

Drought affects the competitive interactions between *Fagus sylvatica* seedlings and an early successional species, *Rubus fruticosus*: responses of growth, water status and $\delta^{13}\text{C}$ composition

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Summary

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- Competitive interactions between European beech (*Fagus sylvatica* L.) seedlings and the early successional species *Rubus fruticosus*, and the role of water availability, are reported and discussed in relation to management practices and climatic changes in beech ecosystems of Central Europe.
- Responses of growth, water status, gas exchange and carbon isotope composition ($\delta^{13}\text{C}$) to two competition and three irrigation treatments were examined in a factorial-design glasshouse study.
- Under regular irrigation, coexistence with *R. fruticosus* did not significantly affect growth, water potential and gas exchange of beech seedlings. However, moderate water shortage caused a twofold reduction in beech biomass and changes in root : shoot ratios. Drought lowered transpiration rates and predawn water potentials (below the xylem embolism threshold) for *F. sylvatica*; $\delta^{13}\text{C}$ of leaves and fine roots increased (discrimination was reduced). By contrast, significantly lower $\delta^{13}\text{C}$ of *R. fruticosus* foliage indicated an improved water status. Competitive interference intensified the effects of reduced irrigation.
- Water availability regulates the competitive interactions between beech seedlings and *R. fruticosus*. Natural regeneration of beech seedlings may be inhibited by interference from a species such as *R. fruticosus*, especially during summer drought, as predicted by actual climate models.

Key words: *Fagus sylvatica*, competition, water availability, growth, water potential, carbon isotope composition, transpiration.

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Introduction

Throughout their life-cycle, trees interact with neighbouring plants composed of different life forms, physiology and resource requirements. For trees, coexistence with other species may have negative effects, such as soil water and nutrient depletion and competition for radiation, or positive effects such as nitrogen fixation (Flint & Childs, 1987; Messier & Kimmins, 1990; Neary *et al.*, 1990; Chang *et al.*, 1996b). Information on the ecophysiological basis of interactions between trees and neighbouring plants is required to understand, predict and manipulate regeneration and successional processes in forests. Moreover,

knowledge of the indirect effects of understorey vegetation on seedling recruitment patterns may have important silvicultural implications and economic benefits. Several cases have been reported of low productivity or even failure of plantations and of regeneration as a result of competition from understorey species (Brand, 1991; Morris *et al.*, 1993; Marino & Gross, 1998).

A number of management practices, including thinning, have focused on improving ecosystem productivity and are routinely used in forests, both to minimize competition between trees and to increase growth rates. Thinning frequently increases irradiance at the forest floor and may improve conditions for