

Working Papers of the Finnish Forest Research Institute 114: 20–22

## Field behaviour of Scots pine cuttings compared to seedlings

Anna-Maija Niskanen<sup>1,2</sup>, Niina Stenvall<sup>2</sup>, Anne Pakkanen<sup>2</sup> and Pertti Pulkkinen<sup>2</sup>

<sup>1</sup>University of Helsinki, Department of Applied Biology/Forest Tree Breeding, Finland;  
[anna-maija.niskanen@helsinki.fi](mailto:anna-maija.niskanen@helsinki.fi)

<sup>2</sup>Finnish Forest Research Institute, Haapastensyrjä Breeding Station, Finland

Scots pine (*Pinus sylvestris* L.) growth and stem form characteristics between cuttings and seedlings of the same origin were compared in a ten-year field trial. The seedlings were taller than the cuttings throughout the experiment, but the growth patterns - profiled by the relative growth rate - were similar in both groups. There were some changes in stem form characteristics after 9 and 10 years in the field, indicating that the use of cuttings for stem quality selection at an early age has no advantages over the use of seedlings. The consistent performance of cuttings compared to seedlings of the same origin indicates that the field performance of cuttings is a valid measure of their genetic potential and that cuttings can be used to speed up selection in breeding programmes with Scots pine.

Keywords: Scots pine (*Pinus sylvestris*), rooted cuttings, field trial

### Introduction

In Finland the breeding of Scots pine started in the beginning of the 1940s and has recently reached the transition to the second breeding cycle (Haapanen and Mikola 2004). The genetic improvement of Scots pine using traditional breeding methods - selection of parents, crossings, rearing of the offspring, progeny tests, backwards selection - is a slow process which could be speed up by using vegetatively propagated material in the breeding programmes. Also, the expected genetic gain from within-family selection has been reported to be higher using cloned material instead of seedling families in *Pinus taeda* (Isik et al. 2004) and the economic input in cloning methodology pays off in shortened breeding cycle with the same or better genetic gain (Danusevičius & Lindgren 2002, Haapanen & Mikola 2004, Isik et al. 2004).

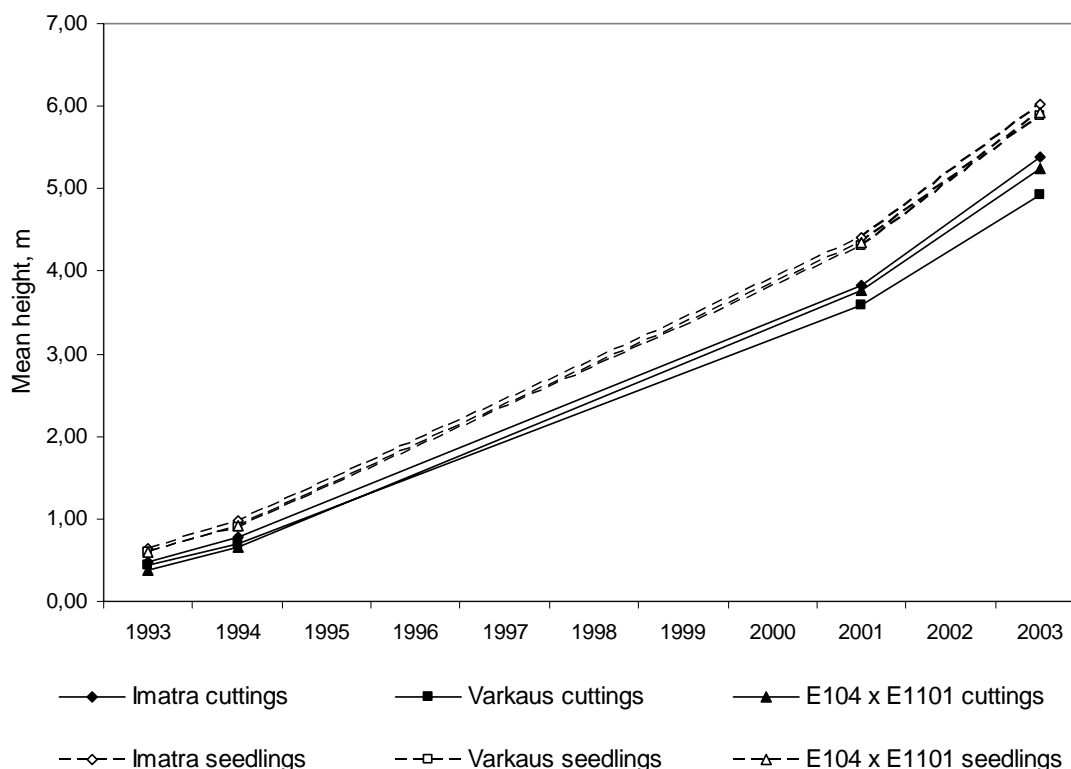
During this work our objective was to find out if the growth and the field performance of rooted Scots pine cuttings is comparable to seedlings of the same origin and can the clones be used to get a higher genetic gain from breeding tests and to speed up the breeding programs of Scots pine.

