From Forest Nursery Notes, Winter 2011

143. © Phenotypic differences in development of cold hardiness in three latitudinal populations of *Acer platanoides* L. Pagter, M., Kristoffersen, A., Bronnum, P., and Jensen, M. Scandinavian Journal of Forest Research 25:412-420. 2010.

Scandinavian Journal of Forest Research, 2010; 25: 412–420

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Phenotypic differences in development of cold hardiness in three latitudinal populations of *Acer platanoides* L.

MAJKEN PAGTER, ALLAN KRISTOFFERSEN, PETER BRØNNUM & MARTIN JENSEN

Department of Horticulture, Aarhus University, Kirstinebjergvej 10, DK-5792 Aarslev, Denmark

Abstract

Variation in cold hardiness, assessed using the electrolyte leakage method, of three 6–7-year-old seedling populations of *Acer platanoides* (L.) originating from Sweden, Denmark and Germany (northern, central and southern population, respectively) was investigated in a Danish field trial during autumn and early winter. Simultaneously, autumnal changes in cold hardiness, stem water content and annual height growth were investigated in field-grown 3-year-old seedlings of the Danish population. The variation in cold hardiness among populations was structured as a moderate latitudinal cline, with the northern population cold acclimating earlier and/or faster than the other populations. Among the central and southern populations the latitudinal gradient was not apparent, resulting in approximately the same percentages of frost damage in the autumn. In early winter no differentiation in cold hardiness was observed among the three populations. In the Danish population cold acclimation was correlated with reduced water content and seedlings that grew longer in the autumn tended to dehydrate late. The results are discussed in relation to the transfer of *A. platanoides* seeds.

Keywords: *Freezing tolerance, genetic variation, Norway maple, relative electrolyte leakage, seed transfer, water content.*

Introduction

In boreal and temperate woody perennials cold hardiness is a characteristic that is acquired by the process of cold acclimation. Cold acclimation is a seasonal process, with cold hardiness increasing during the autumn, reaching its maximum in mid-winter and declining in the spring. Susceptibility of plants to frost injury may therefore be attributed not only to insufficient maximum cold hardiness, but also to the timing and rates of acclimation and deacclimation (Suojala & Lindén, 1997). Cold acclimation in freezing-tolerant woody perennials is often regarded as a two-stage process. In the first stage a reduced photoperiod triggers growth cessation, formation of terminal buds, development of dormancy and a moderate increase in cold hardiness. In the second stage, cold hardiness is further promoted by low temperatures (Weiser, 1970; Li et al., 2004). Genotype-specific differences in susceptibility to cold temperatures have been documented in a range of woody perennials showing a wide geographical distribution (Flint, 1972; Jensen & Deans, 2004; Reyes-Díaz et al., 2005). Similarly, the timing changes and the rate of cold acclimation have been shown to increase gradually with increasing northern latitude of origin in *Salix pentandra* L. and *Betula pendula* Roth (Junttila & Kaurin, 1990; Li et al., 2002).

Acer platanoides L. (Norway Maple) occurs over a wide geographical range in central and eastern Europe and its northern area of distribution extends to the southern parts of Norway, Sweden and Finland (Nowak & Rowntree, 1990; van Gelderen et al., 1994). Owing to its wide distribution, it is likely that *A. platanoides* possesses a large amount of genetic variation and that distinct climatic populations have developed in response to a variety of environments (Yao & Tigerstedt, 1995; Joyce et al., 2002). Westergaard (1997) reported a clinal variation for growth cessation in *A. platanoides* populations in the latitudinal range 55–60° N in Scandinavia. Similarly, there was considerable variation in bud flushing and height growth among Swedish populations of *A. platanoides* originating in

Correspondence: M. Pagter, Department of Horticulture, Aarhus University, Kirstinebjergvej 10, DK-5792 Aarslev, Denmark. E-mail: majken.pagter@agrsci.dk

(Received 11 November 2009; accepted 27 July 2010)

ISSN 0282-7581 print/ISSN 1651-1891 online
DOI: 10.1080/02827581.2010.512872