

Bracke C16c productivity studies in small tree thinnings

This infosheet summarizes the results from productivity studies in Sweden, Finland and Slovenia on an upgraded Bracke C16c accumulating felling head mounted on a Komatsu 901.4 harvester base machine. Two work methods, boom corridor thinning and standard selective thinning was compared in dense small diameter stands regarding productivity of felling and bunching of whole trees and quality on the remaining stand

Background

Tree biomass is an important resource in the transition from a fossil-based economy to a bioeconomy within the European Union (EU). In 2010, even-aged forests up to 40 years old covered ~36 million ha across Europe, which will generate an increased need for thinning work.

Selective thinning from below (ST) is the most common thinning method used in Europe. With ST, usually the subdominant, suppressed and low-quality trees with poor growth potential are removed (Fig. 1).

In conventional pulpwood thinning only trees with a diameter at breast height above ~8–10 cm are removed. Trees smaller than that are regarded as unmerchantable. However, if whole (un-delimbed) small trees are harvested, biomass removal can be increased at least two-fold. This biomass can be used for bioenergy and/or bio-refining purposes.

Boom-corridor thinning (BCT) is a novel working method in which trees are cut with linear movements of the harvester's boom reach, along narrow (1–2 m wide) corridors, instead of cutting each tree selectively

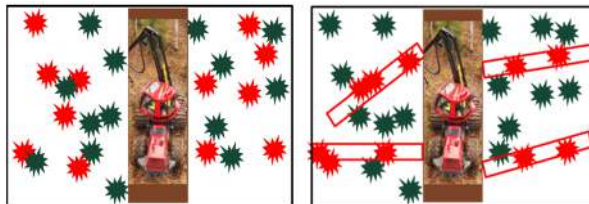


Figure 1. Selective thinning (left) and boom corridor thinning work methods (right).

The aim was to study the effects of BCT and stand conditions on harvester productivity and thinning quality in dense small-diameter stands in comparison to ST.

Materials and methods

Field trials were carried out between autumn 2019 and spring 2020, in Sweden, Finland and Slovenia. The same harvester, Bracke C16c accumulating felling head and operator were used throughout trials. At each site:

- Dense, non-commercially thinned, small-diameter forest stands were selected, and time-study units were marked out and inventoried.
- Time-and-motion studies of the thinning harvester during ST and BCT were carried out.
- Cut biomass was either scaled or calculated using biomass functions.
- Remaining stand properties and thinning quality were inventoried.

Results

On average, no differences was found in quality on the remaining stands between BCT and ST. The thinning ratio, i.e. the quota of diameter of the harvested and remaining trees averaged 0.7, while removal of the basal area averaged 56%. The strip-road width averaged 4.8 m and the share of strip-road area of the total harvested area averaged 24% (Fig. 2).

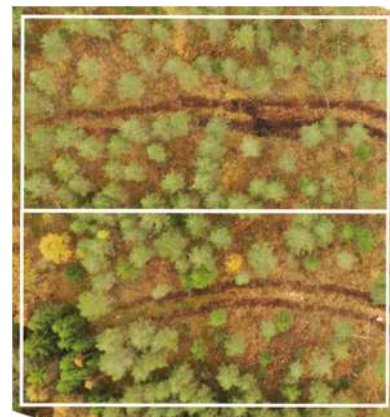


Figure 2. Plot with BCT (above) and ST (below)

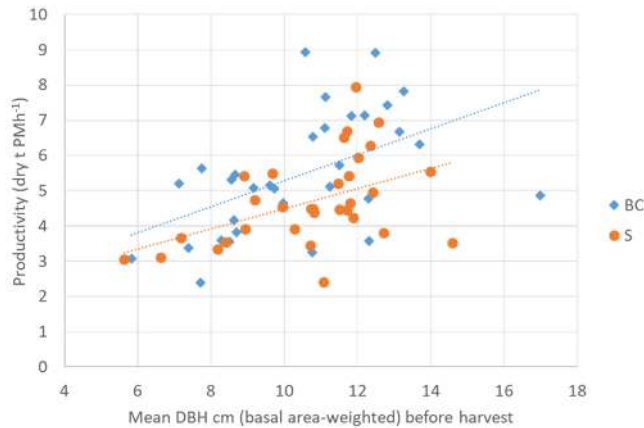


Figure 3. Harvesting productivity as function of mean diameter of trees before thinning. BC = BCT, S = ST

The total time consumption per tree was on average 28% less for BCT. The number of cut trees per crane cycle was on average 33% higher for BCT. The harvest productivity in BCT averaged 5.4 dry ton biomass per productive machine hour (about 11 m³ solid biomass per hour) and yielded on average 16% higher productivity than ST. (Fig. 3).

Thinning in small diameter dense stands results in rather large volumes. In most cases 30-60 dry tons of biomass per ha was harvested (about 60-120 m³ solid biomass per ha) (Fig. 4).

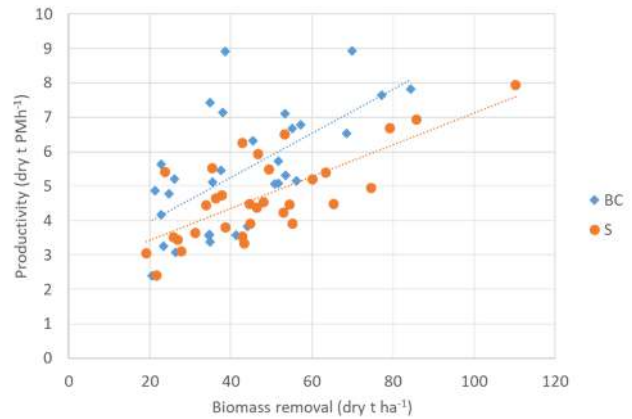


Figure 4. Harvesting productivity as function of biomass removal in thinning. BC = BCT, S = ST

Discussion and conclusions

Felling and bunching work with the Bracke C16 head in combination with BCT show great potential to make utilization of whole tree biomass from dense small diameter stands feasible. If BCT is applied with high selectivity, as in our trials, the remaining stand quality is high. With increase marked demand for woody biomass we can expect that BCT will become a common forest practice in EU in the near future.

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References:

- [1] Bergström, D., Fernandez-Lacruz, R., Fuente, T., Höök, C., Krajnc, N., Malinen, J., Nuutinen, Y., Triplat, M. & Nordfjell, T. 2022. Effects of boom-corridor thinning on harvester productivity and residual stand structure, International Journal of Forest Engineering, DOI: 10.1080/14942119.2022.2058258



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