AN ABSTRACT OF THE THESIS OF

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Abstract approved:

Robert W. Rose, Jr.

The overall purpose of this study was to examine the root and shoot development of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) seedlings at two distinct time periods in seedling establishment (after 1 and 3 growing seasons) in response to fertilizer, stock size, vegetation control, and soil moisture treatments. Two separate experiments were implemented to observe seedling development after one growing season, which is the first experiment known as "FIELD", and after three growing seasons, which is the last experiment known as "CONTROL". In the first experiment, "FIELD", a sub-sample of three trees was excavated at the end of the third field growing season to measure shoot and root development in response to 12 treatment combinations of two stock sizes (large or small), two vegetation control treatments (2 years and 3 years), and three fertilizer treatments (none, 1 year, 2 years). Planting larger seedlings and increasing the intensity of vegetation control significantly increased shoot and root development, but had no influence on shoot to root ratios. Seedling response to the fertilizer treatments showed no significant differences in any growth characteristic between any of the treatments, including the non-fertilized by

year three. This lack of response to the fertilizer treatments initiated the development of the second experiment, "CONTROL", which examines first year root and shoot growth responses to three soil moisture regimes (no drought, 1½ months drought, and 2½ months drought) and four fertilizer rates (0, 20, 50, 70 grams). The no drought moisture regime caused increased growth rates in both shoots and roots, but the rate at which roots developed exceeded that of shoot development, resulting in a lower shoot to root ratio for the no drought moisture treatment. A convex, quadratic relationship was observed between increasing fertilizer rates and the growth responses of the shoot and roots, where the greatest growth occurred at the 20 gram treatment. Unlike the moisture response, shoot growth exceed that of root growth, resulting in significantly higher shoot to root ratios under fertilization, regardless of rate. Increased osmotic potential with the addition of fertilizer salts may have reduced water content in the root types, resulting in a salt injury effect on root development. These salt injury effects on the root system, which can be seen by the significantly smaller root length and fine root percentage in comparison to the non-fertilized seedlings, may have caused the increase in shoot to root ratios under fertilized conditions. The results from both of these experiments indicate that the lack of fertilizer response in year three is the product of the imbalance in shoot to root ratios created early on by the salt injury effects of fertilizer applications.