

FOREST PRODUCTIVITY RESPONSES TO LOGGING DEBRIS AND COMPETING VEGETATION: EFFECTS OF ANNUAL PRECIPITATION AND SOIL TEXTURE

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ABSTRACT

Logging debris and competing vegetation are being manipulated at two sites to determine their potential influences on selected soil factors and productivity of planted Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*). The sites, located at Matlock WA and Molalla OR, were selected to differ in annual precipitation and soil texture. As part of the field tour for the Forest Productivity Conference, participants visited the Matlock site to observe the various treatments and vegetation responses in the first year since study initiation.

KEYWORDS: Long-term site productivity, soil properties, microclimate, plantations.

STUDY OBJECTIVES AND TREATMENTS

In 1998, the Fall River long-term site productivity (LTSP) study was initiated to examine effects of logging debris removal, competing vegetation control, fertilization, compaction, and tillage on soil characteristics and Douglas-fir growth (Terry et al. 2001). The study is affiliated with the national network of Long-Term Soil Productivity studies (Powers et al. 1990). In 2002, the Agenda 2020 program, members of forest industry, and the USDA Forest Service, PNW Research Station provided financial support to initiate an expansion of the Fall River research. The new research was designed to quantify potential effects of annual precipitation and soil texture on Douglas-fir responses to logging debris manipulation and competing vegetation removal. Six treatments have been replicated at two sites: Matlock WA (Olympic Peninsula) and Molalla OR (Western Cascades). The sites differ from Fall River and from each other in soil texture, precipitation, and temperature (fig. 1). Each site is an independent study.

The research will quantify stand establishment, early (1 to 5 years) and longer-term (5 to 20 years) growth of planted Douglas-fir, and long-term site productivity. A variety of pre-treatment and first-year measurements have been taken at each site, including soil nutrient content, bulk density, *in situ* net nitrogen mineralization and needle decomposition rates, logging debris mass and soil disturbance intensity, competing vegetation abundance, microclimate (air and soil temperatures and soil water content), and Douglas-fir initial size. The specific research objectives are to determine:

1. effects of logging debris abundance (retained vs. removed) and spatial distribution (dispersed vs. piled) and competing vegetation (presence vs. absence) on selected soil factors.
2. influence of soil responses on early growth and nutrition of Douglas-fir seedlings.
3. whether soil and Douglas-fir responses vary between sites differing in annual precipitation and soil texture.

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The following experimental treatments have been replicated four times at each site in a randomized complete block design:

Competing Logging debris treatment	vegetation	
control		
1. <u>Stem-only harvest</u> : removal of merchantable logs only (i.e., retention of logging debris)	Absent	Present
2. <u>Stem-only harvest + piling</u> : removal of merchantable logs plus moving of tops and limbs into piles (i.e., retention and piling of logging debris).	Absent	Present
3. <u>Whole-tree harvest</u> : removal of merchantable logs plus tops and limbs (i.e., removal of logging debris)	Absent	Present

