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Root hydraulic conductance, gas exchange and leaf water potential in seedlings of *Pistacia lentiscus* L. and *Quercus suber* L. grown under different fertilization and light regimes

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ABSTRACT

Differences in morphology, biomass allocations and physiological responses were investigated in seedlings of Mastic tree (*Pistacia lentiscus* L.) and Cork oak (*Quercus suber* L.) submitted to contrasting fertilization and light regimes during early growth. These species are two evergreen sclerophyllous Mediterranean species frequently used in Mediterranean reforestation programmes. Fertilization was the treatment that affected most of the morphological and physiological variables evaluated in *P. lentiscus* and *Q. suber* seedlings. Leaf area and specific leaf area (SLA) were affected by shading treatment in both species, showing higher values in seedlings grown under shade. *P. lentiscus* seedlings showed a high capacity to modify root morphological variables and root hydraulic conductance (K_R) with the fertilization treatment. In contrast, *Q. suber* showed low to moderate root system changes with the treatments applied, although the fertilization level affected biomass allocation (i.e., root to shoot ratio) in both species. Under high water demand, *P. lentiscus* seedlings with high K_R allowed transpiration (E) to increase without increasing the water potential gradient between soil and leaves. In *Q. suber*, high fertilization induced significant increases in photosynthesis (A), as well as a tendency to increase E with significantly lower leaf water potential (ψ_L).

1. Introduction

Water stress is one of the main environmental limitations for plants in Mediterranean climate areas (Di Castri, 1981). A long dry season with negligible rainfall, high radiation and high evaporative demand imposes severe stress on plants. These abiotic conditions lead to water deficits that affect many physiological processes and can have consequences for survival and plant growth (Larcher, 2001; Lo Gullo et al., 2003). Species tend to adapt to environmental conditions by different morphological and physiological adjustments (Larcher, 2001; Wood, 2005). This fact is especially important at the seedling stage since seedling establishment and growth in field conditions strongly depend on soil water availability (Vallejo et al., 2000). The capacity of the different species to avoid damaging effects determines their chances of survival and growth (Filella et al., 1998; Vilagrosa et al., 2003).

One of the main morpho-functional traits of species is to optimize water absorption and transport to leaves, thus maximizing their hydraulic system, and this is important when interpreting leaf physiological behaviour (Tyree et al., 1991; Maherali et al., 1997; Cochard et al., 2002; Bacelar et al., 2007). Water flow through leaves has significant implications for whole plant hydraulics, plant growth, leaf structure, function and ecology. Therefore, limiting the water loss by leaves to a minimum in order to avoid the interruption of water flow in the xylem under conditions of severe drought is of utmost importance (Burghardt and Riederer, 2003). When the threshold is exceeded xylem cavitation occurs and both the growth and survival of the species become compromised (Sperry, 2000; Cochard, 2006). Stomata response has been found to be related to changes in plant hydraulic conductance to prevent desiccation by maintaining the xylem water potential above the minimum threshold (Cochard et al., 2000; Sperry et al., 2002; Vilagrosa et al., 2003). Because the hydraulic conductance determines how much xylem water potential falls below the soil water potential during transpiration, it indicates that there should be a link between the plant's hydraulic traits and the transpirational demand of its foliage (Sperry et al., 1998; Brodribb and Field, 2000). Moreover, reductions in stomatal aperture to avoid excessive water losses can increase water use efficiency at leaf level, playing an important role in plant response to drought (Cochard et al., 2004; Agele et al., 2005).

In addition to water availability, light and nutrients are two of the most important resources for plant life, and they often interact

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