

Photoprotection in avocado leaves in relation to canopy management

Fotoprotección en las hojas de avocado en relación con el manejo del canopeo



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Abstract. avocado retains a deep canopy of shade leaves with high photosynthetic efficiency. They are doubly photoprotected by 2 pigment systems and do well in diffuse light and long sunflecks, achieving 20-50% photosynthesis rates of sun leaves at the same light intensity. Depending on pruning style shade leaves suffer light stress for >3 days, but re-invent the pigment systems of sun leaves in ~10 days; simply amazing!!

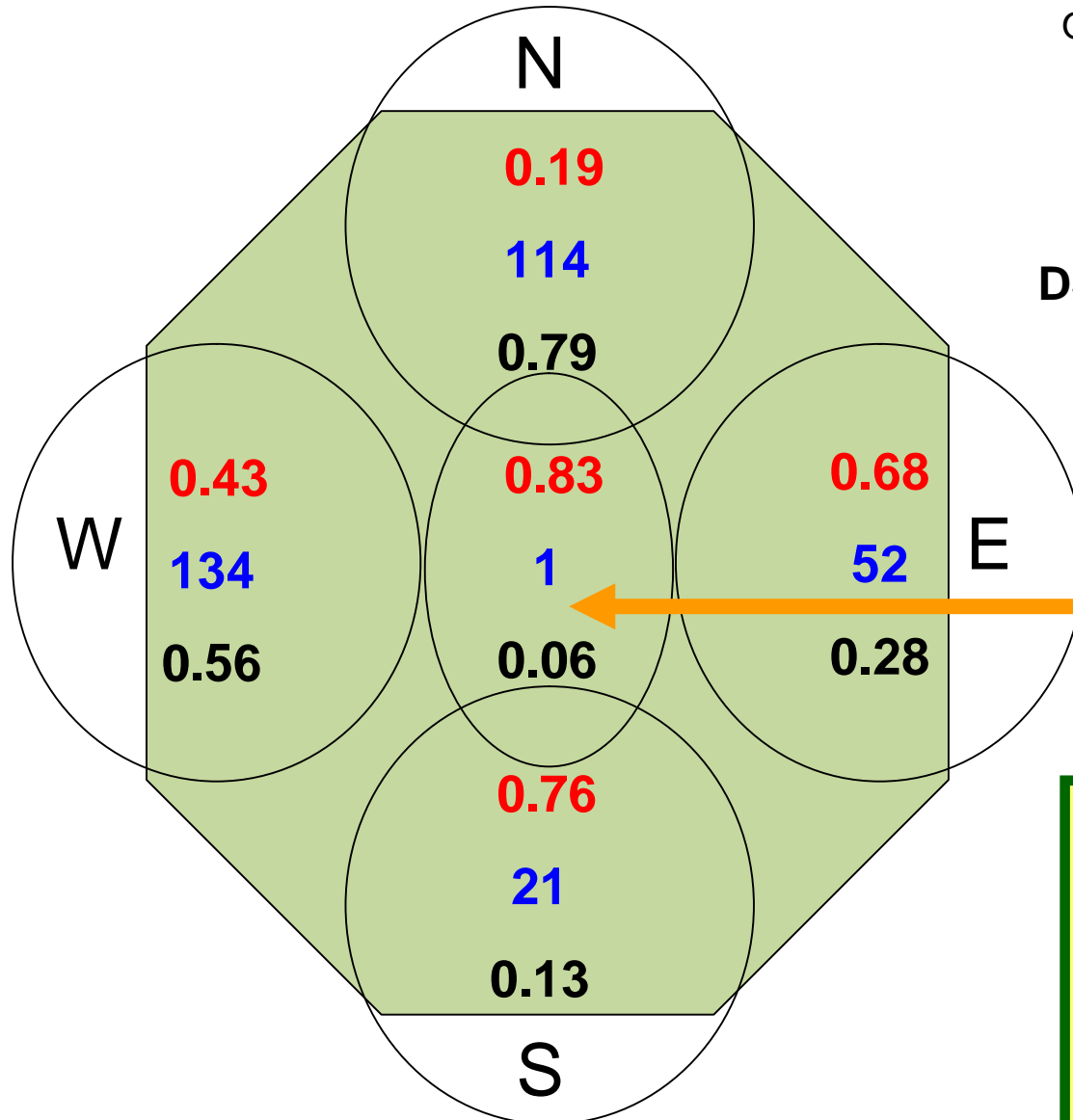
One hundred-fold range in photosynthesis within a Southern Hemisphere avocado canopy at noon