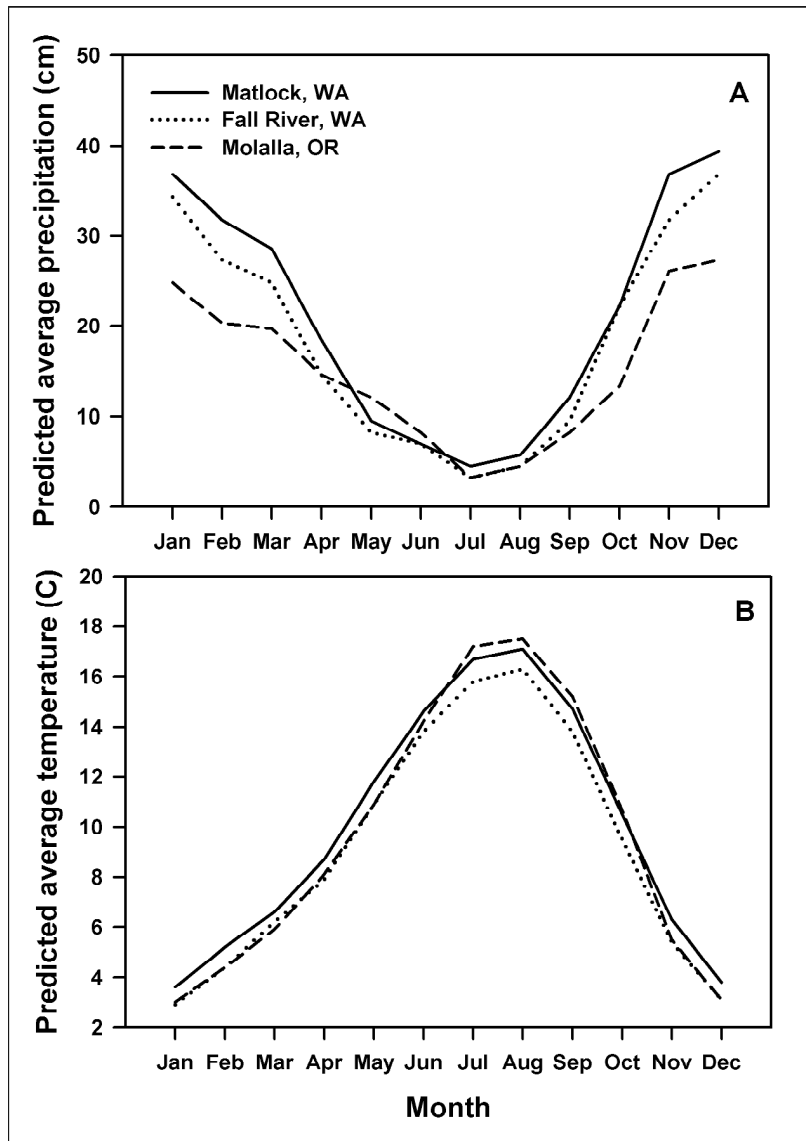


Figure 1—Predicted average monthly values for (a) precipitation and (b) air temperature at three forest productivity study sites in Washington and Oregon. Values were predicted from the PRISM model (Spatial Climate Analysis Service 2005).

CURRENT FINDINGS

In the first 3 or 4 months after treatment, mass of logging debris varied nearly two-fold between the stem-only (20.5 to 20.7 Mg ha⁻¹) and whole-tree (10.9 to 12.3 Mg ha⁻¹) harvesting treatments at each site. In August 2004, first-year cover of competing vegetation differed between herbicide-treated and non-treated plots at Matlock (12% vs. 20%, respectively) but not at Molalla (61% vs. 59%, respectively) where trailing blackberry (*Rubus ursinus* Cham. & Schlecht.) became dominant. The logging debris treatments had no detectable effect on abundance of competing vegetation at either site. Additional herbicide treatments are planned to achieve vegetation-free conditions on 80% or more of the area within treated plots. Although first-year measurements of the planted Douglas-fir have not yet been completed, field observations indicate that survival will be more than adequate for long-term monitoring of forest productivity.

FUTURE DIRECTION

In 2004, additional funding was received from the Agenda 2020 program to begin a new phase of research at Matlock and Molalla. Abundance of logging debris will be varied systematically to quantify the level at which it causes potential effects such as increased soil water conservation and thermal insulation, and shifting roles as a nitrogen source vs. a nitrogen sink. Logging debris will be applied to create 0, 40, or 80% covers ($\pm 10\%$) in 2- x 2-m areas around individual Douglas-fir growing either with or without competing vegetation. This new phase of research will identify some of the mechanisms by which logging debris and competing vegetation influence Douglas-fir productivity. In combination with the Fall River study, the research will contribute to a regional database that will enable forest managers to make more effective silvicultural prescriptions for maintaining or enhancing productivity of Douglas-fir plantations.

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