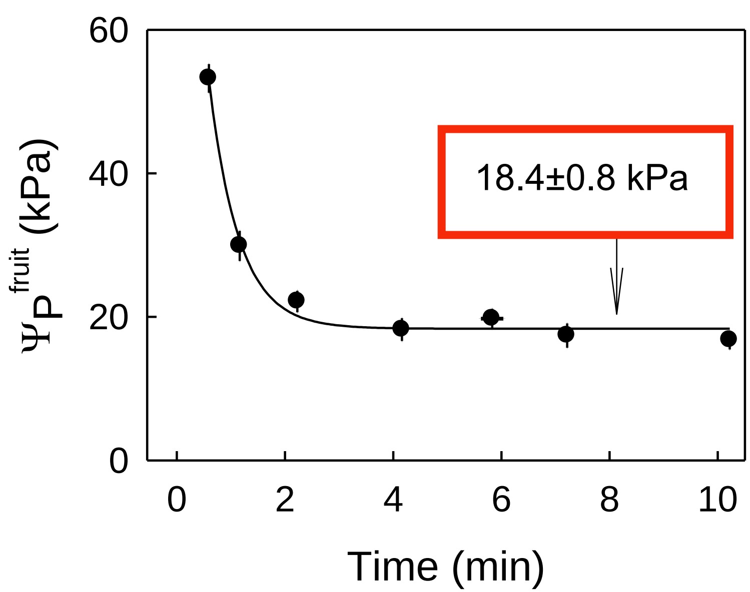
Cultivar	Ψ_P^{cell} (kPa)
Sam	28.1 ± 2.2
Samba	17.5 ± 2.8
Mean	22.0 ± 1.8

