

Evaluation of a mature lodgepole pine stand's resistance to the current mountain pine beetle infestation after nitrogen fertilization

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Abstract

Research is currently under way in the Southern Interior Forest Region to determine whether nitrogen fertilization can be used to increase mature lodgepole pine trees' natural defences against the mountain pine beetle (MPB) and thereby reduce the impact of the MPB infestation in pine stands. In fall 2006, three nitrogen fertilizer treatments (0, 200, and 400 kg N/ha) were applied randomly to each of 10 plots in a 140-year-old fire-regenerated stand of mixed lodgepole pine, spruce, and true fir. In 2007, the stand was inoculated with two isolates of blue stain fungus and with local beetle microflora. A forest health survey helped determine the level of MPB within the stand before the plot centres were baited with pheromones. Early results show that the 400 kg N/ha treatment significantly increased nitrogen levels in pine phloem and needles. No significant differences were apparent in lesion length related to nitrogen treatment levels within each of the three fungal isolates. Measurements in 2008 will show whether MPB attack success varies among nitrogen treatments.

KEYWORDS: *lodgepole pine, mountain pine beetle, nitrogen fertilization, Southern Interior Forest Region.*

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Introduction

Research is currently under way in the Southern Interior Forest Region to determine whether nitrogen fertilization can be used to increase mature lodgepole pine trees' natural defences against the mountain pine beetle (MPB) and thereby reduce the impact of the MPB infestation in these stands. Numerous studies have shown that nitrogen is the most limiting nutrient in lodgepole pine forests in the interior of British Columbia.

Methods

The stand is a mixture of lodgepole pine, spruce, and true fir that regenerated 140 years ago after fire. In the summer of 2006, thirty 40 × 40 m plots were established (Figure 1). In fall 2006, three nitrogen fertilizer treatments were applied randomly on 10 plots each: control (0 kg N/ha), 200 kg N/ha, and 400 kg N/ha. In summer 2007, fungal inoculations were performed to evaluate the effect of fertilizer treatments on the response of trees against two isolates of the blue stain fungus *Grosmannia clavigera* and on local beetle microflora. The level of MPB within the stand was established with a spring 2007 forest health survey.

This project is assessing whether nitrogen fertilization can be used to increase mature lodgepole pine trees' natural defences against the mountain pine beetle and thereby reduce the impact of the infestation in these stands.

Before the flight of MPB in 2007, trees closest to the plot centres were baited with pheromones. In fall 2007, the lodgepole pine trees were surveyed for current year MPB activity.

Results

Compared to the control and 200 kg N/ha treatments, the 400 kg N/ha treatment resulted in a significant increase in the percent nitrogen content of the phloem (Figure 2). The percent nitrogen content of the needles was significantly different for all three treatments (Figure 3).

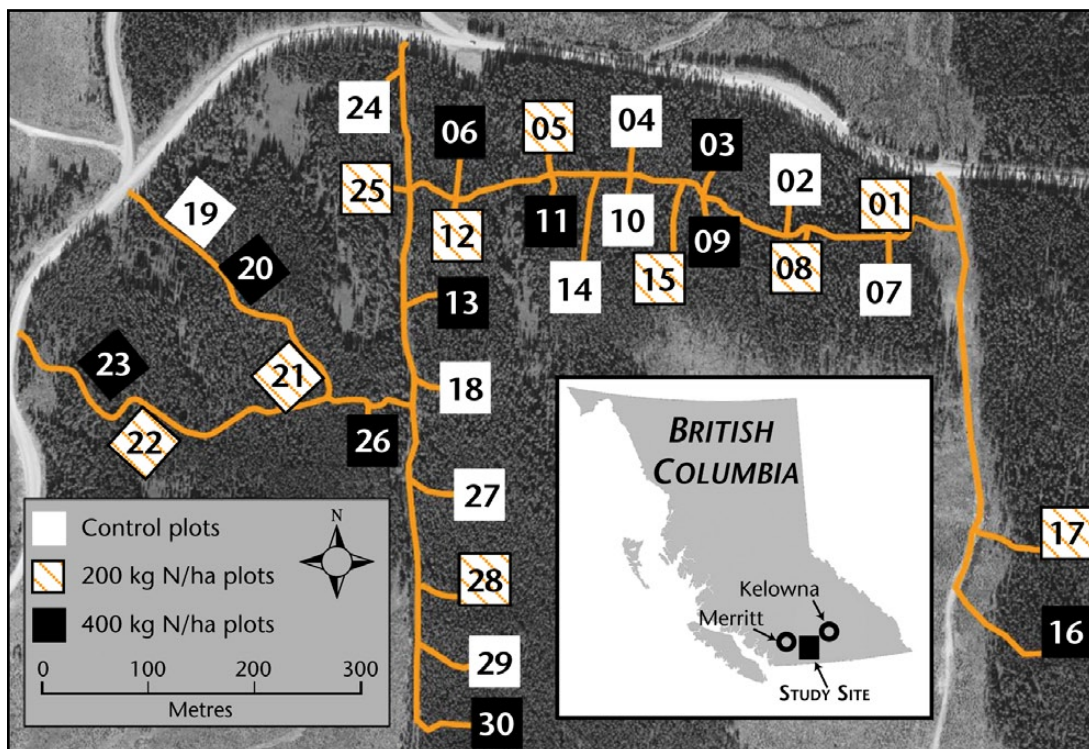


FIGURE 1. Map showing site location, the location of the plots, and the randomly assigned treatments.