## Material and methods

The Scots pine seeds for stock plants originated from two seed orchards (Varkaus and Imatra) and from one controlled cross (E104 x E1101). The 2-5 years old stock plants were sprayed with bentzyladenin solution (0.25 mM and 0.5 mM) for four weeks starting in June 1989 and in spring 1990 all shoots that had elongated 1.5 cm or more were cut, soaked in 0.5 mM IBA for 20 hrs and stuck to peat-sand-perlite mixture (40:40:20). The control seedlings were sown at the same time with the rooting of the cuttings. The field experiment was established with 2 yrs old cuttings (n=158) and seedlings (n=300) in July 1992 in Haapastensyrjä Breeding Station, Läyliäinen as a completely randomized test of single seedling/ramet plots, 1.8 x 1.8 m. The height and stem diameter at breast level were measured and the bole straightness assessed on a scale of 1-3 in 2001 and 2003. Relative growth rate, stem taper and stem volume were calculated as described by Niskanen et al. (2008). The effect of plant type (cutting or seedling) and origin (Imatra, Varkaus or E104 x E1101) and their interactions, on height, dbh, vol. and stem taper were assessed by 2-way ANOVA. The difference in bole straightness between cuttings and seedlings was analysed using Pearson Chi-Square test. All tests were performed using SPSS for Windows, release 15.0 (SPSS, Chicago, IL, USA).

## Results

The cuttings were shorter than the seedlings throughout the experiment (Fig. 1). However, the origin (d.f. = 2,  $F = 4.611$ ,  $p = 0.010$ ) of the plants had more significant effect on the height than the plant type (d.f. =1,  $F = 5.185$ ,  $p = 0.023$ ) after 10 years on the field.



**Fig. 1.** Mean heights of Scots pine cuttings and seedlings of three different origins in the field trial in 1993-2003 (from Niskanen et al. 2008).

The RGR patterns of both the cuttings and the seedlings stabilized before the 9th year in the field, indicating similar growth patterns of the both plant types (Fig. 2). Also, there were no differences in dbh (d.f. = 1,  $F = 1.772$ ,  $p = 0.190$ ), stem volume (d.f. = 1,  $F = 2.165$ ,  $p = 0.174$ ), stem taper (d.f. = 1,  $F = 0.688$ ,  $p = 0.408$ ) or bole straightness (d.f. = 2,  $X^2 = 0.853$ ,  $p = 0.653$ ) between the cuttings and the seedlings at the end of the field trial.

