

Title: Coordination of morpho-physiological and metabolic traits of *C. incanus* to overcome heatwave-associated summer drought: a two-year on-site field study

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Abstract:

The shrub *Cistus incanus* L. is well adapted to Mediterranean conditions thanks to its morpho-anatomical, physiological and biochemical traits. However, its distribution and survival in coastal dunes will be likely threatened by ongoing runaway climate change. We investigated how the harsh climatic conditions generated by the 2015 summer heat wave triggered specific anatomical, physiological and biochemical responses of this species in its natural environment. These adjustments were compared to those measured in summer 2014. The drier and hotter conditions of summer 2015 determined an increment in leaf lamina thickness, due to a greater palisade parenchyma, thus leading to an increase in the whole leaf mass per area. These morphoanatomical adjustments enhanced leaf resistance against dehydration, optimized carbon assimilation, and delayed leaf senescence.

In addition, the activation of secondary metabolic pathways, in particular the biosynthesis of tannins and monoterpenes, helped prevent oxidative stress through the consumption of excess reducing power, thus contributing to the maintenance of physiological performances even under hotter and drier conditions. In conclusion, our study offers new evidence on the integration of morphophysiological and metabolic adjustments of this species growing in its natural habitat to cope with ongoing climate change.