Regeneration of wet and drained forests by mounding in Latvia

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Summary
Mounding is soil scarification method suitable for problematic stand types with low soil bearing capacity, high groundwater level and fertile soils, where use of disc trencher might not be efficient. Forest site types *Myrtillosa mel., Myrtillosa turf. Mel.* are the most suitable for mounding. These stand types are characteristic for 20% of Latvia forests. The presented study summarizes results of pilot studies of reintroduction of mounding as the forest soil preparation method in Joint Stock company "Latvia State forestsò managing approximately half of forests in Latvia. Productivity studies and evaluation of quality of soil preparation was done within the scope of the study.

Introduction
Mounding is well known in Latvia but in last twenty years very rarely used soil preparation method (Buģs 1932, Katkeviļ s 1986, Mangalis 2004). Since disk trenchers started to operate in the country, application of mounding rapidly decreased. Fertile and wet forest sites with peat layer of more than 40 cm, such as *Myrtillosa* was left for natural regeneration more often as other, because it was impossible to prepare soil with disc trenchers due to low soil bearing capacity. Nowadays foresters can use improved planting material promising to reach by 20 % higher increment, better stem quality, resistance to diseases and better adaptation to climate change, and so called ñartificial regenerationò of stand coming actual again (Jansons 2008). Excavators are able to move on soft and wet soils, operators of these machines can choose discrete place to prepare soil for a single tree when prepare mounds, inverted humus layer, patch or just scarify the soil (Sutton 1993, Orlander et al. 1998, Saksa 2005).

Materials and Methods
Mounding trials were done in Eastern part of Latvia, on drained forest sites (*Myrtillosa mel., Myrtillosa turf. mel.),* in spring and autumn in the second year after clear-cut. Soil preparation were done by three different buckets: conventional excavator bucket (110 cm wide), special mounding bucket Karl Oscar (50 cm wide) and specialized bucket MPV-600 (60 cm wide, produced by LSFRI Silava and engineering company Orvi). All three devices were mounted on New Holland E165 excavator. Time studies were done during soil preparation; site characteristic parameters and work elements used for comparison of productivity were: ñweather conditionsò; ñamount of slash on fieldò; ñmoving in stand and outò; ñmoving looking for suitable place to make moundò; ñremoving of slash or overgrowth before making of moundò; ñmaking of moundò; ñcompression of moundò; òother movements with craneò; ñmon work related operationsò Number and dimensions of mounds, coverage of ground vegetation on mound and seedling surviving were evaluated in sampling plots in each stand in the next autumn after completion of time studies.

Results
Time studies and productivity
During spring the most important factor affecting productivity of mounding was skills of operator, because productivity of work increase constantly during the time studies and did not correlate with equipment used or work conditions. But in autumn there were some, but non-significant, differences between productivity of mounding and bucket used (Figure 1).

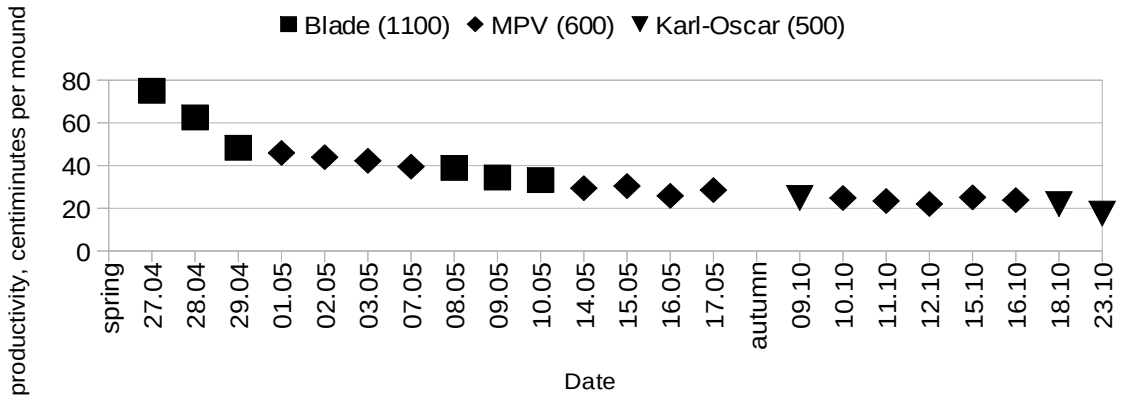

Figure 1 Growth of productivity of mounding during the trials.

Comparison of the work operations shows that proportion between them are approximately the same during the time and the most time consuming operations are crane movement and removal of slash & overgrowth (Figure 2). This result points to importance of leaving clean felling site with piled or extracted harvesting residues before soil preparation.

