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Twenty-Year Response of Ponderosa Pine (*Pinus ponderosa* Laws.) to Treatment with Hexazinone in Northeastern Oregon

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ABSTRACT

Chemical control of competing vegetation with hexazinone is a common and effective silvicultural treatment for ensuring ponderosa pine (*Pinus ponderosa* Laws.) plantation success on dry sites in the western United States, yet few studies document the effect for more than the first few years after planting. This study, re-evaluated 20 years after planting, followed ponderosa pine growth and survival when hexazinone was applied in broadcast and spot treatments for control of competing vegetation. We continued work from the first 5 years after establishment that identified early differences in ponderosa pine seedling survival and growth with treatment. Examination of 20-year trends indicated that individual tree volume and volume per hectare continued to diverge among treatments. The economic differences among treatments may increase as more surviving, faster-growing trees in the broadcast treatments reach higher-value products sooner. Initial control of competing vegetation increased the likelihood of seedling survival and increased tree size after 20 years. Results pertained to ponderosa pine of the Douglas-fir/spiraea (*Pseudotsuga menziesii* var. glauca Beissn./*Spiraea betulifolia* Pall.) and Douglas-fir/common snowberry (*Pseudotsuga menziesii* var. glauca Beissn./*Symphoricarpos albus* [L.] S. F. Blake) plant associations in northeastern Oregon, but they should apply to similar sites throughout much of the intermountain West.

Keywords: broadcast application, spot application, herbicide, silviculture, site preparation

Vegetation management increases the success of ponderosa pine (*Pinus ponderosa* Laws.) plantation establishment in the western U.S (Oliver 1990, Powers and Reynolds 1999, Wagner et al. 2006). Typically, ponderosa pine plantations are on sites that are seasonally hot and dry, with most of the precipitation occurring during the winter as snow. During the first few years of plantation establishment, roots of ponderosa pine seedlings share portions of the soil profile used by forbs, grasses, and small shrubs (Newton 1973). Low summer moisture, low soil water holding capacity, and low humidity during the growing season make competition from forbs, grasses, and small shrubs on dry sites potentially lethal for ponderosa pine seedling establishment; thus, retention of soil moisture is essential (Newton 1973). Decreasing leaf area of competing species in early spring increases retained soil water and nutrients for establishing tree seedlings. Competing vegetation also delays the onset of maximum growth of conifer plantations (Oliver 1990, Wagner et al. 2006), potentially resulting in economic loss from plantations managed on short rotations.

In previous work in northeastern Oregon, Oester et al. (1995) found that hexazinone applied for control of herbaceous species significantly improved short-term ponderosa pine seedling survival, growth, and vigor and reduced seedling establishment costs. The original objectives of this study were to provide information for successful vegetation control as part of artificial regeneration of ponderosa pine for land managers to meet regulations and goals for timber management and wildlife habitat on cut-over, burned, and insect-killed stands. Similar short-term survival and growth results have been documented for ponderosa pine from studies in northeastern California, eastern Washington, western Montana, and Idaho (Christensen et al. 1974, Boyd et al. 1995).

To determine the long-term effect of vegetation management treatments on growth of ponderosa pine, studies ideally need to evaluate differing degrees of competing vegetation and evaluate plantation growth through rotation age (Oliver 1990, McLeod and Mandzak 1991). Here we build on earlier results by extending seedling performance through the first 20 years of plantation establishment. Our current objective was to determine whether the effect of different levels of competing vegetation control on ponderosa pine and the resulting growth trajectories 20 years after plantation establishment differed from the 5-year results presented by Oester et al. (1995). To accomplish this objective, we examined the effects of hexazinone site preparation treatments by analyzing tree size at 20 years and regressed tree size through the 20th growing season to determine growth trajectories.

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This article uses metric units; the applicable conversion factors are: millimeter (mm): 1 mm = 0.039 in.; centimeters (cm): 1 cm = 0.39 in.; square centimeters (cm^2): 1 cm^2 = 0.155 in^2; meters (m): 1 m = 3.3 ft; square meters (m^2): 1 m^2 = 10.8 ft^2; cubic meters (m^3): 1 m^3 = 35.3 ft^3; hectares (ha): 1 ha = 2.47 ac; square meters per hectare (m^2/ha): 1 m^2/ha = 4.32 ft^2/ac.