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102. © Early growth responses of lodgepole pine and Douglas-fir to soil compaction, organic matter removal, and rehabilitation treatments in southeastern British Columbia. Tan, X., Curran, M., Chang, S., and Maynard, D. Forest Science 55(3):210-220. 2009.

Early Growth Responses of Lodgepole Pine and Douglas-Fir to Soil Compaction, Organic Matter Removal, and Rehabilitation Treatments in Southeastern British Columbia

Xiao Tan, Michael Curran, Scott Chang, and Douglas Maynard

Abstract: Effects of soil compaction, organic matter removal, and rehabilitation on lodgepole pine (*Pinus contorta* Dougl. ex. Loud.) and Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) were studied after three growing seasons in a long-term soil productivity study established on three calcareous soils in southeastern British Columbia. Effects of soil compaction and organic matter removal on tree growth were site and species specific. Moderate soil compaction increased the diameter and height increment of both species within the stem-only harvest treatment on all three sites, particularly at the coarser textured site (Emily Creek). Compaction tended to reduce tree mortality. Growth of both species was reduced by forest floor removal in the noncompacted soil at Mud Creek and Emily Creek and by whole-tree harvest in the moderately compacted soil at Mud Creek and Kootenay East, possibly due to treatment-induced water limitation. Whole-tree harvest and forest floor removal stimulated lodgepole pine and Douglas-fir growth in the noncompacted soil at Kootenay East. The rehabilitation treatment (established by tilling a heavily compacted soil) reduced lodgepole pine tree mortality on all sites and increased rootcollar diameter and height increment at Mud Creek and Kootenay East. Our findings may provide early growth indication and help assess long-term tree growth trends at these and other long-term soil productivity or related sites. FOR. SCI. 55(3):210–220.

Keywords: calcareous soil, tree growth, long-term soil productivity, Interior Douglas-fir Biogeoclimatic Zone, soil disturbance

FOREST MANAGEMENT PRACTICES such as harvesting and aggressive mechanical site preparation may cause soil and site disturbances such as compaction from the use of heavy forestry equipment and exposure of mineral soil by forest floor removal or displacement. The amount of organic matter removed off site through log harvesting depends on the disturbance intensity (e.g., removing trees, piling and burning slash, scalping forest floor, and mixing organic materials with mineral soil). The degree of soil compaction depends on the type of equipment used, number of passes, and site conditions such as soil texture, water content, and temperature (Greacen and Sands 1980, Kozlowski 1999). Soil compaction and organic matter removal are considered to be the two most important site disturbances caused by forest management practices and have been hypothesized to have the potential to reduce forest productivity (Powers et al. 1990). To address those issues a coordinated network of long-term soil productivity (LTSP) studies was initiated to determine how soil compaction and organic matter removal affect fundamental soil processes controlling forest productivity and to compare responses among major forest types and soil groups in North America (Powers et al. 1990). Fourteen LTSP sites have been established in British Columbia (BC) to provide data for five common forest and soil types in the province. The broad objective of the LTSP program is to establish experiments that will produce meaningful results to help forest managers make management decisions (Holcomb 1996).

Results from the first 10 years of tree growth at several of the LTSP sites have been reported (Powers et al. 2005, Sanchez et al. 2006). Effects of soil compaction on forest productivity depended on soil texture, the presence or absence of understory vegetation, and tree species. In general, soil compaction tended to reduce tree growth on clayey soils but to increase tree growth on sandy soils (Gomez et al. 2002a). Severe compaction may not affect tree growth when understory vegetation competition for site resources (e.g., water and nutrients) is removed (Sanchez et al. 2006). Responses to soil compaction and organic matter removal can differ among tree species because of differences in rooting habit, tolerance to increased soil strength, and water stress (Kozlowski 1999, Fleming et al. 2006, Hope 2007). For example, lodgepole pine growth was increased, whereas that of hybrid spruce was unaffected by organic matter removal over a period of 10 years in interior BC (Hope 2007).

It is possible that results of LTSP and related studies may change as longer-term data and/or data from more sites with

Xiao Tan, Albian Sands Energy Inc.—Xiao.Tan@albiansands.ca. Michael P. Curran, British Columbia Forest Service, Forest Sciences, 1907 Ridgewood Road, Nelson, BC V1L 6K1, Canada—Phone: (250) 825-1118; Fax: (250) 825-9657; mike.curran@gov.bc.ca. Scott Chang, University of Alberta—scott.chang@afhe.ualberta.ca. Douglas Maynard, Canadian Forest Service—dmaynard@pfc.cfs.nrcan.gc.ca.

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