Orchard at Goodwood Qld; at noon 23 July 2010

ØPSII = efficiency of light use

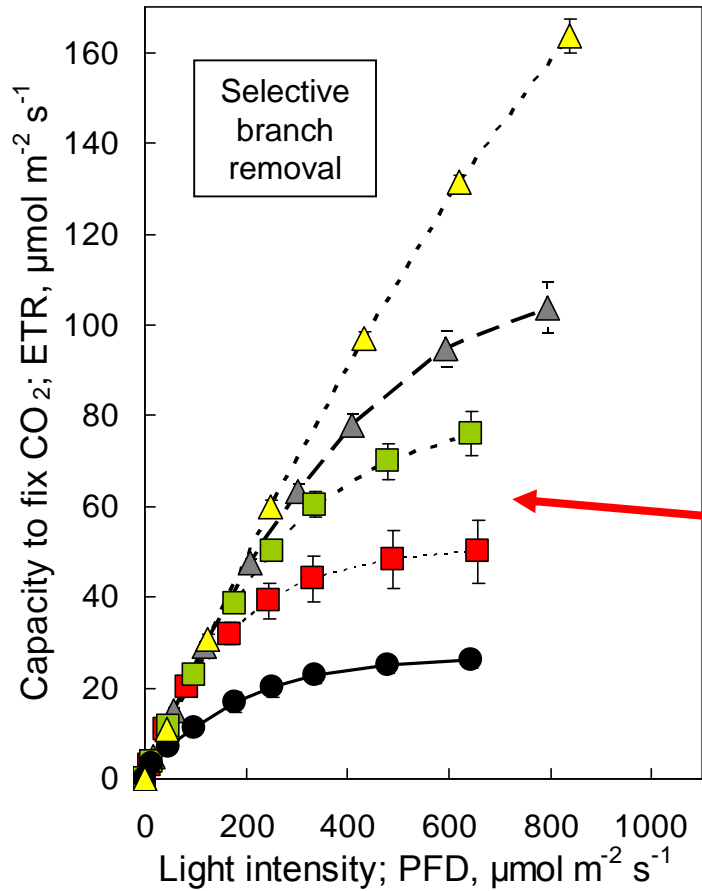
ETR = capacity to fix carbon

DS = protection against excess light

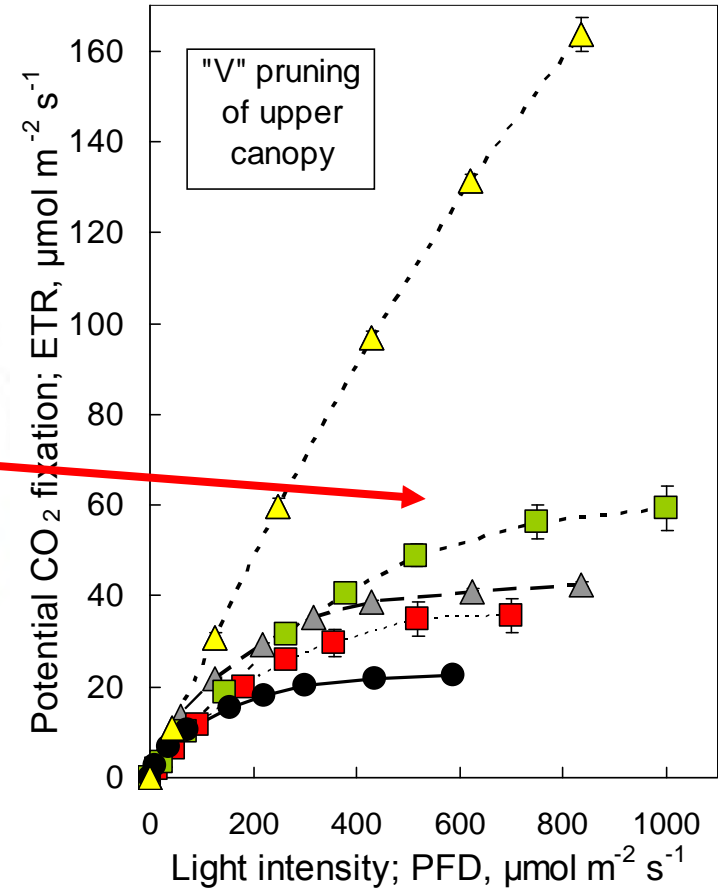
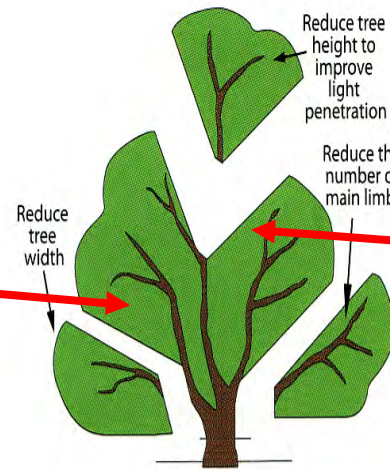


- why do avocados keep deeply shaded inner canopies with high efficiency, low capacity leaves seemingly poorly protected against excess light?
- how do these leaves tolerate extreme canopy management regimes?