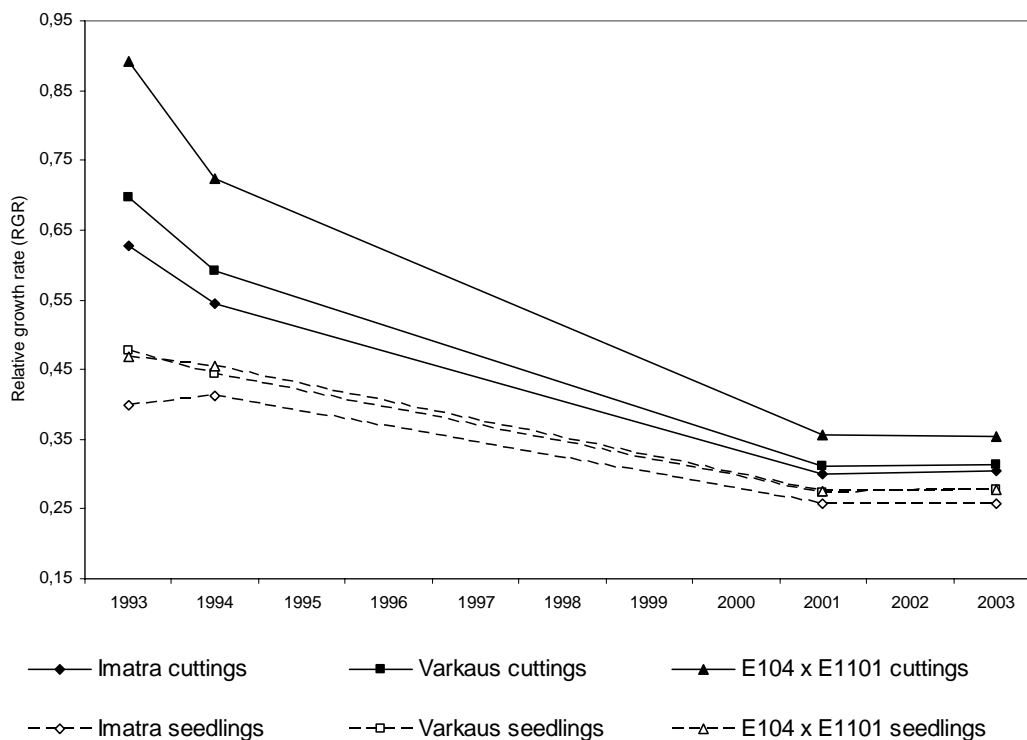


Fig. 2. Scots pine relative growth rates in a field trial in 1993 - 2003 (from Niskanen et al. 2008).

## Conclusions

The results of this experiment was that the Scots pine seedlings were taller than rooted cuttings of the same origin indicating that the height growth of Scots pine seedlings is faster than the height growth of rooted cuttings. However, the other observed growth parameters were similar in both plant types indicating similar growth patterns and the effect of plant origin to height was more significant than the effect of plant type. Therefore, we conclude that the height growth of Scots pine families may be predicted using cloned material and that rooted cuttings may be used to speed up Scots pine breeding programmes.

## References

- Danusevičius, D. & Lindgren, D. 2002. Efficiency of selection based on phenotype, clone and progeny testing in long-term breeding. *Silvae Genetica* 51: 19–26.
- Haapanen, M. & Mikola, J. 2004. Metsänjalostus 2050 – Pitkän aikavälin metsänjalostusohjelma. [Forest Tree Breeding 2050. Long-term Tree Breeding Program]. Finnish Forest Research Institute, 61 pp. (In Finnish).
- Isik, F., Li, B., Frampton, J. & Coldfarb, B. 2004. Efficiency of seedlings and rooted cuttings for testing and selection in *Pinus taeda*. *Forest Science* 50: 44–53.
- Niskanen, A.-M., Stenvall, N., Pakkanen, A. & Pulkkinen, P. 2008. Comparison of growth and stem form characters of *Pinus sylvestris* clones and seedlings of the same origin in a 10-year field trial. *Scandinavian Journal of Forest Research* 32: 484–490.