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Which grow better under the canopy of Norway spruce—planted or sown seedlings of European beech?

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Summary

Direct seeding and planting of European beech (*Fagus sylvatica* L.) are two common techniques for the conversion of pure Norway spruce (*Picea abies* [L.] Karst.) stands into mixed stands. This study tested whether the growth of sown beech seedlings differs from that of planted seedlings of two stock types. Therefore at two experimental sites repeated measurements were made of height, stem and first order branch diameter on sown and planted seedlings over a period of nine years. The results showed that the growth responses of planted and sown seedlings to the environmental conditions below the canopy of overstorey Norway spruce were rather similar. No differences between planted and sown seedlings were found in their diameter and their estimated aboveground dry weight. For all three batches the ratio between the estimated branch dry weight and the estimated main stem dry weight (branch-shoot-ratio (BSR)) was increased with age. Due to intraspecific competition BSR was lowest for the sown seedlings irrespective of their age. Differences in growth dynamics between planted and sown seedlings were found. For example, differences in the height or the estimated aboveground woody dry weight between sown and planted seedlings at a given age were not constant. Height, diameter and estimated dry mass of the seedlings in relation to age could be modelled precisely by a second-order polynomial function in the hitherto studied period.

Introduction

During the last decade direct seeding, which had been the common method of achieving artificial regeneration up to the middle of the nineteenth century, has once again been advocated for regeneration and reforestation purposes (Kübner and Wickel, 1998; Ammer *et al.*, 2002; Löff

et al., 2004; Madsen and Löff, 2005). Direct seeding has been suggested as a particularly appropriate and cheap technique for the conversion of pure secondary conifer stands into mixed stands by introducing shade-tolerant broadleaf species (Gommel, 1994; Baumhauer, 1996; Leder and Wagner, 1996; Städtler and Melles, 1999). However, some problems are inherent to direct