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Critical night length for bud set and its variation in two photoperiodic ecotypes of *Betula pendula*

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Summary - We studied the variation in critical night length for bud set in two photoperiodic ecotypes (two latitudinally distant stands) of silver birch *(Betula pendula* Roth) in three phytotron experiments. Seeds from 21 open-pollinated mother trees in a southern (Tuusula, 60° N) and a northern (Kittika , 67° N) Finnish stand were germinated and grown for 4 weeks in a 24-h photoperiod in a greenhouse and then moved to different night length treatments at 18 °C for 4 to 6 weeks. Night lengths from 5 to 8.5 h were used for southern origin seedlings and from 1 to 4.5 h for northern origin seedlings. At the end of the treatments, apical bud set was observed and the percentage of seedlings with bud set calculated for each treatment and tree progeny. The critical night lengths (CNL) for 50% bud set were determined separately for seedlings from each mother tree by regression analysis. In both ecotypes. the mean percentage of seedlings with bud set was lowest for the shortest night lengths and increased rapidl y as night lengths increased. Mean CNL with its 95% confidence interval for the southern and northern ecotypes was 6.3 ± 0.2 and 3.1 ± 0.3 h. respectively. The CNL of the two ecotypes differed significantly in three experiments. Within-ecotype variance of the CNL was significantly higher in the northern ecotype (0.484) than in the southern ecotype (0.150). Significant differences in CNL were detected between individual mother trees of the southern ecotype. hut not between mother trees of the northern ecotype. The ranking of individual mother trees. based on CNL. differed in the three experiments.

Keywords: *annual rhythm, climatic adaptation, critical day length, growth cessation, photoperiod.*

Introduction

Well-timed development of dormancy and .frost hardiness are crucial for the success of northern temperate tree species. In trees with a free growth pattern, cessation of height growth, which is the first visible sign of the frost hardening process (Weiser 1970), is predominantly triggered by changes in photoperiod (Nitsch 1957. Fuchigami et al. 1982). The critical day length for growth cessation is defined as the maximum day length (i.e., the minimum night length) causing cessation of extension growth, but the photoperiod for 50% bud set is also used to define the critical day length (Thomas and Vince-Prue 1997). In this study, night length rather than day length was used because the effect of photoperiod is determined by the length of the unbroken dark period and not by day length (Nitsch 1957, Thomas and Vince-Prue 1997).

Tree species with a wide geographic distribution have photoperiodic ecotypes that differ in critical night length (CNL): northern ecotypes having shorter CNLs than southern ecotypes (Sylven 1940, Vaartaja 1954, 1959, Heide 1974, Ekberg et al. 1979). Hilbjorg (1972a) demonstrated the existence of photoperiodic ecotypes in *Benda pubescens* Ehrh.. as has been found in other Scandinavian tree and shrub species, including *Betula pendula* Roth (Habjorg 1978). Because of the gradual change in photoperiod with latitude and effective gene flow between birch populations (Hjelmroos 1991, Eriksson et al. 2003), the adaptive variation in timing of growth cessation among adjacent populations shows a gradual clinal pattern of change rather than differentiation into discrete ecotypes (Vihera-Aarnio et al. 2005). However, when comparing origins from distant latitudes, the concept of ecotype is commonly used.

The within-population variation in several characteristics of birch has been studied including growth and quality traits