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ORIGINAL PAPER

Fall fertilization of Holm oak affects N and P dynamics, root growth potential, and post-planting phenology and growth

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Abstract

• ***Introduction*** For Holm oak (*Quercus ilex* L.), a flush growing species, nutrient loading during the growing season is difficult and can lead to a low nutrient status of the seedlings. To provide insights about Holm oak nutrient dynamics during fall in the nursery and subsequent planting performance, a factorial nursery experiment was conducted in a mild fall–winter area testing the effects of timing of fertilization (early and late fall) and rate (two doses of a NPK fertilizer that applied 28 and 56 mg N per seedling), followed by an experimental plantation.

• ***Results*** Biomass, allocation pattern, shoot N and K, and root K were unaffected by both rate and timing of fall fertilization. However, shoot P concentration of fall fertilized plants was significantly increased, and root P concentration was enhanced by applying fertilizer at either the highest rate or during early fall. This revealed a different nutrient dynamics during fall that was dependent on the specific nutrient and plant component.

• ***Discussion*** Root growth potential was positively correlated to nursery root P concentration. Six months after planting, fall fertilized plants showed higher shoot biomass, higher proportion of new leaves, and faster development, producing leaves earlier compared with unfertilized plants.

• ***Conclusion*** It is concluded that early fall fertilization promotes nutrient loading of P in Holm oak, with significant effects on root growth potential and field growth by means of a phenologically earlier development and a higher aboveground biomass.

Keywords Late season fertilization · *Quercus ilex* · Nutrient loading · Phosphorus · Root growth potential

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1 Introduction

Fertilization strategies that promote nutrient loading during seedling nursery culture have been recommended to increase the performance of transplanted seedlings (Timmer and Aidelbaum 1996; Salifu et al. 2008). Nutrient loaded seedlings usually exhibit superior survival, growth, and competitive ability over non-loaded cohorts when transplanted in a variety of habitats (Oliet et al. 2009a). Remobilization of internal nutrient reserves to support