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ORIGINAL PAPER

Root spatial distribution and biomass partitioning in *Quercus robur* L. seedlings: the effects of mounding site preparation in oak plantations

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Abstract In a reforestation field experiment undertaken in southern Sweden and planted with pedunculate oak, three site preparation treatments (herbicide application (H), mounding site preparation (MSP) and combined herbicide and mounding treatment (H + MSP)) were compared to an undisturbed control (C). We analysed root spatial and biomass distribution in 48 harvested seedlings. Compared to the control, both MSP and H treatments resulted in a significantly higher root system biomass (means C: 16.4 g, H: 45.7 g, MSP: 41.4 g, MSP + H: 102.2 g). The proportion of lateral root biomass increased from 38% (C) to 62% (MSP + H), while the two remaining treatments (H, MSP) attained percentages of 48% and 51%, respectively. The treatments did not alter seedlings' allometry and root:shoot ratio significantly. However, biomass distribution of different root system parts varied among treatments, so that lateral root biomass increased relative to leaf biomass from C to MSP + H variant. Site preparation treatments (MSP, MSP + H) increased the horizontal extension of root biomass, compared to C and H variants. We conclude that mounding site preparation is an efficient method for the reforestation of pedunculate oak stands. Due to the comparative positive effects on root system development, MSP presents an alternative to herbicide treatment, particularly at sites where the use of chemicals is restricted.

Keywords Pedunculate oak · Herbicide · Site preparation · Root collar diameter · Lateral root length · Root system biomass · Allometry · Root:shoot ratio

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Introduction

Oaks (*Quercus* ssp.) are major components of European temperate vegetation types, and oak forests previously covered larger areas than today (Bradshaw and Lindbladh 2005). For Europe, climate models project prolonged, and more frequent summer droughts in areas such as southern Scandinavia, central Europe and the Mediterranean, and an increased frequency of major storm events (Schär et al. 2004; Luterbacher et al. 2004; Leckebusch et al. 2006; Christensen and Christensen 2007; IPCC 2007). Oaks are among the most wind-stable and drought-tolerant tree species (Ellenberg 1988; von Lüpke and Spellmann 1999). Like other broadleaved tree species, they may become more competitive than several conifers like Norway spruce (*Picea abies*) and can attain higher production potentials due to increased air temperature and prolonged growing seasons (Koca et al. 2006). Thus, oaks are a preferred tree genus in any adaptation strategies to climate change for both ecological and economic reasons in these regions, and the oak forest area may increase in the future (Berg et al. 1994; Larsen 1995).