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Fertilized lodgepole pine trees have lower root starch reserves

GOODSMAN, D.W., LIEFFERS, V.J., LANDHÄUSSER, S.M., AND N. ERBILGIN

There has been considerable interest in identifying the factors that might make trees more resistant to insect attack such as from mountain pine beetle (MPB). It has been suggested that better defended trees have higher concentrations of storage carbohydrates such as starch that could be used for the production of defensive chemicals to protect the tree from insect attack. Silvicultural treatments such as fertilization and thinning have been suggested to be beneficial in creating physiological conditions that might make trees resistant as a result of higher carbohydrate reserves.

Methods: We collected root samples from four lodgepole pine trees in each of 40 plots that were given different combinations of fertilization and thinning. We measured several tree features including size, height to live crown and vigor index (basal area increment/sapwood area).

Results: Root starch concentrations were generally lower in fertilized trees but were largely unaffected by thinning.

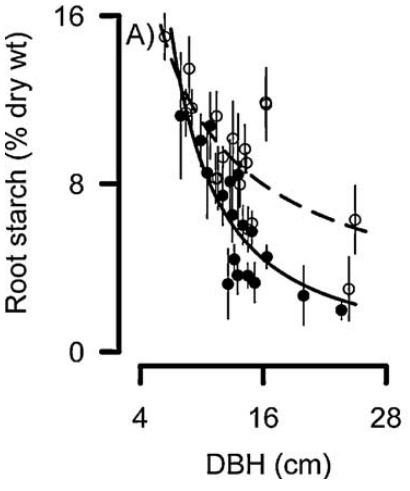

Fig. 1. Root starch concentrations of fertilized (filled circles) and unfertilized (open circles) lodgepole pine trees in relation diameter at breast height

Good predictors of root starch concentration were tree DBH and height to live crown. Large trees and trees with a short live crown had the lowest levels of root starch.

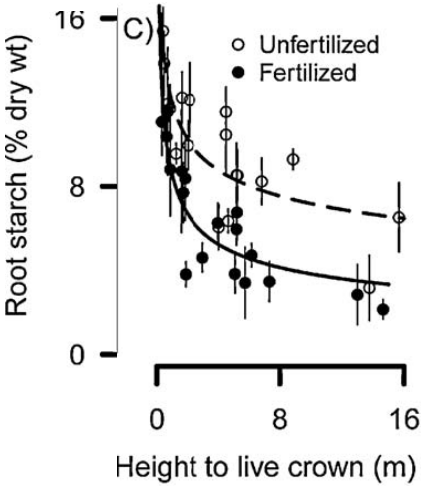

Fig. 2. Rot starch concentration of un-fertilized and fertilized lodgepole pine trees in relation height to live crown

Vigor index, a commonly used indicator to quantify tree resistance, was a poor predictor of root starch concentration.

Implications: It is likely that fertilized trees are allocating more reserves to growth instead of defence. Thinning had no effect on root carbohydrate reserves. Large trees and particularly those with short live crowns had lower levels of root carbohydrates – and presumably a lower ability to defend. Tree growth rates commonly used in calculation of indices such as growth efficiency and vigor index were poor predictors of starch reserves and are unlikely to be consistent predictors of resistance.

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Further Information:

Goodsman, D.W., Lieffers, V.J., Landhäusser S.M. and Erbilgin, N. 2010. Fertilization of lodgepole pine trees increased diameter growth but reduced root carbohydrate concentrations. For. Ecol. Manage. 260: 1914-1920.

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Centre for Enhanced Forest Management, Dept. of Renewable Resources, U. of A., Edmonton, AB T6G 2H1

Erbilgin@ualberta.ca; Simon.Landhausser@ualberta.ca