Differential effects of pruning strategy on shade leaf photosynthesis

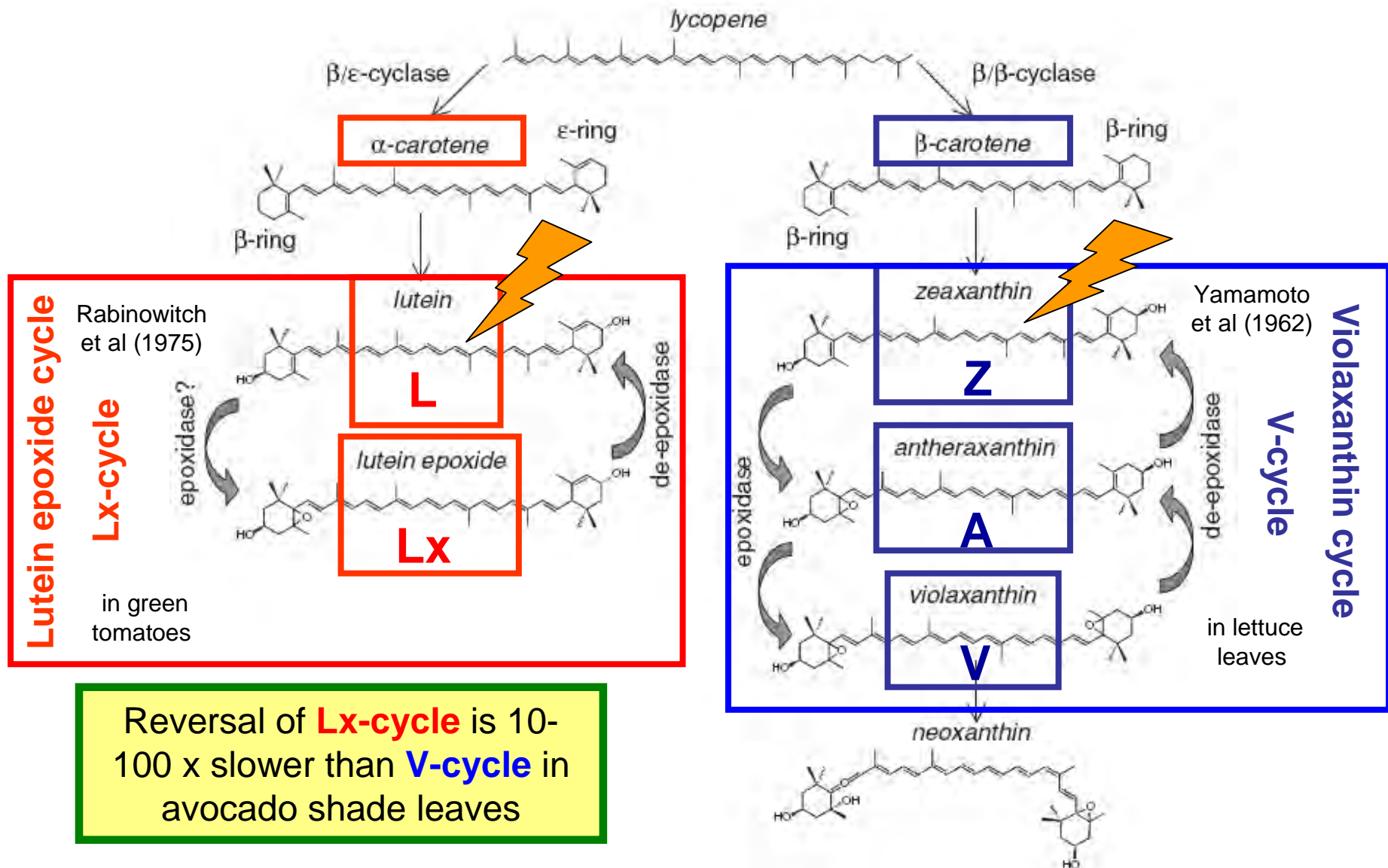


- ▲— shade (Fv/Fm 0.75±0.02)
- sun 4.5 h (Fv/Fm 0.76±0.01)
- sun 3 d (Fv/Fm 0.70±0.02)
- dark 3 d (Fv/Fm 0.77±0.03)
- ▲- sun (Fv/Fm 0.73±0.02)



