Productivity, quality of work and silvicultural result of mechanized planting

Nordic Nursery Conference 2007
5th September
Suonenjoki

Veli-Matti Saarinen
Finnish Forest Research Institute
Suonenjoki Research Station
Mechanized planting in Finland

- The estimated degree of mechanization is total 3 - 4% (~3000 hectares), but ~25% in forest industry-owned forests
- Three machine types:
  - Bräcke (24 machines)
  - Ecoplanter (2 machines, in use ??)
  - Lännern, Ilves (5 machines, in use ??)
  - M-Planter (1 machine, promising prototype)
Field experiment

- Planting methods
  - EcoPlanter planting machine
  - Bräcke planting machine
  - Mounding and manual planting
- Slash (logging residues) removing (no/yes)
- Experimental sites
  - Site 1. “Normal” mineral soil, Kangasniemi
  - Site 2. Drained mire (Stonefree), Jäppilä
  - Site 3. Stony mineral soil, Karttula
Ecoplanter planting machine

- Mounted to a harvester crane
- Two mounds are made by rotovator wheels
- Possible to plant two seedlings simultaneously
- The soil around seedlings is not compacted

- Phases of planting:

Photo: Ecofrässten Ab
Bräcke planting machine

- Mounted to an excavator (90%) or a harvester (10%) crane
- Mound is made by mounding blade
- The soil around seedling is compacted
Mounding and manual planting

- Excavator mounted mounding blade (Bräcke type mounds)
- Forest worker with planting tube

Photos: Leo Tervo
Productivity of planting

Planted seedlings per effective hour ($E_0$)

<table>
<thead>
<tr>
<th></th>
<th>No slash removal</th>
<th>Slash removed</th>
<th>No slash removal</th>
<th>Slash removed</th>
<th>No slash removal</th>
<th>Slash removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1. &quot;Normal&quot; mineral soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 2. Stonefree drained mire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 3. Stony mineral soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ecoplanter  Bräcke
Planting cost (excluding seedlings)

<table>
<thead>
<tr>
<th>Site</th>
<th>Soil Type</th>
<th>Slash Removal</th>
<th>Cost per Seedling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Normal</td>
<td>No slash</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removed</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slash</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removed</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.45</td>
</tr>
<tr>
<td>2.</td>
<td>Stonefree</td>
<td>No slash</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removed</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slash</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removed</td>
<td>0.45</td>
</tr>
<tr>
<td>3.</td>
<td>Stony</td>
<td>No slash</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>mineral</td>
<td>removed</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>soil</td>
<td>Slash</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removed</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.45</td>
</tr>
</tbody>
</table>

- **Ecoplanter**
- **Bräcke**
- **Mounding and manual planting**
Planting density and planting points

The diagram shows the planting density and planting points for different methods and harvesting strategies. The x-axis represents the planting points, while the y-axis represents the density in ha⁻¹. The legend indicates the different methods and harvesting strategies:

- Mineral soil mound
- Mineral soil-humus mound
- Humus-mineral soil mound
- Humus mound
- Slash mound
- Patch or uncultivated

Each bar represents a different planting point, with the segments indicating the density contributions from each method and harvesting strategy.
Proportion of correctly planted seedlings

(Correct covering, compaction, planting depth and straightness of the seedling)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Yes No Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Planting method, logging residues (slash) harvesting (No/Yes)
Proportion of seedlings without planting damages

(Without crown, branch or bark damages)

SITE 1. "Normal" mineral soil
SITE 2. Stonefree drained mire
SITE 3. Stony mineral soil

Planting method, logging residues (slash) harvesting (No/Yes)

No Yes No Yes No Yes No Yes No Yes No Yes No Yes No Yes No Yes


20.9.2007
Survival and mean height after the 5th growing season

SITE 1. "Normal" mineral soil
SITE 2. Stonefree drained mire
SITE 3. Stony mineral soil

Planting method, logging residues (slash) harvesting (No/Yes)
Conclusions

- Minor differences on planting quality and on regeneration result between mechanized (Bräcke) and manual planted seedlings
- Cost efficiency of mechanized planting can be improved by:
  - new technical solutions (M-planter ?)
  - labour shortage
  - increasing harvesting of logging residues