Compression plate (CP) for quantifying fruit turgor





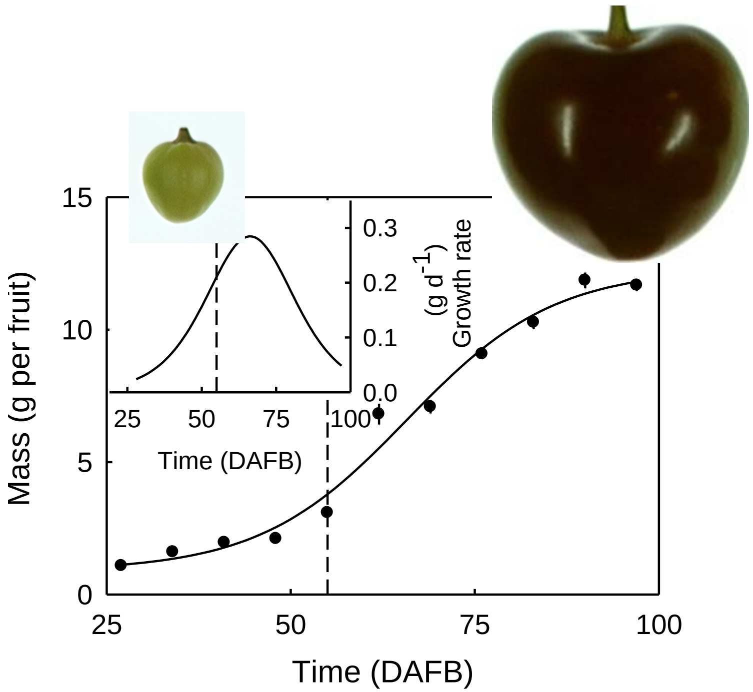
$$\Psi_P^{fruit} = \frac{F}{A}$$

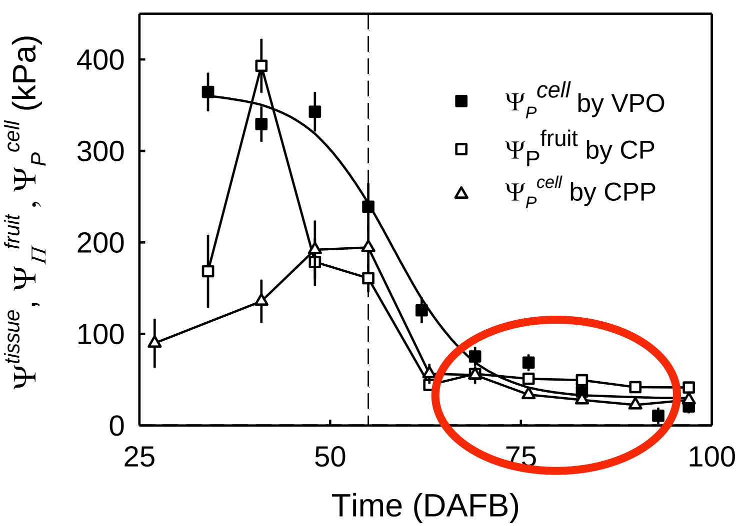


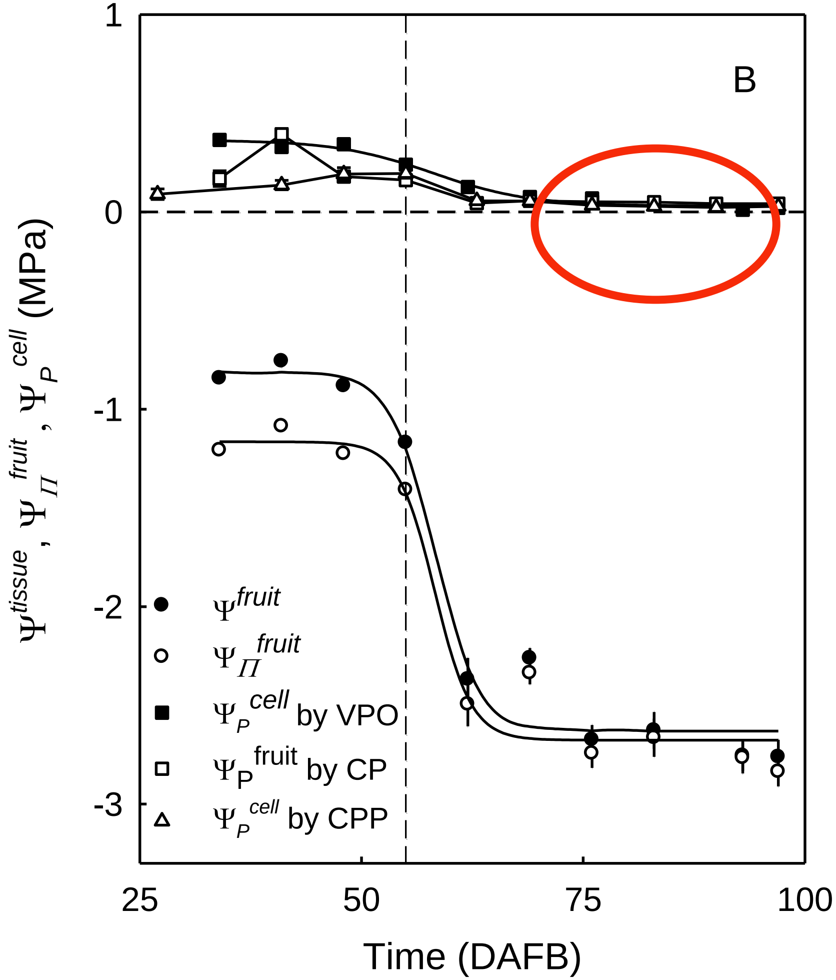
Vapor pressure osmometry (VPO) for quantifying turgor

Cultivar	Water potentials (kPa)		
	Ψ	Ψ_{Π}	Ψ_{P}^{cell}
Kordia	-4035	-4116	38
Sweetheart	-3195	-3257	49
Staccato	-2968	-3020	64
Grand mean	-3399	-3464	50