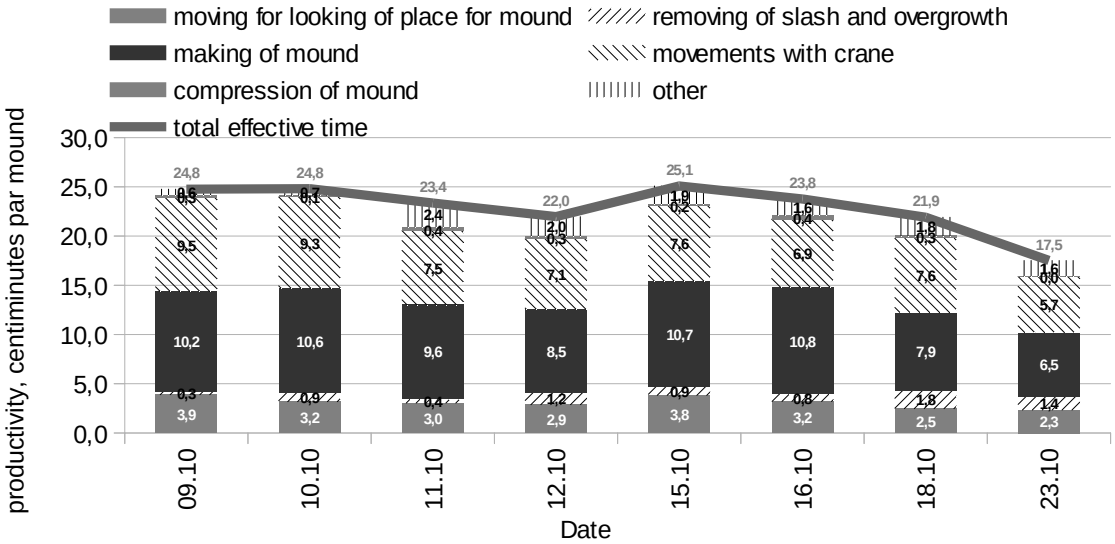

Figure 2 Distribution of effective time between work elements during mounding.

Average time spent to prepare one mound for trained operator at autumn was 22.9 centiminutes.

Ecological issues ï level of scarification and growth conditions

According to FSC certification rules it is allowed to scarify no more than 30 % of the stand area. Rules of cabinet of ministries No 308 determinate that in case of ñartificial regenerationò it is necessary to plant at least 50% of trees and final number of trees should be at least 2000 for spruce or 3000 for pine. Figure 3 shows estimated percentage of scarified area depending from required number of planting spots using different mounding devices. For spruce stands preparation of 2000 planting spots wound not exceeds the FSC thresholds for all devices, except the excavator bucket (width 1100mm) but in pine stands only the narrow Karl-Oscar bucket is suitable ï to prepare 3000 mounds per ha. Wider blade could be used only for reduced number of trees, when it is planned to plant only so called ñfuture treesò considering certain amount of natural ingrowths in the regenerated stand.

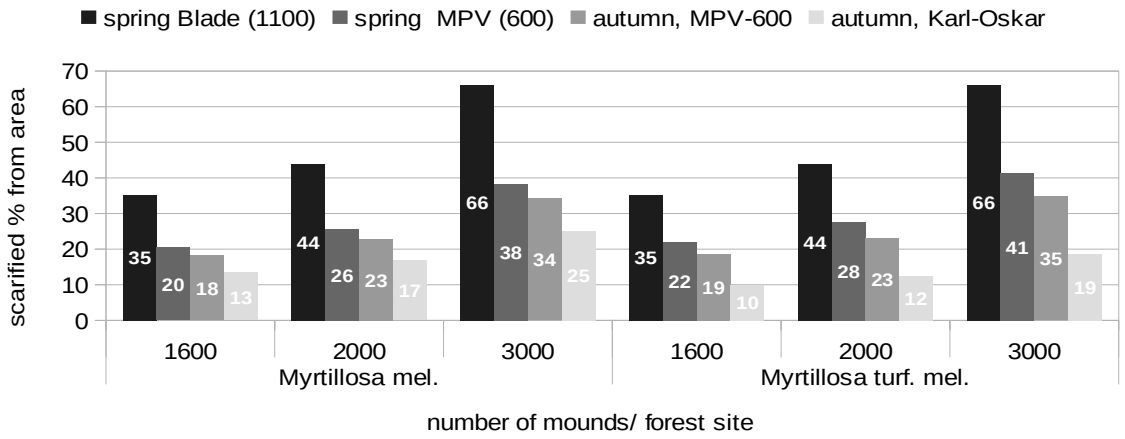

Figure 3 Estimated proportion of scarified area depending from proposed number of planting spots per ha using different buckets.

In Nordic conditions mounds are free from ground vegetation during two years, but in Latvia the situation is different, because of more fertile soils and climatic conditions, responsible for different balance between grasses, cereals and caulescent plants. In forest site type *Myrtillosa turf. mel.,* vegetation covered only 16-22% of the moundsô area after the first growing season, but in site type *Myrtillosa mel.* 39-41% of moundsôarea were covered by caulescent vegetation. Percentage of area covered by vegetation was smaller on mounds prepared by wider buckets. In cases, when ground vegetation contained *Juncus sp*. it was necessary to make weed control already in of first growing season on *Myrtillosa mel.* stands.

Conclusions

Mounding is suitable and ecologically sustainable soil preparation method in artificial forest regeneration for planting up to 2000 trees for ha. Considering soil scarification thresholds and productivity of the operation optimal number of mounds is close 1600 trees per ha. Wider buckets are recommended in fertile site types with more aggressive vegetation, where it is enough to plant target trees considering certain percentage of natural ingrowths. In *Myrtillosa mel.* site type it is necessary to do weed control already during the first growing season.

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