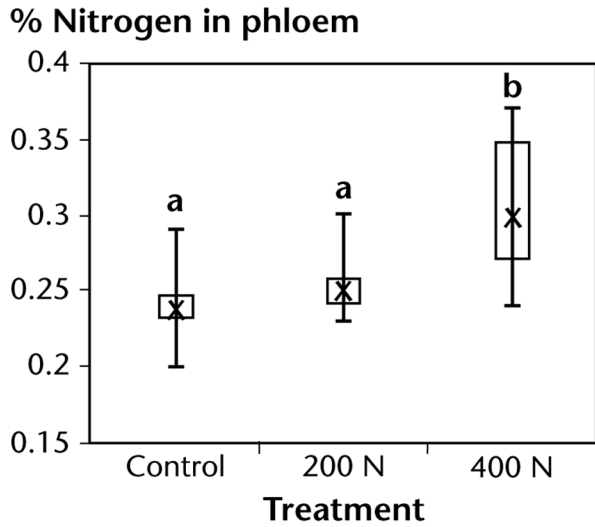


FIGURE 2. Box plot showing the percent nitrogen content of phloem from two trees per plot for 15 plots (collected August 22, 2007); 400 kg N/ha plots were significantly higher nitrogen than control and 200 Kg N/ha plots.

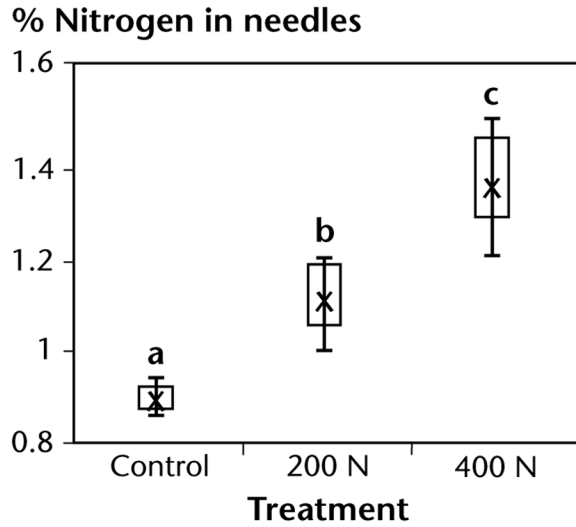


FIGURE 3. Box plot showing the percent nitrogen content of needles from two trees per plot for 15 plots (collected November 3, 2007). All three treatments are significantly different.

The resulting lesion lengths between the fungi isolates (ATCC18086, KW1407, and MPB-squashed) were significantly different (Figure 4); however, differences between nitrogen treatments were not significant within each isolate (Figure 4). Only the ATCC18086 showed a significant aspect difference in lesion lengths (Figure 5).

Some level of MPB activity is currently evident on 36% of the lodgepole pine and it is equally distributed across treatments.

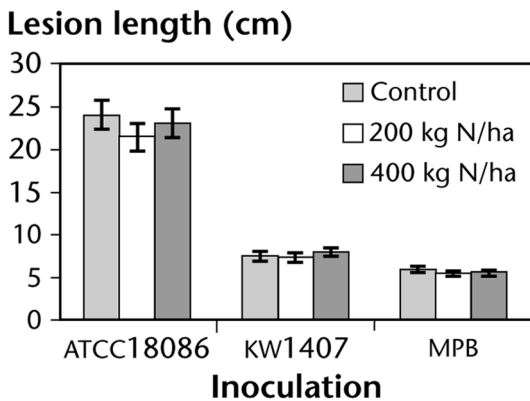


FIGURE 4. Difference between fungi isolates was significant. Difference between treatments was not significant within each isolate.

Conclusions/Future Work

- The nitrogen fertilizer applied in September 2006 resulted in increased nitrogen concentrations in the lodgepole pine phloem and needles.
- No significant differences were evident in lesion length related to nitrogen treatment levels within each of the three isolates.
- The 2008 measurements will show whether MPB attack success varies among nitrogen treatments.

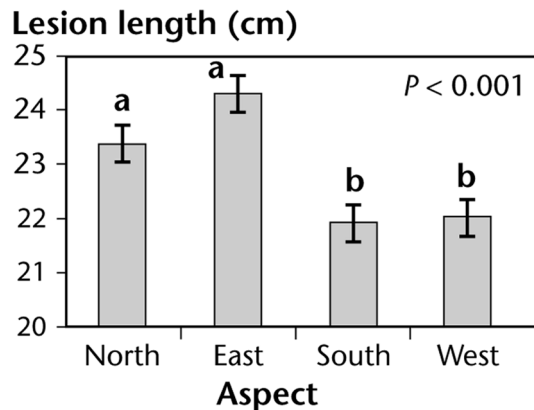


FIGURE 5. ATCC18086 lesion lengths on the north and east aspects were significantly greater than the south and west sides of the tree; no significant aspect relationships were found with KW1407 or MPB-squashed.

In the spring of 2008, an overwintering MPB success survey will determine the effects of the first-year results of fertilization on MPB development. The defence characteristic across treatments will be followed up, including further investigation of the physiological changes in response to fertilizer treatments.

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