Effect of development on turgor



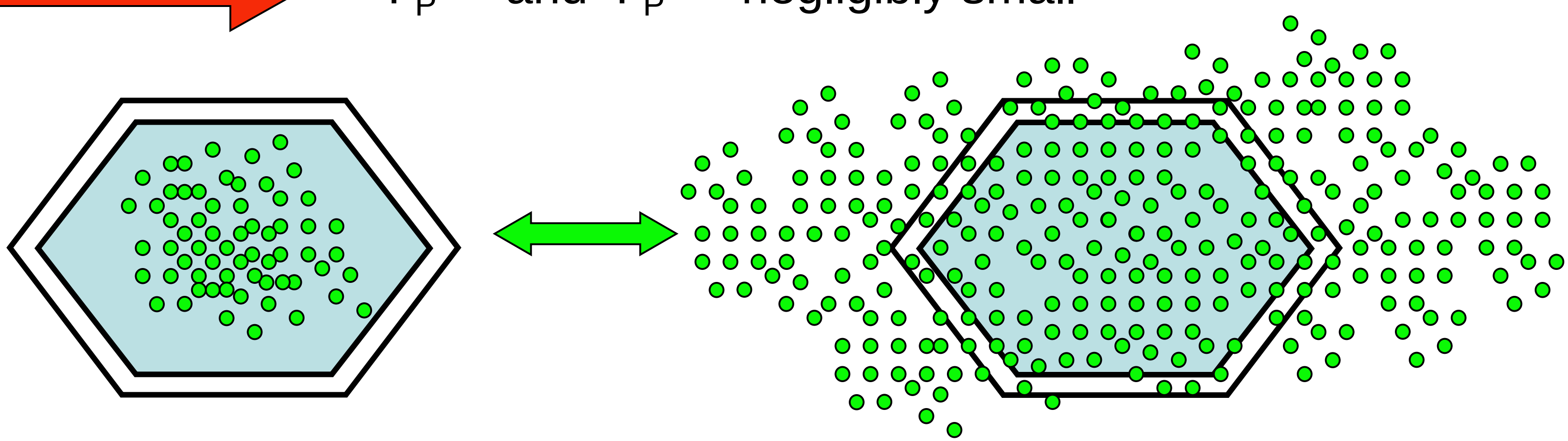




Conclusion

- Ψ_P^{fruit} and Ψ_P^{cell} between 20 and 100 kPa throughout stage III
- transient peak Ψ_P^{fruit} and Ψ_P^{cell} during stage II/III transition (200 to 400 kPa)
- Ψ_Π between -2800 to 4500 kPa (mature fruit)

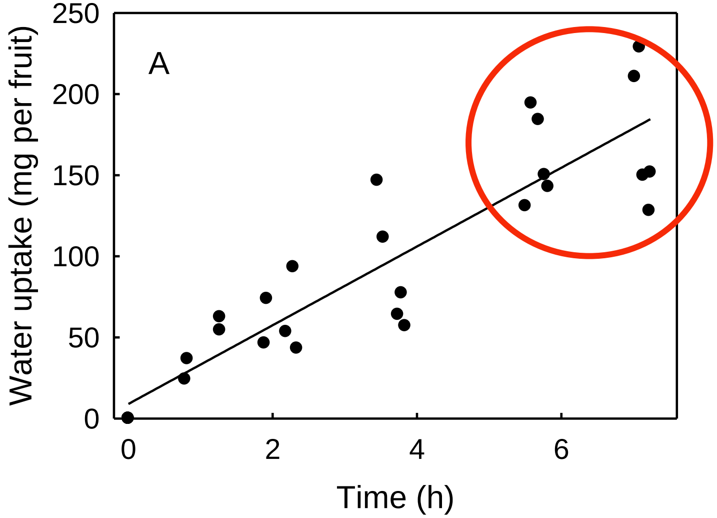
Ψ_P^{fruit} and Ψ_P^{cell} negligibly small

