From Forest Nursery Notes, Winter 2009

138. © Survival, growth, and nutrition of tree seedlings fertilized at planting on Andisol soils in Iceland: six-year results. Oskarsson, H., Sigurgeirsson, A., and Raulund-Rasmussen, K. Forest Ecology and Management 229:88-97. 2006.

Available online at www.sciencedirect.com
SCIENCE DIRECT
Forest Ecology and Management 229 (2006) 88–97
Forest Ecology and Management
www.elsevier.com/locate/foreco

Survival, growth, and nutrition of tree seedlings fertilized at planting on Andisol soils in Iceland: Six-year results

Hreinn Óskarsson [a,b,*], Adalsteinn Sigurgeirsson [a], Karsten Raulund-Rasmussen [c]

[a] *Icelandic Forest Research, Mógilsá, IS-116 Reykjavik, Iceland*
[b] *Danish Centre for Forest, Landscape and Planning, KVL, Rolighedsvej 23, 1958 Frederiksberg C, Denmark*
[c] *Department of Applied Ecology, Danish Forest and Landscape Research Centre, Hørsholm Kongevej 11, DK-2970 Hørsholm, Denmark*

Received 15 March 2005; received in revised form 27 February 2006; accepted 20 March 2006

Abstract

A field trial was carried out in 1995 to study the effect of fertilization at planting on the survival, growth, and nutrition of tree seedlings planted on Andisol soils at two sites in South Iceland. Nine fertilizer treatments were tested on three tree species *Betula pubescens* Ehrh., *Larix sibirica* Ledeb. and *Picea sitchensis* (Bong.) Carr. After six growing seasons, seedlings provided with controlled-release-fertilizer (Osmocote®: 25 g per seedling) or smaller amounts of easily soluble nitrogen–phosphorus fertilizer (e.g. 1.2 g N per seedling and 1.4 g P per seedling) showed significantly improved survival and growth. Larger amounts of N increased mortality during the first year. Fertilized trees were less subject to frost heaving than untreated trees. In the year following application of NPK fertilizer the effect was insignificant on the foliar concentration of macronutrients of the fertilized seedlings, compared to control seedlings. It is concluded that fertilization during afforestation in Iceland and other areas in the world with similar climatic and soil properties could make the difference between plantation success or failure.

Keywords: Growth; Survival; Foliar nutrient concentration; Frost heaving; *Betula pubescens* Ehrh.; *Larix sibirica* Ledeb.; *Picea sitchensis* (Bong.) Carr.; Fertilizer; Containerized seedlings

1. Introduction

It has been estimated that over 60% of Iceland was covered with vegetation at the time of settlement some 1100 years ago (Bjarnason, 1942). Downy birch (*Betula pubescens* Ehrh.) woodlands dominated, covering 25–30% of the island's total area (Blöndal, 1993). Severe degradation of the vegetative cover occurred thereafter because of heavy grazing, felling of trees for charcoal and firewood, and deforestation for grazing land, combined with frequent volcanic eruptions and a cooler climate during the Middle Ages. The result was severe soil erosion so that today only 25% of the country is vegetated (Arnalds et al., 1995), with woodlands covering approximately 1.3% (Blöndal, 1993).

The climate in Iceland is cold temperate, moderated by the North Atlantic Current, and is characterized by mild, windy winters and damp, cool summers (Einarsson, 1984). Most Icelandic soils belong to the Andisol soil group (Arnalds et al., 1995) and are developed in volcanic material. The soils tend to be high in amorphous clays and soil organic matter (Arnalds et al., 1995). Because of its volcanic origin and fine sandy–silty texture, Icelandic soils are highly susceptible to erosion, particularly by wind. During winter frequent shifts between freezing and thawing are common, and these shifts, accompanied by high precipitation and high soil moisture, intensify frost heaving of plants (Arnalds, 1998).

Afforestation efforts in Iceland started on a small scale around 1900, and have until recently involved planting of bare-rooted transplants of exotic conifers within the native downy birch woodlands. During the 1990s, afforestation activities shifted to open land, using young containerized one- or two-year-old planting stock. Current government policy calls for an increase in the afforestation effort to 5400 ha per annum over the next 40 years, corresponding to afforestation of approximately 2% of the island's land area.

Early mortality and low growth rate has been identified as critical factors for successful plantation establishment in Iceland (Óskarsson and Ottósson, 1990; Aradóttir and Grétarsdóttir, 1995; Halldórsson et al., 2000). There are several

* Corresponding author at: Icelandic Forest Service, Austurvegur 1, 800 Selfoss, Iceland. Tel.: +354 4801821; +354 8641102(M); fax: +354 4801818.
E-mail address: hreinn@skogur.is (H. Óskarsson).

0378-1127/$ – see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.foreco.2006.03.018