

# Modelling the potential of vineyard management practices to counteract heatwaves

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## Context

The combination of heat and drought stress compromises yield, fruit quality, and wine style. We modelled vine canopy temperature and transpiration in response to practices that favour evaporative cooling or reduce radiation load including (a) irrigation before a heatwave, (b) kaolin application, (b) shade cloth, (d) canopy trimming, (e) row orientation, and (f) trellising system.

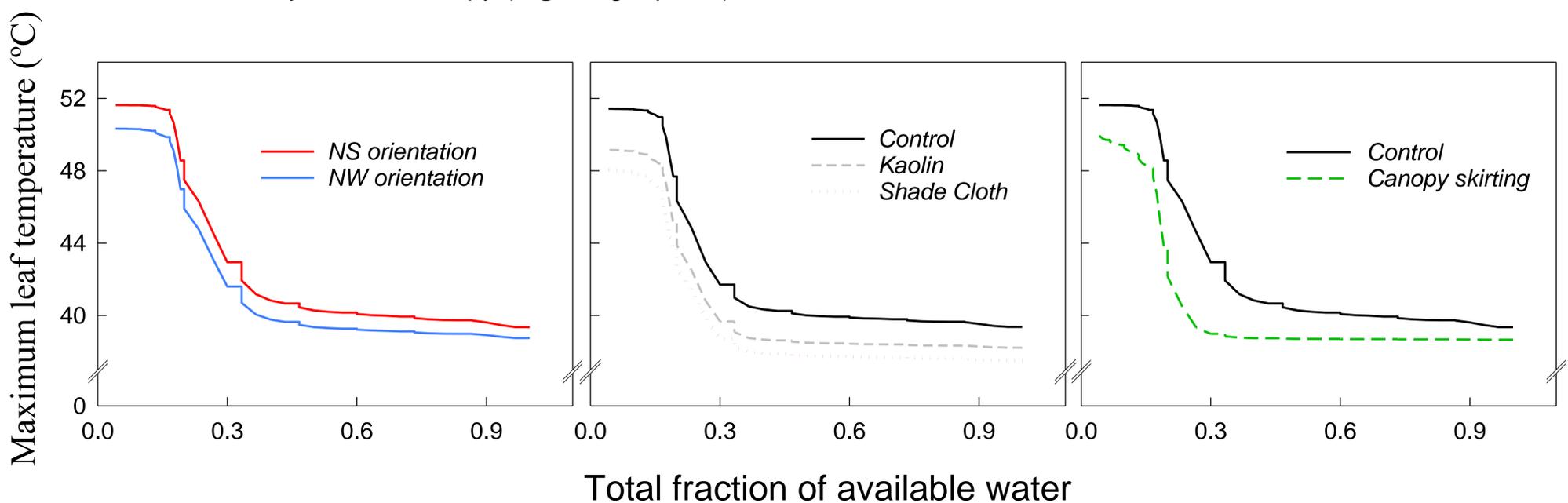
## How?

We used a biophysical model that simulates a vine growing in the field and that accounts for plant, soil and weather conditions (**Fig 1**). The model predicts water potential ( $\Psi$ ), stomatal conductance ( $g_s$ ), photosynthesis ( $A_n$ ) but, more importantly for this work, transpiration ( $E$ ) and leaf temperature ( $T$ ).

Both modelled canopy temperature (14 to 43 °C, RMSD=2.6 °C), and transpiration (0.1 to 5.4 mm/day, RMSD=0.96 mm/day) aligned with measurements in field-grown vines.

## Some remarks!

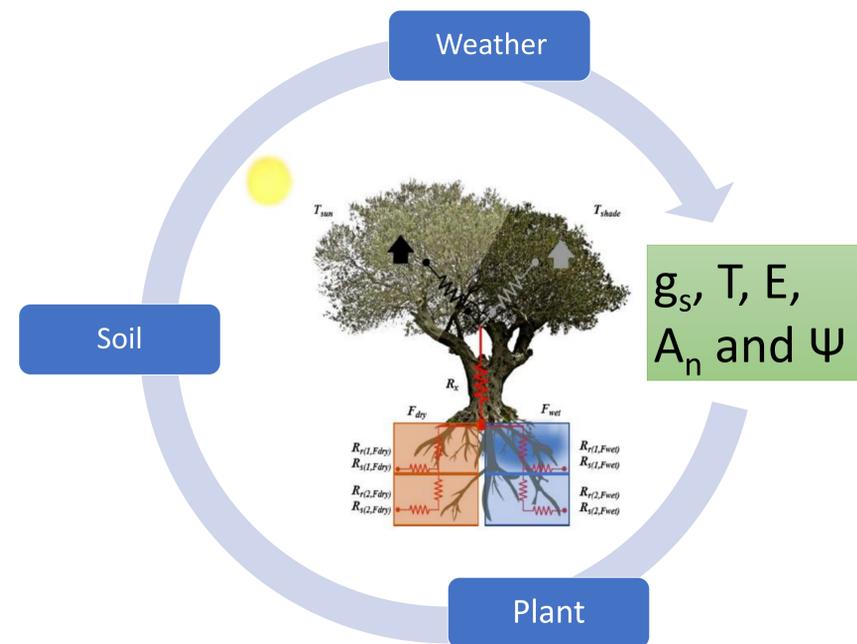
- Row orientation impacted on canopy temperature by affecting both the total amount and distribution of intercepted radiation during the day; NW orientation, with maximum intercepted radiation during the cooler morning, was ~ 1.6 °C cooler than in the NS orientation (**Fig 2**, left panel).
- Shade cloth reduced canopy temperature more than kaolin irrespective of soil water content (**Fig 2**, middle panel).
- Additional irrigation did not result in extra canopy cooling once total fraction of available water was approx. above 0.4.
- Canopy skirting before a heatwave reduced canopy temperature between 2 and 7 °C as the roots were able to supply more water to the relatively smaller canopy (**Fig 2**, right panel).



**Fig 2.** Effect of the reduction on radiation load in maximum leaf temperature at different soil water content by changes on: (left) row orientation, (middle) application of kaolin or shade cloth (50% light exclusion), or (right) by canopy skirting that reduced canopy width 0.5 m (from 1.7 to 1.2 m) on a single-wire sprawling trellis.

## ... in conclusion

Our analysis reveals new insights on the factors affecting canopy temperature during heatwaves. Irrigation is a widely recommended practice and could be refined by consideration of soil water content required to maintain stomatal conductance, transpiration and evaporative cooling. Kaolin and shade cloth can be useful, especially when water allocation is limited. Canopy skirting could reduce energy load and improve plant water status but may risk increased bunch exposure to solar radiation. Row orientation and trellising system may be useful long-term strategies in combination with in-season management.



**Fig 1.** Schematic representation of the model combining the soil-plant-atmosphere continuum (García-Tejera et al. 2017).