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Joint Scots pine cutting propagation project Finland-Latvia-Sweden

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A research project on Scots pine cutting propagation has been launched as a joint effort involving researchers from Finland, Latvia and Sweden. The aim is to develop pine cutting propagation to a standard that makes it possible to use for cloning candidates in the breeding programme. The key problem in this research is how to optimize the two conflicting factors corresponding to donor plant age: shoot production and high rooting success.

Keywords: adventitious shoots, donor plant, shoot production, rooting environment

Background

Vegetative propagation is a tool for speeding up the breeding cycle by enabling candidates in the next generation to be tested as clones and not by their progenies. In the Swedish spruce (*Picea abies*) breeding programme, vegetative propagation by cuttings is routinely used. The second conifer species of great economic importance in Nordic countries, Scots pine (*Pinus sylvestris*), is more difficult to propagate by vegetative means (Boeijink & van Broekhuizen 1974, Strömquist 1979, Lindgren et al. 1992). However, more recent experiments suggest that it could be possible to develop cutting propagation of Scots pine to a level that allows use in breeding. Högberg (2005) reported 54 % rooting of cuttings taken after top pruning the second year. This rooting experiment was conducted in late summer with donor plants from 46 open-pollinated families. Some experiments on smaller materials, where the rooting took place during winter, have resulted in even higher rooting success (Skogforsk, unpublished data). However, the results are not consistent and more stable results are needed to include cutting propagation as a routine operation in Scots pine tree breeding.

Rooting ability of cuttings decreases with the age of the donor plants (Boeijink & van Broekhuizen 1974, Strömquist 1979). Already a two-year old donor plant tends to give low rooting percentages, but as indicated by Högberg (2005), this is not always the case. The aging effects highlight the conflict that has to be handled in development of cutting propagation method. An old donor plant can produce more shoots suitable for cutting propagation but the rooting ability decreases. The now initiated project, involving the institutes Metla in Finland,

Silava in Latvia and Skogforsk in Sweden, aims at finding the best solution of this unfavourable relation.

Research approach

The present model for cutting propagation starts with sowing of in early spring and then cultivation with a generous fertilisation program to get large-sized plants with well-developed root systems. In spring the following year, the donor plants are top pruned just below the point where the first year's bud was formed. Adventitious shoots from needle-pairs develop during the summer year 2 and is harvested and rooted in winter year 3. Fig. 1 below shows the sequence of events. Observe that with sowing in early spring a second flush the first year can be expected like the donor plant in A in Fig. 1.



Fig. 1. Cutting propagation of Scots pine: (A) donor plant ready to be pruned, (B) pruned donor plant with developing adventitious shoots, (C) adventitious shoots in a later stage of development, (D) rooted cutting. (Photos: A and C taken by Tuija Aronen, B by Karl-Anders Högberg, and D by Jörgen Hajek)

Rooting is performed on a heated bed that enables the temperature to reach +25°C in the substrate. The relative humidity is kept between 60-75%, while the photoperiod is set to 18h with a light intensity of 12000 lux. The cuttings are hormone treated by dipping the cutting base in 8000-12000 ppm solution for 5-10 seconds. A porous substrate is used to allow for irrigation to keep the relative air humidity in the desired interval.

The basic idea in the new project is to harvest cuttings twice on the same donor plant with the aim to produce ten ramets of each donor plant appropriate for planting in field tests.

Organisation of the work

Five alternative models are tried:

- A. Two consecutive winter propagations, year 3 and year 4 after sowing, respectively.
- B. A winter propagation year 3 followed by a late summer propagation the same year.
- C. A spring propagation year 2 after shoot production in a heated greenhouse during winter, followed by a late summer propagation the same year.
- D. Two consecutive late summer propagations year 2 and year 3, respectively.
- E. One winter propagation year 4 after sowing.

Rooting environment factors (F) are studied in separate experiments including temperature, water regime and GA-inhibitor treatment.

The models are distributed on participants according to Table 1 below. Sweden is represented by Skogforsks research stations Sävar and Ekebo, Finland by the Metla research stations Haapastensyrjä and Punkaharju, Latvia by Silava institute in Salaspils.

Table 1. Distribution of the project work on the five participating units. Model labels are explained in the text above.

Model	Sävar	Haapastensyrjä	Punkaharju	Ekebo	Salaspils
A	x	x	x	x	x
B	x	x			
C	x		x		
D	x			x	
E	x				x
F	x	x	x		

The plant material consists of five families in common in all experiments and at all locations. Furthermore, 15 local families are included at each location. For the rooting environment studies a separate set of ten families at each location is included.

Beside the search for the best production-rooting compromise, important issues in the project are the genetic influence on propagation ability and possible propagation effects on growth habit.

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