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Growth and frost hardening of European aspen and backcross hybrid aspen as influenced by water and nitrogen

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Abstract

• **Introduction** The interactive effects of water and nitrogen (N) on frost hardiness are not well known in broad-leaved trees. Furthermore, new environmental conditions may favour naturally generated hybrids between native and introduced tree species over native species.

• **Methods** A greenhouse experiment with freezing tests was carried out to study how water (low, medium, high) and N (low, high) supply influence the growth, bud phenology and frost hardening of seven young European aspen (*Populus tremula*) and backcross hybrid aspen (*[P. tremula × Populus tremuloides] × P. tremula*) families.

• **Results** The native European aspen grew faster, whereas hybrid aspen × aspen frost hardened faster and exhibited better overall frost hardiness and earlier budburst. Hybrid aspen × aspen also showed intraspecific variation in frost hardiness. The two species showed similar responses to different water and N supplies, and both species were more affected by changes in N supply than in water supply. Higher N supply—especially when combined with drought—

delayed frost hardening, an effect that was more pronounced in European aspen.

• **Conclusions** The results suggest that backcross hybrid aspen may in some respects be better adapted to a range of environmental conditions than the native species.

Keywords Frost hardiness · Environmental change · *Populus* · Hybrid

1 Introduction

Together with the increasing use of introduced species in many parts of the world, the consequences of possible natural hybridization between introduced and native tree species have raised concern. Hybridization may increase competition and narrow the gene pool of native species, thus threatening their overall fitness (Vanden Broeck et al. 2005). European aspen (*Populus tremula*) is a widely distributed species native to Eurasia and of high ecological importance in terms of biodiversity and soil processes of boreal forests (Suominen et al. 2003; Kouki et al. 2004). It has been demonstrated that hybrid aspen, a man-made cross between European aspen and North American trembling aspen (*Populus tremuloides*) which is commercially cultivated in Fennoscandia and Baltic countries (Holm 2004; Rytter 2006), can hybridise with European aspen in nature (Suvanto et al. 2004). Furthermore, backcrosses between hybrid and European aspen may have some advantages over the pure native species concerning seed production and viability, as well as early competition (Suvanto et al. 2004; P. Pulkkinen, unpublished data).

Although the performance of secondary hybrids is generally considered inferior to that of the parent species (Burke and Arnold 2001), sometimes, especially in new

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