Preliminary results of mechanized planting and mounding

Tampere 23.3.2006
Veli-Matti Saarinen
Background

- Logging residues (slash) removal in regeneration areas has become common (about 30000 ha/a) (2004: 64% of forest chips from slash)
- Stump removal has been started mainly around some power and heating plants (about 2400 ha/a) (2004: 6% of forest chips from stumps)
- Possible to use new methods in forest regeneration after logging residues and stump harvesting
Aim of the study

- To study the effects of logging residues (slash) and stump removal on site preparation and planting (Norway spruce)
  - Work productivity
  - Work quality
  - Initial regeneration costs
  - Survival and growth increment and total regeneration costs of the planted seedlings (after the 3rd growing season)
- To clarify possibilities to use new methods in forest regeneration operations after logging residues or/and stump harvesting
1. Mechanized planting

- **Planting methods**
  - EcoPlanter planting machine
  - Bräcke planting machine
  - Spot mounding + manual planting

- **Sites**
  - “Normal” mineral soil
  - Stony mineral soil
  - Thick humus layer on fine grained soil

- Logging residues (slash) removal (yes/no)

- 2 yrs Norway spruce, peat plug
Planting machines

**Ecoplanter**
- Two mounds are made by rotovator wheels
- Possible to plant two seedlings simultaneously
- The soil around seedlings is not compacted

**Bräcke**
- Mound is made by mounding blade
- The soil around seedling is compacted
Productivity of planting

![Bar chart showing productivity of planting with different conditions: No slash removal, Slash removal, Drained mire (stonefree), Normal, Stony. The y-axis represents the number of planted seedlings per effective hour (E₀), ranging from 0 to 300. The chart compares two methods: Ecoplanter and Bräcke.]
Quality of the mounds (all sites)

Surface layer of the mounds

Proportion

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

No slash removal  Slash removal  No slash removal  Slash removal  No slash removal  Slash removal

EcoPlanter  Bräcke  Mounding and manual planting

- Pile of slash
- Humus
- Humus - mineral soil
- Mineral soil - humus
- Mineral soil
Survival and growth
(3 growing season after planting, “normal” site)

- Height -03, cm
- Height growth -04, cm
- Survival, %

Planting method, logging residues harvesting (Yes/No)

No, Yes

EcoPlanter
Bräcke
Manual planting
Survival and growth
(3 growing season after planting, drained mire)

EcoPlanter | Yes | No | Bräcke | Yes | No | Manual planting | Yes
--- | --- | --- | --- | --- | --- | --- | ---
Survival, % | 80 | 75 | 90 | 85 | 70 | 95 | 90
Heigth -03, cm | 45 | 40 | 40 | 35 | 35 | 30 | 30
Height growth -04, cm | 50 | 55 | 60 | 65 | 70 | 60 | 70
Planting method, logging residues harvesting (Yes/No)
Survival and growth
(3 growing season after planting, stony site)
2. Mounding (spot mounding)

- Mounding methods
  - Excavator mounted
    - Ditching bucket (without soil compaction)
    - Mounding blade (Naarva)
  - Forwarder mounted mounders
    - Bräcke BD 296
    - Toimi
    - Varis

- Low and medium stony sites on mineral soil
- Logging residues (slash) removal (yes/no)
- Manual planting, 2 yrs Norway spruce, peat plug
Excavator mounted mounders

Forwarder mounted mounders

Toimi
Varis
Bräcke BD 296 (in figure)
Productivity of mounding

- Excavator mounted mounders
  - On average 22% higher productivity (310 mounds/h ($E_0$)) after slash removal with mounding blade
  - On average 40% higher productivity (500 mounds/h ($E_0$)) after slash removal with ditching bucket
  - On average 50% higher productivity with ditching bucket
  - On average 0.2-0.3 hectares per effective hour ($E_0$)

- Forwarder mounted mounders
  - Not noticeably higher work productivity after slash removal
  - On average 1.1 hectares per effective hour ($E_0$)
Quality of mounding
(planting points of the seedlings, both sites)

Mounding method, logging residues harvesting (yes/no)

- Bucket
- Blade
- Toimi
- Varis
- Bräcke BD 296

Proportion

- Mound
- Patch
- Uncultivated
Survival and growth
(3 growing season after planting, low stony site)

- Heighth -04, cm
- Height growth -05, cm
- Survival,%

Site preparation method, logging residues harvesting (Yes/No)

- Excavator, bucket
- Excavator, blade
- Toimi
- Varis
- Bräcke BD 296
Survival and growth
(3 growing season after planting, medium stony site)

Site preparation method, logging residues harvesting (Yes/No)
3. Effects of stump harvesting

- Regeneration chains
  - Mounding (bucket)+manual planting
  - Stump extraction with rake+mounding (bucket)+manual planting
  - Ecoplanter
  - Stump extraction with rake+Ecoplanter
  - Combined stump extraction and mounding+manual planting

- 2 yrs Norway spruce, peat plug

Excavator mounted stump rake with mounding blade for combined stump extraction and mounding
Time consumption

- Only stump extraction
- Combined stump extraction and mounding
- Stump extraction and separate bucket mounding

Effective hours (E₀) per hectare:

- Separate mounding time
- Mounding time
- Stump extraction time
Survival and growth
(3 growing season after planting)

Site preparation/planting method, stump extraction (Yes/No)

- Excavator, bucket+manual planting
- Ecoplanter
- Combined+ manual planting

Height growth -05, cm
Survival,%
Conclusions

- Benefits of slash and stump removal
  - Higher (0…20 %) work productivity in planting
  - Higher (0…40 %) work productivity in mounding
  - Possible to use different (more cost-effective) regeneration methods as before, for example
    - Planting machines
    - Forwarder mounted mounders
    - Combined stump extraction and mounding

- The effects of logging residues and stump removal on growth increment and survival of the seedlings has not been very strong so far