Commercial thinning as a mean to increase diurnal C uptake for jack pine and black spruce in eastern boreal forest

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Context

Jack pine and black spruce are two important commercial species. They were shown to respond to thinning by increasing their biomass (Robinson et al., 2001). However, little is known about the ecophysiological processes underlying this response because a net increase in photosynthesis following canopy opening may result from an increase in resources availability, a greater photosynthetic efficiency, an aptitude to capture a greater amount of available resources or different carbon allocation patterns (Binkley et al., 2004). The aim of this study was to determine to what extent ecophysiological processes of closed-crown jack pine and black spruce stands are affected by canopy opening following commercial thinning.

Material and Methods

Photosynthesis was measured in the summer 2004 and 2005. Experiments were conducted with a factorial experimental design with 3-treatments replicated twice and representing 3 levels of canopy opening: heavy, moderate and control. Field measurements were made two growing seasons after thinning with a portable infrared gas analyser Li-cor 6400 on current-year and one-year-old needles with three such measurements per tree and two trees per experimental plot. Instantaneous photosynthesis was measured every two hours, before the onset, through all the day and after the sunset when the amount of light was approaching or becoming zero. Photosynthesis light response were conducted the time of the day when the photosynthesis is highest, between 9:00 and 12:00 am.

Results

Either it was removed 0%, 50% and 60% of the stems in the control, moderate and heavy thinning, maximum photosynthesis ($A_{\text{max}}$), photosynthesis light compensation point (LCP), apparent quantum yield (AQY) and diurnal respiration ($R_d$) remained unaffected for jack pine. Similarly, $A_{\text{max}}$, AQY and $R_d$ did not vary for black spruce while LCP was lower for black spruce in eastern boreal forest.

Discussion

While it is a generally assumed that forest canopy opening reduces competition for light, soil nutrients and water and hence could increase photosynthetic efficiencies, our research conducted on mature jack pine trees growing in stands subjected to heavy and moderate canopy opening did not show such evidence two years after treatment application. Photosynthetic efficiency remained relatively unaffected despite the more favourable light environment due to canopy opening in the heavy treatment. These results are consistent to those of Sullivan et al. (1997) who made the same observations for needles located in the lower part of the canopy.

It was evidenced that light had the most environmental impact on tree functioning after thinning. Needles were exposed to light for longer periods when canopy was more open.

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