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ORIGINAL PAPER

Consequences of cutting off distal ends of cotyledons of *Quercus robur* acorns before sowing

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Abstract

• ***Background*** Production of seedlings, especially in containers, requires simultaneous germination and emergence. Mechanical scarification often speeds up the growth of embryo axes, increases the percentage of germinating seeds and seedling emergence. Cutting off the distal ends of cotyledons is a mechanical scarification technique sometimes used in the container production of oak seedlings. However the consequences of this procedure for seedling development are little known. We wanted to determine these effects on development and metabolic changes of pedunculate oak (*Quercus robur* L.) seedlings.

• ***Results*** The majority of seedlings from acorns with cut cotyledons emerged two weeks earlier, more simultaneously and their total emergence (due to rejecting spoiled acorns) was ca. 20% higher. The main result is that the strong damage to cotyledons (more than one fifth of acorn mass) caused a decrease of seedling height and mass even after the second growing season. Negative consequences on seedling root/shoot ratio or on their metabolism were not observed.

• ***Conclusion*** We conclude that this method is useful for seedling production in containers when acorn mass is reduced by one fifth.

Keywords *Quercus robur* · Acorn · Cotyledon removal · Seedling · Preparation for sowing

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1 Introduction

In recent years, the production of forest tree seedlings (including oaks) very often occurs in container nurseries. Production of seedlings in containers requires simultaneous germination and emergence, because if there are large differences in the time of germination, the earlier germinated plants quickly develop leaves which overshadow neighbor seedlings and restrict access to water (Suszka 2006). European oaks — pedunculate (*Quercus robur* L.) and sessile oak (*Q. petraea* (Matt.) Liebl.) — germinate unevenly under natural conditions. The difference between first and last germinating acorns can be up to a few weeks (Suszka et al. 2000). A technique that helps cause faster and more uniform germination in germination tests is to remove pericarp from the distal end of the seed (ISTA 1999). A modified version of this method—to cut off about 1/3 of the distal ends of the acorns—is sometimes used in container nurseries (Suszka 2006). It is obvious that cutting off the distal ends of acorns damages and reduces the cotyledons. However, the process of damaging the pericarp and cotyledons without lethal consequences for seedlings sometimes occurs in natural conditions too, when mice bite off parts of acorns before seed germination (Andersson and Frost 1996). In the case of *Quercus suber*, cotyledon damage by insects causes faster and more synchronous germination of acorns (Branco et al. 2002). Oak germinates hypogeally; the acorns remain below the ground surface and do not take part in photosynthetic activity, remaining storage organs only. The consequences of cotyledon removal just after emergence of *Quercus robur* seedlings are very significant for seedling growth (Garcia-Cebrian et al. 2003). The growth, maturation and flowering of some dicotyledonous grassland species is also affected by cotyledon damage (Hanley and Fegan 2007). Kennedy et