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Differential drought resistance strategies of co-existing woodland species enduring the long rainless Eastern Mediterranean summer

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In view of the threat to forests exposed to a drier climate, and to enable projecting future changes in forest dynamics, there is an urgent need to improve our understanding of species-specific differences in drought resistance strategies on the one hand and their vulnerability to drought on the other hand. Trees growing in drylands are regularly subjected to various degrees of extreme drought and are suitable for elucidating the relations between ecophysiological mechanisms and survival. The objectives of this study were to form a comprehensive understanding of the drought resistance strategies adopted by Eastern Mediterranean woodland species, and to elaborate specific ecophysiological traits that can explain the observed variation in survival among these species. We examined leaf water potential ([U+1D6F9]), gas exchange and stem hydraulics over a period of 3 years in key woody species, i.e. Phillyrea latifolia, Pistacia lentiscus and Quercus calliprinos, which co-exist in a dry woodland that annually experiences ~6 rainless and hot summer months. As compared to the other two similarly functioning species, Phillyrea displayed a considerably lower [U+1D6F9] (minimum seasonal [U+1D6F9] of -8.7 MPa in Phillyrea vs. -4.2 MPa in Pistacia and Quercus), lower [U+1D6F9] at stomatal closure, lower leaf turgor loss point ([U+1D6F9]TLP), but reduced hydraulic vulnerability and wider safety margins. Notably, Phillyrea allowed [U+1D6F9] to drop below [U+1D6F9]TLP under severe drought, whereas the other two species maintained positive turgor. These results indicate that Phillyrea adapted a more "anisohydric" drought resistance strategy as it apparently depleted the water in its rooting zone until the loss of leaf turgor and subsequent stomatal closure. Pistacia and Quercus adapted a more "isohydric" strategy by having smaller safety margins than Phillyrea, avoiding spending all their water, and not reaching turgor loss and stomatal closure. Considerably higher mortality was observed for Quercus than for the other two species, which may be a result of higher water consumption due to its 2.5-10 times larger crown volume. The observed physiological differences between species exhibiting different levels of mortality indicated drought resistance strategies rather than actual drought stress experienced by the plants. Our results suggest that similar levels of drought resistance in terms of survival can be achieved via different drought resistance strategies. Conversely, similar resistance strategies can lead to different levels of vulnerability to drought. Consequently, physiological responses to drought need to be examined in conjunction with actual tree mortality rates.