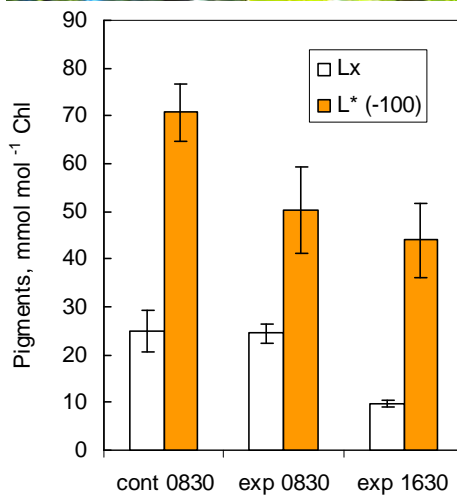
- ▲— shade (Fv/Fm 0.82±0.01)
- 1 d sun (Fv/Fm 0.47±0.03)
- 3 d sun (Fv/Fm 0.43±0.01)
- 3 d dark (Fv/Fm 0.78±0.01)
- ▲- sun (Fv/Fm 0.73±0.02)

Two pigment cycles in avocado shade leaves: both may stabilize photoprotection (NPQ)



Reversal of **Lx-cycle** is 10-100 x slower than **V-cycle** in avocado shade leaves

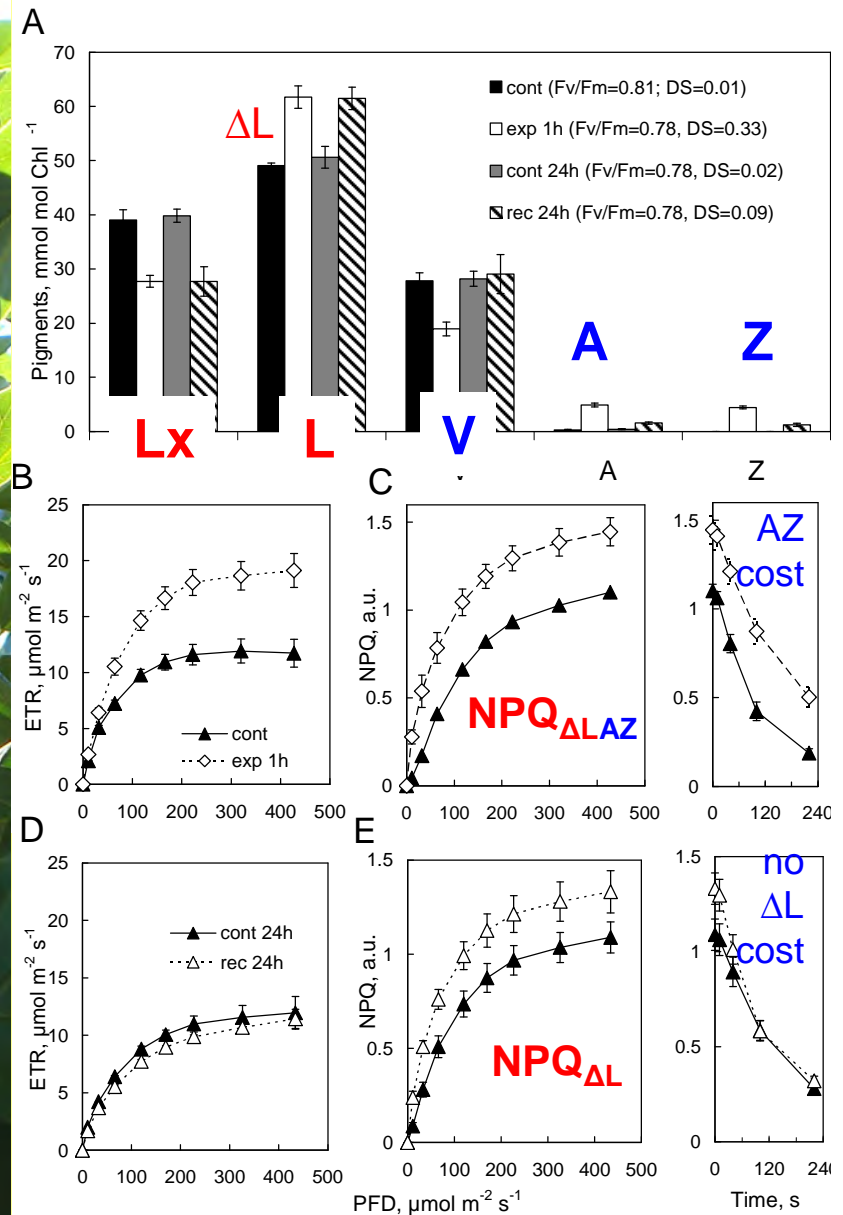
**New science from avocado:
shade leaves prove that
LUTEIN has one, possibly
two, roles in photoprotection**



