

Impact of Insect-Feeding and Fire-Heating Wounding on Wood Properties of Lodgepole Pine

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Abstract : Mountain pine beetle (MPB) outbreaks are currently devastating lodgepole pine forests in western North America, which are also widely disturbed by frequent wildfires. Both MPB and fire can leave scars on lodgepole pine trees, thereby diminishing their commercial value and possibly compromising their utilization in solid wood products. In order to fully exploit the affected resource, it is crucial to understand how wounding from these two disturbance agents impact wood properties. Moreover, previous research on lodgepole pine has focused solely on sound wood and stained wood resulting from the MPB-transmitted blue fungi. By means of a quantitative multi-proxy approach, we tested the hypotheses that (i) wounding (of either MPB or fire origin) caused significant changes in wood properties of lodgepole pine and that (ii) MPB-induced wound effects could differ from those induced by fire in type and magnitude. Pith-to-bark strips were extracted from 30 MPB scars and 30 fire scars. Strips were cut immediately adjacent to the wound margin and encompassed 12 rings from normal wood formed prior to wounding and 12 rings from wound wood formed after wounding. Wood properties evaluated within this 24-year window included ring width, relative wood density, cellulose crystallinity, fibre dimensions, and carbon and nitrogen concentrations. Methods used to measure these proxies at a (sub-)annual resolution included X-ray densitometry, X-ray diffraction, fibre quality analysis, and elemental analysis. Results showed a substantial growth release in wound wood compared to normal wood, as both earlywood and latewood width increased over a decade following wounding. Wound wood was also shown to have a significantly different latewood density than normal wood 4 years after wounding. Latewood density decreased in MPB scars while the opposite was true in fire scars. By contrast, earlywood density was presented only minor variations following wounding. Cellulose crystallinity decreased in wound wood compared to normal wood, being especially diminished in MPB scars the first year after wounding. Fibre dimensions also decreased following wounding. However, carbon and nitrogen concentrations did not substantially differ between wound wood and normal wood. Nevertheless, insect-feeding and fire-heating wounding were shown to significantly alter most wood properties of lodgepole pine, as demonstrated by the existence of several morphological anomalies in wound wood. MPB and fire generally elicited similar anomalies, with the major exception of latewood density. In addition to providing quantitative criteria for differentiating between biotic (MPB) and abiotic (fire) disturbances, this study provides the wood industry with fundamental information on the physiological response of lodgepole pine to wounding in order to evaluate the utilization of scarred trees in solid wood products.

Keywords : elemental analysis, fibre quality analysis, lodgepole pine, wood properties, wounding, X-ray densitometry, X-ray diffraction

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