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# Scots pine stand establishment with special emphasis on uncertainty and cost-effectiveness, the case of northern Finland

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**Abstract** The effect of uncertainty on the cost-effectiveness of alternative chains of stand establishment in northern Finland was examined. The data were from a reforestation study of Scots pine (*Pinus sylvestris* L.) consisting of 288 sample plots, which were measured with respect to regeneration success. The study design included four site-preparation methods (patch scarification, ploughing, prescribed burning and disk trenching) combined with three reforestation methods (sowing, planting with containerized seedlings and planting with bare-rooted transplants). Initial reforestation density was 2,500 spots or seedlings per hectare, and the regeneration success was modeled as probability with two thresholds, namely 500 and 1,100 saplings. On formerly spruce-dominated as well as pine-dominated sites the most cost-effective chain was ploughing and planting with containerized seedlings, when threshold was 1,100 saplings per hectare. However, with threshold of 500 saplings the best performer was ploughing and direct sowing on both sites.

**Keywords** Chain of stand establishment · Uncertainty · Regeneration success · Financial performance

## Introduction

Unfavourable soil characteristics combined with harsh climatic conditions (see e.g. Varmola et al. 2004) have been considered to be the main causes of severe dieback of Scots pine (*Pinus sylvestris* L.) seedlings on reforestation sites in northern Finland (Pohtila 1977; Mäkitalo 1999). Particularly, regeneration success of direct seeding has varied drastically both in northern and central Finland (Valtanen and Engberg 1987) as in northern Sweden (Winsa and Sahlen 2001). With Scots pine planting soil scarification methods have been evidenced to affect significantly on survival and growth of the seedlings (Roturier and

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