# Field growth and mycorrhization of *Pinus sylvestris* and *Picea abies* seedlings produced under different nursery cultivation systems

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## Introduction

Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) are the principal tree species north temperate and boreal forests in Europe and they are commonly used in reforestation. In Latvia, forest nurseries produce over 45 million of pine and spruce seedlings yearly. Seedling cultivation system can have significant effect on development of beneficial mycorrhizal fungi which may determine success of reforestation. The aim of this study was to evaluate growth and ectomycorrhizal (ECM) colonization of containerized and bare-root nursery cultivated pine and spruce seedling after their outplanting in the field.

## Materials and Methods

Planting was carried out in 2006 in the central part of Latvia, in clear-cut 7500m$^2$ in size (Fig.1). Containerized and bare-rooted seedlings were planted in rows as different replicates (Fig. 2). In total 752 spruce and 644 pine seedlings were planted.

Mycorrhiza were identified using both morphological characterization and ITS rDNA sequencing. Totally, 3600 root tips were analyzed.


Fig. 1. Study site

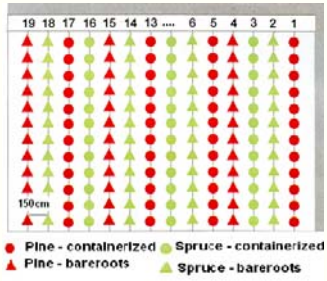


Fig. 2. Experimental design


Fig. 3. Containerized seedlings after first growing season (autumn 2006)

## Results

Table 1. ECM species composition on root tips of spruce and pine seedlings

(1- year 2006, 2 – autumn 2006, 3 – 2007, 4 – 2008, 5 – 2009)

| containerized | | | | | Spruce | bare-root | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | Species | 1 | 2 | 3 | 4 | 5 |
| | | | - | - | *Thelephora terrestris* | - | | - | - | - |
| - | | | | | *Amphinema byssoides* | | | | | - |
| - | - | | | | *Wilcoxina rehmii* | - | - | | - | - |
| - | - | - | | | *Amphinema* sp. | - | - | - | | |
| - | - | - | - | - | *Wilcoxina* sp. | - | - | - | - | |
| - | - | - | - | - | *Tuber* sp. | - | - | - | - | |
| - | - | - | - | - | *Tylospora asterophora* | - | | - | - | |
| - | - | - | - | | *Humaria hemisphaerica* | - | - | - | - | - |
| | - | - | - | - | *Hebeloma populinum* | | - | - | - | - |
| - | - | - | - | - | *Cadophora finlandica* | - | | - | - | - |
| - | - | - | - | - | *Laccaria bicolor* | - | | - | - | - |
| - | - | - | - | - | *Atheliaceae* sp. | - | - | | - | - |
| - | - | - | - | - | *Phlebiopsis gigantea* | - | - | - | | - |
| - | - | - | - | - | *Clavulina* sp. | - | - | - | - | |
| - | - | - | - | | *Lactarius deterrimus* | - | - | - | - | - |

| containerized | | | | | Pine | bare-root | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | Species | 1 | 2 | 3 | 4 | 5 |
| | | | | - | *Thelephora terrestris* | | | | - | - |
| - | - | - | - | - | *Amphinema byssoides* | - | - | | - | - |
| - | | - | | - | *Wilcoxina rehmii* | - | | - | | - |
| - | - | | - | - | *Amphinema* sp. | - | | - | | - |
| - | - | - | - | | *Wilcoxina* sp. | - | - | - | - | - |
| - | - | - | - | | *Tuber* sp. | - | - | - | - | - |
| - | - | - | - | - | *Tylospora asterophora* | - | | - | - | - |
| - | - | - | - | - | *Humaria hemisphaerica* | - | - | | - | - |
| - | - | - | - | - | *Laccaria laccata* | | - | - | - | - |
| - | - | - | - | - | *Laccaria amethystina* | | - | - | - | - |
| - | - | - | - | - | *Tricholoma cingulatum* | | - | - | - | - |
| | - | - | - | - | *Suillus bovinus* | | - | - | - | - |
| - | - | - | | - | *Suillus luteus* | | - | - | - | - |
| | - | - | - | - | *Suillus flavidus* | - | - | - | - | - |
| | | - | - | | *Suillus variegatus* | - | - | - | - | - |
| - | | - | - | - | *Rhizopogon rubescens* | - | - | - | - | - |
| - | - | - | - | - | *Russula velenovskyi* | - | - | - | | - |
| - | - | - | - | - | *Cortinarius* sp. | - | - | - | - | |
| - | - | - | - | - | *Tomentella* sp. | - | - | - | - | |

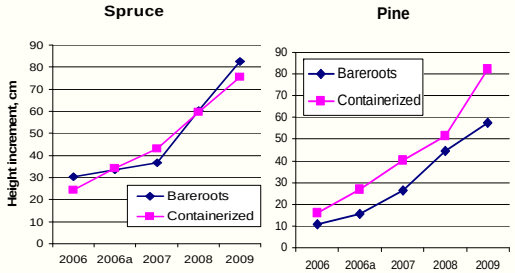


Fig. 4. Average height increment of spruce and pine seedling (cm)

## Conclusions

- Lower total ECM diversity was observed on containerized seedlings of both species but species on containerized seedlings were more permanent.
- In spruce, height growth and survival (2009) were better in bare-root seedlings than in containerized seedlings ($p<0,05$) which was probably due to the better developed root systems of bare-root seedlings and more abundant root colonization by diverse ECM species.
- In pine, height growth and survival (2009) were better in containerized seedlings than in bare-root seedlings ($p<0,05$), and this was probably due to the colonisation of roots by ECM symbionts with more developed external mycelium.

## Acknowledgements

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