SMALL WOOD

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INFOSHEET

Effects of boom-corridor thinning on harvester productivity in dense small-diameter forests: a Finnish Case Study

The aim was to study the effects of boom corridor thinning (BCT) and stand conditions on a harvester equipped with accumulation felling head (AFH), cutting work time consumption, productivity, and thinning quality, in dense small-diameter stands, compared to selective thinning from below (ST).

Material and methods

The study was carried out in October 2020 in eastern Finland in Kontiolahti (Figure 1). The thinning treatments were established in two blocks, in dense, not commercially thinned stands, in a planted pine (Pinus sylvestris L.) stand and in a naturally regenerated downy birch (B. pubescens Ehrh) stand. The pine stand was planted 25 years ago but heavily damaged by moose browsing and therefore dominated by naturally regenerated small-diameter energy wood birch and spruce with very few pines were left of 80 m3/hectare wood. The birch stand with about a meter high dense spruce (Picea abies) undergrowth was 30 years old naturally regenerated ditched farmland. It was peatland containing 125 m^3 per hectare wood, 50% of pulpwood and 50% small-diameter energy wood.

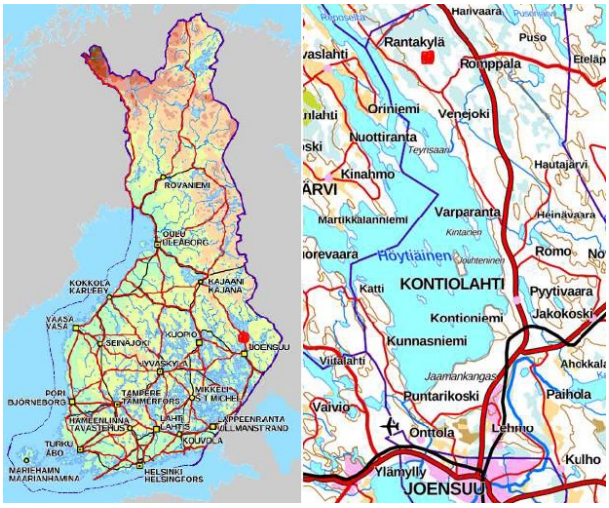

Figure 1. Location of the study site in Kontiolahti.

In total, 12 study units were established, six units for both blocks and the number of replications per BCT and ST were balanced in both blocks. Study units were 50 m long and 20 m wide. The variables of growing stock were measured pre- and post-thinning and logging damage post-thinning in two 100 m^2 transects (Figure 2).

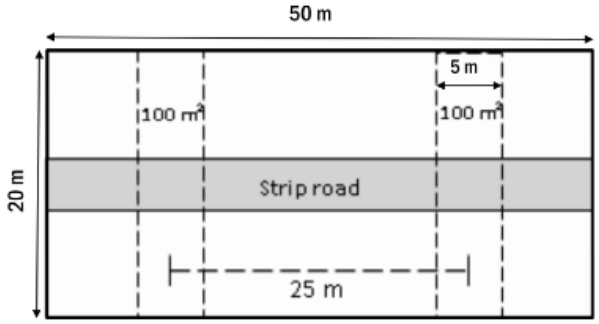

Figure 2. Study unit with 100 m^2 transects.

The base machine was a six-wheeled Valmet 901.4 harvester (Komatsu Forest AB, Sweden) manufactured in year 2008 equipped with Bracke C 16 AFH. The AFH had four-jawed gathering arms, four-jawed accumulating arms and a self-tensioning ¾" cutting chain mounted on a circular saw disc, with a maximum cutting capacity of 26 cm in diameter (Figure 3). The operator was experienced. About half of the standing volume was removed from both blocks to undelimbed energy wood. The stand structure of blocks was even and the terrain was flat throughout and easy for the harvester to move. The time-and-motion study was

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conducted by mounting inside the harvester's cabin an action camera. The recorded videos were used to conduct a continuous time study.

Figure 3. The harvesting machine in action on a test site. Photograph: Jukka Malinen.

Results and conclusions

In the birch block with the height of dominating trees of over 10 m the harvester productivity of BCT and ST was 3.5 and 3.6 dry-tonnes per PMH (productive machine hour). In this block, the reason for lower productivity of BCT was that the block contained many long trees requiring cross-cutting of the standing trees to produce the right length of tree section for effective forwarding work. Top bucking increased time consumption notably, as the Bracke C16 AFH is not featured with feed-rollers which render effective bunch bucking. In the pine block, with smaller energy trees, the AFH showed a significantly higher productivity of 5.5 dry-tonnes per PMH in BCT and respectively in ST the productivity rose to 4.7 tonnes. There was significantly less tree damage in the BCT units than in ST units.

Although the stand volume of pine block was smaller than that of birch block, the productivity level of the pine block was significantly higher compared to the birch block. Also, in the pine block, the productivity of BCT was 17% higher than that of ST. These differences can be explained by the more efficient use of the AFH:

- As the length of the trees was shorter in the pine block it was possible to process the trees without an additional cross-cutting.

- In pine block of dense and small-diameter trees, the AFH had the potential to exploit of it's continuous felling property, that is, the cut-disc could at the same time fell and accumulate groups of more trees if the trees were located close to each other, below the grasp width of the AFH.

All treatments met the recommendations of Finnish forest management. Based on the results of this study, BCT is worth of further examination and development in young dense forests. See more in the article [1].

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References:

[1] Bergström, D., Fernandez-Lacruz, R., de la Fuente, T., Höök, C., Krajnc, N., Malinen, J., ... & Nordfjell, T. (2022). Effects of boom-corridor thinning on harvester productivity and residual stand structure. *International Journal of Forest Engineering*, 1-17. https://doi.org/10.1080/14942119.2022.2058258

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