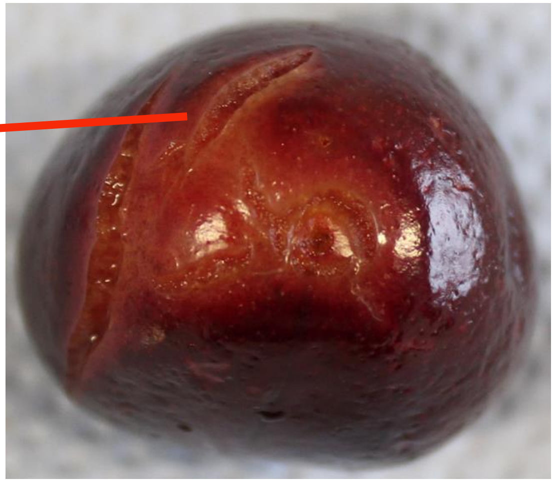


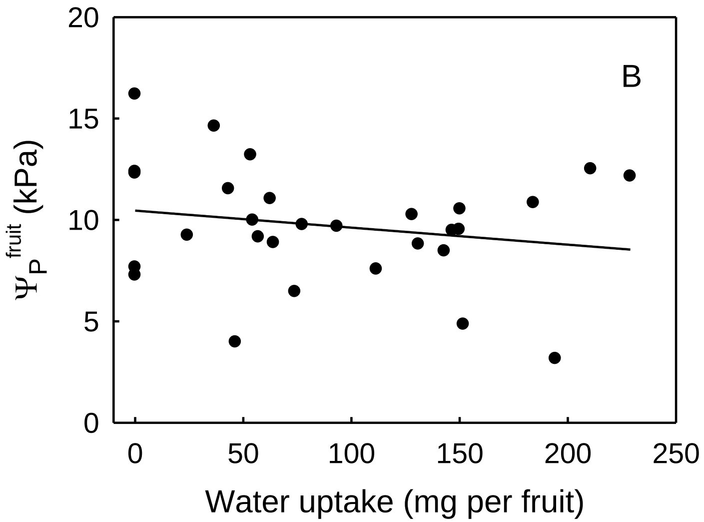
$$\Psi_P^{cell} = f\left(\Psi_\Pi\right)$$

$$\Psi_P^{cell} \approx 0$$

Effect of water uptake on Ψ_P^{fruit}

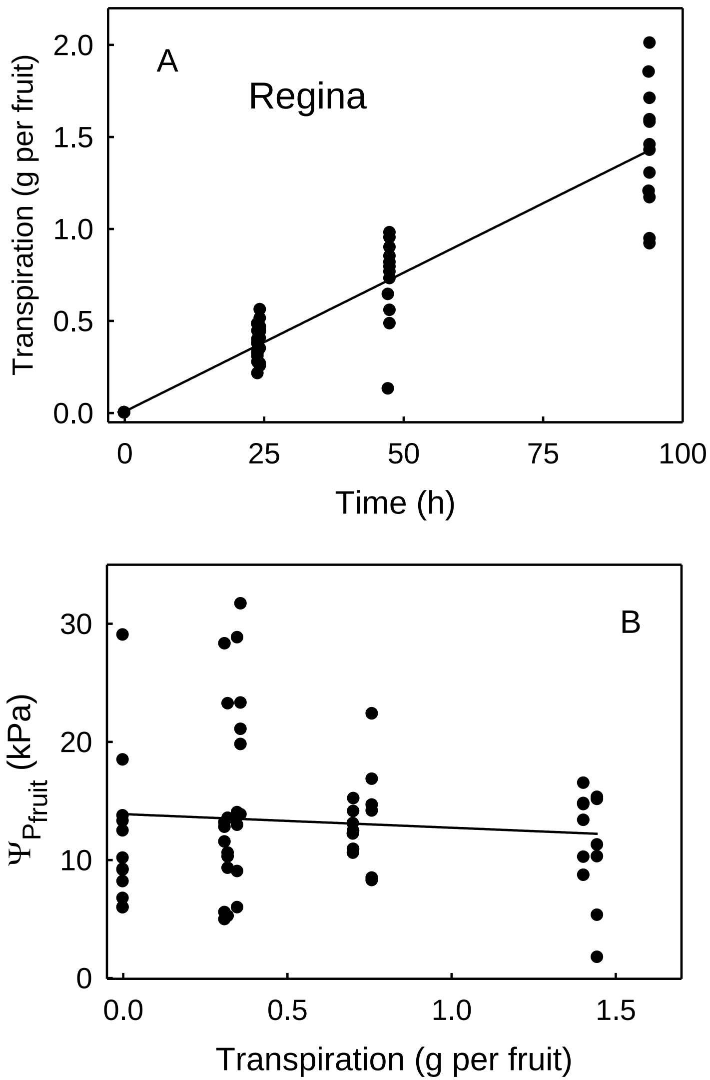






No detectable change in turgor!

Effect of transpiration on Ψ_P^{fruit}



No detectable change in turgor despite a 20% mass loss!

Summary

- CPP, CP, VPO yield pressures between

  20 and 100 kPa in mature sweet cherry

- Osmotic and water potentials range from -2800 to -4500 kPa or even lower
- **No** detectable effect of transpiration or water uptake on Ψ_P !
- Potential explanation:
  - low Ψ_P due to apoplastic solutes
  - viscoelasticity of fruit skin

For complete reference and detailled discussion see:

- Knoche, M., Grimm, E. and H. Schlegel (2014): Mature sweet cherries have low turgor. J. Amer. Soc. Hort. Sci. 139, 3-12.
- Schumann, C., Schlegel, H.J., Grimm, E., Knoche, M. and Lang, A. (2014): Water potential and its components in developing sweet cherry. J. Amer. Soc. Hort. Sci. 139: 349-355.