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Short-day treatment enhances root egress of summer-planted **Picea abies** seedlings under dry conditions

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ORIGINAL ARTICLE

Short-day treatment enhances root egress of summer-planted Picea abies seedlings under dry conditions

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Abstract

Second year Norway spruce [Picea abies (L.) Karst.] container seedlings, short-day (SD) treated for 3 weeks in July, were exposed together with untreated control seedlings (Co) to three different drought treatments for 5 weeks after planting in early August. The treatments were: (1) regular watering (0 week drought); (2) 2 weeks of drought and 3 weeks of watering; and (3) no watering (5 week drought). No difference was found in the vigour and shoot xylem water potential between the SD-treated and the Co seedlings after the drought treatments. The root growth decreased less for the SD seedlings than for the Co seedlings along with the increase in the length of the drought period.

Keywords: Bud formation, drought stress, height growth, root growth, xylem water potential.

Introduction

Short-day (SD) treatment is currently a widely used practice in forest tree nurseries for Norway spruce [Picea abies (L) Karst.] and Scots pine (Pinus sylvestris L.) (see Colombo et al., 2001, for review). The SD treatment is mainly used to control the height growth of seedlings, and to hasten the frost hardening of seedlings delivered for planting in autumn, overwintered outdoors at the nursery or in freeze storage (Grossnickle, 2000). In Fennoscandia, traditionally a majority of the seedlings are planted in May and early June before shoot elongation during the time when the soil is moist enough for survival. Nowadays, seedlings are more and more often planted by machine. To ensure that the investment in expensive planting machine is economically viable, the operation time for the machine should be as long as possible. Recently, promising results have been achieved by extending the traditional planting period to July and August for silver birch, hybrid aspen and Norway spruce (Luoranen et al., 2003, 2005, 2006a,b).

In southern and central Finland evaporation exceeds precipitation in May, June and July (Solantie & Ekholm, 1985). In early May, soil water content remains relatively high owing to the melted snow cover. During June, July and early August, however, soil water content begins to decrease because of the intense evaporation, accompanied by transient increases due to rain showers. According to calculations based on the rainfall data collected in central Finland, a 1 week rainless period (i.e. potential drought period) exists about every second summer (June-August), and a 2 week rainless period about every 10th summer (Helenius, 2005). Since the mechanism behind the drought damage is the same at the cellular level as in frost damage, i.e. excessive movement of water out of the cells (Larcher, 1995; Zwiazek et al., 2001), in theory SD treatment could decrease the risk of drought damage after planting. For example, in North America, SD treatment is used for seedlings slated for summer planting because it is believed to "harden" the seedlings and thereby enable them to withstand field site environmental conditions during the summer (Grossnickle, 2000, p. 201). The shortening of the daylength in late summer, or SD treatment, induces height growth cessation and then budset. After that,

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