NPQ_{ΔL}

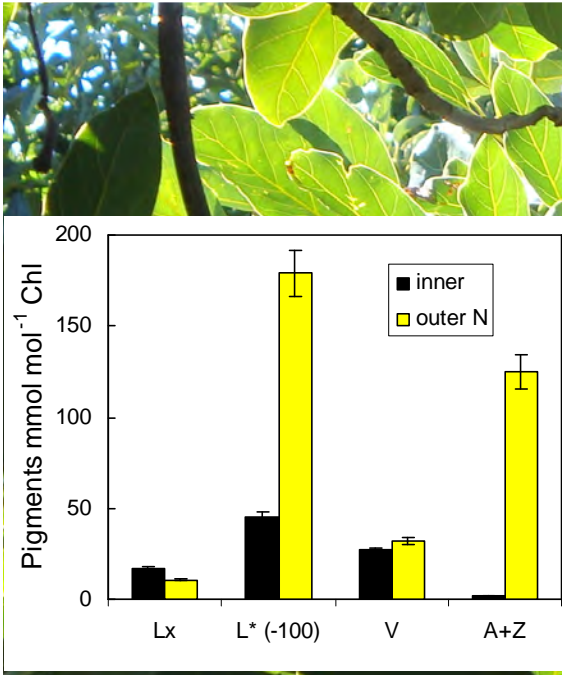
Lutein first to decrease
on shade-sun transfer:
photooxidative protection
(as in retina?)

After just 1 h in 10 %
sun Lx → ΔL and ΔL
replaces A+Z
overnight to sustain
high NPQ

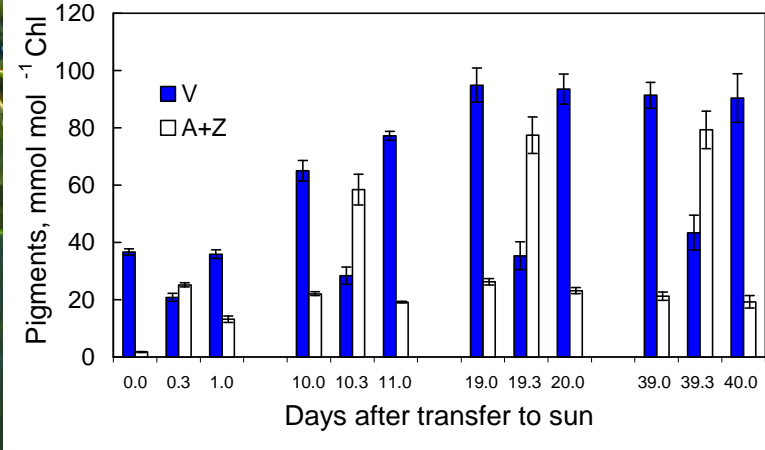
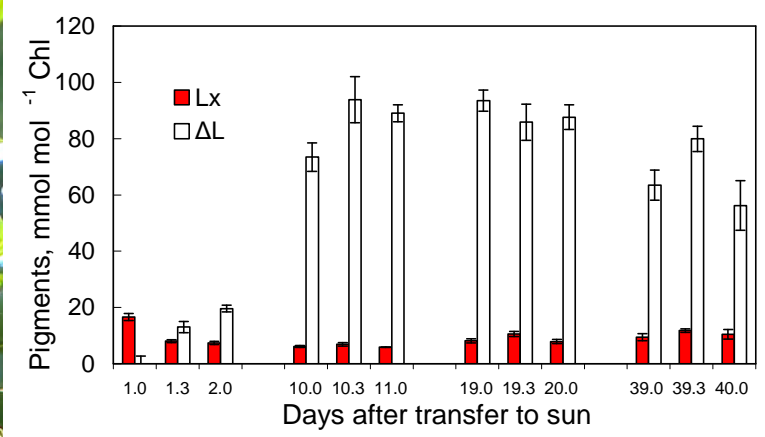


Photoprotection 1: ΔL “locks-in” high NPQ for 72h in shade leaves

Surprising science: old avocado shade leaves are able to reinvent themselves as sun leaves in ~10 days



avocado pigments, Goodwood



Photoprotection 2: huge new synthesis of ΔL and A+Z from carotenes