Ericaceous shrubs and black spruce growth check on boreal sites: is there a competitive interaction affecting nutrition and physiology?

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Following clear-cutting or fire regeneration of boreal conifer stands may be checked by the presence of invasive ericaceous shrubs such as Kalmia angustifolia. Foliage chlorosis observed on black spruce (Picea mariana) seedlings indicated that Kalmia may in fact be causing a nutritional imbalance to conifer seedlings. Studies have suggested that Kalmia's extensive root system allelopathic compounds and recalcitrant tannin-rich litter may be factors that increase its competitive ability to acquire soil resources relative to spruce seedlings. Globally these studies have consisted mainly of laboratory experiments or observational field studies and many of them outlined the need for more experimental field research. In the absence of manipulative field experiments it remains unclear whether the association between poor spruce growth and an abundant cover of Kalmia is causal or spurious: does the presence of Kalmia cause the poor regeneration of black spruce or is Kalmia simply adapted to grow in poor quality soils that also retard spruce growth? We report on a six-year study conducted on a Kalmia-dominated site where we tested the effects of two experimental factors – (1) the presence/removal of Kalmia and (2) nitrogen fertilizer amendments – on soil chemical and biochemical properties and on the growth and physiological status of black spruce seedlings. As we expected both Kalmia removal and fertilization enhanced growth and nutritional status of seedlings confirming the competitive effect of Kalmia on black spruce nutrition. Moreover shrub removal increased litter nitrogen mineralization indicating a shift in soil biochemical process after removal of Kalmia. Soil microbial activity was greater in plots with Kalmia perhaps as a result of Kalmia's more extensive root system. Photosynthetic nitrogen-use efficiency of seedlings growing with Kalmia was higher indicating that black spruce physiology acclimates to competition with Kalmia. Long term water-use efficiency (delta13C) measurements showed that seedlings growing without Kalmia were less water-stressed.