SHORT AND LONG-TERM EFFECTS OF WHOLE-TREE THINNING ON FOREST GROWTH

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Introduction

The use of logging residues for bioenergy is encouraged in many countries, due to an increasing demand for renewable energy. However, as needles and branches are nutrient rich, this whole-tree harvesting (WTH) increases the export of nutrients from the site. There is concern that removal of logging residues may cause a long-term reduction in soil nutrient availability, reducing forest growth in the remaining stand. Some studies have shown growth reduction after WTH [1, 2, 3], while others have not found significant effects on growth [4, 5]. The response seems to be variable, and site- as well as species-specific. There is a need for short and long-term growth results to assess the sustainability of intensive biomass harvesting and to understand the processes involved. The objective of this study was to quantify the growth response of Norway spruce (*Picea abies*) and Scots pine (*Pinus silvestris*) to whole-three harvesting at first thinning.

Method

In 1972-1977 a series of eight field experiments was set up in young Norway spruce and Scots pine sites in SE Norway. In the stands, thinning plots using both conventional (CH) and whole-tree harvesting were established, with five replicates of each treatment. The pine and spruce stands were thinned to 800 and 1 100 trees ha^{-1}, respectively. The amount of dry matter and nutrients removed in the thinning was computed, and tree growth was measured each 5th year. In addition, growth was measured every year the first 5 years in the spruce stands. Total study period with all plots intact was 25 years for spruce and 20 years for pine stands. Growth increment was analyzed separately for spruce and pine, using analyses of variance to compare the two treatments.

Results and discussion

For spruce, WTH lead to a decrease in forest growth. The effect was present more or less immediately after thinning, and was still present after 25 years. The average reduction in growth was around 10 % compared to CH after 25 years, if adjusted for initial differences in standing volume. The difference was statistically significant. After 20 years there was a non-significant average growth reduction in the pine stands of 4 %, adjusted for initial differences in standing volume.

The results show that growth reduction in spruce stands after WTH may take place straight after harvesting, and is present at least 25 years after thinning. As decomposition of logging residues takes some years to initialize, we suggest that other factors than differences in nutrient availability must have caused the immediate effect. The effect in pine stands was smaller. Also [6] and [3] found a more explicit growth reduction after WTH in spruce compared to pine stands. When transferring the results to practical silvicultural measures, one should consider that the results are generated under experimental conditions. In practice, a share of the residues is left on site during harvesting, decreasing nutrient loss compared to a total removal of branches and tops.

References

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