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Relationship between acorn size and seedling morphological and physiological traits of *Quercus ilex* L. from different climates

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Abstract

Effects of *Quercus ilex* acorn size on seedling morphological and physiological traits were analysed. The study was carried out with five populations from different geographical areas and covering an aridity gradient. Seedling morphological traits (height and total leaf area) were analyzed during the first growing year. Physiological traits (net photosynthesis, stomatal conductance, leaf transpiration, and intrinsic water-use efficiency) were analysed at different air temperatures during spring, summer, and winter months, and in response to water stress. There were significant correlations among the considered acorn (volume, fresh mass) and seedling traits. Differences in growth and physiological traits among the considered populations were found. The larger differences in the growth parameters were observed during the first growing season, and they could be justified by the significant differences among acorn size. On the contrary, the physiological response to air temperature and aridity was more related to the geographical origin of the considered populations than to acorn size. *Q. ilex* acorn and seedling traits more tolerant to drought might have a high potential for vegetation recovery in afforestation projects and restoration programmes particularly under water-limited environments or in degraded areas.

Additional key words: acorn size; gas exchange; predawn leaf water potential; relative growth rate in height; relative water content at predawn; total leaf area.

Introduction

Mediterranean shrublands are largely distributed in areas around the Mediterranean region, which is one of the most heavily utilised by man (Boix-Fayos *et al*. 2009). Nevertheless, large areas in the Mediterranean region have suffered degradation and habitat loss by human activities (Evrendilek *et al*. 2006). Moreover, most major responses of Mediterranean shrublands to global change seem to be variations in their structure and productivity in the long term (Haase *et al*. 2000, Saxe *et al*. 2001). There is an increased interest in the restoration of savannah-like oak forests on abandoned agricultural areas in the Mediterranean region (DOCE 1992, BOE 1994, BOJA 1995, Oliet *et al*. 2007), where the establishment of forest plantations in areas subjected to seasonal drought is strongly limited by water availability (Padilla and Pugnaire 2007, Pérez-Devesa *et al*. 2008).

Seedling stage is a critical phase in the regeneration of woody species (Leiva and Fernández-Alés 1998, Zheng *et al*. 2009), and plantation success can be greatly dependent upon seedling morphological and physiological traits (Trubat *et al*. 2010). The seedling establishment capability confers a high potential for the vegetation recovery (Bognounou *et al*. 2010). Also seed size plays an important role in the establishment of woody species (Meyer and Carlson 2001, Cordazzo 2002, Gomez 2004a). Seed size variation often occurs within a species, with important consequences for the reproductive success of plant species (Gomez 2004a, Baraloto *et al*. 2005). Seed germination capability is significantly affected by seed size, with large seeds having a greater germination success than small seeds (Pizo *et al*. 2006). In order to create systems able to self-regenerate in afforestation projects, it is important to take into account seed and seedling traits more related to drought tolerance (Leiva

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Abbreviations: D – maximum acorn diameter; FM – acorn fresh mass; g_s – stomatal conductance; IWUE – intrinsic water use efficiency; LA – leaf area; P_N – net photosynthetic rate; PAR –photosynthetically active radiation; RGR_H – relative growth rate in height; RWC_{pd} – relative water content at predawn; SH – seedling height; SH_6 – seedling height 6 months after germination; SH_{18} – seedling height 18 months after germination; TLA – total leaf area per seedling; TLA_6 – total leaf area per seedling 6 months after germination; TLA_{18} – total leaf area per seedling 18 months after germination; V – acorn volume; Ψ_{pd} – predawn leaf water potential.
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