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Post-Planting Treatments Increase Growth of Oregon White Oak (*Quercus garryana* Dougl. ex Hook.) Seedlings

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Abstract

The extent of Oregon white oak woodland and savanna ecosystems in the U.S. Pacific Northwest has diminished significantly during the past century due to land use changes and fire suppression. Planting Oregon white oak seedlings is often necessary when restoring these plant communities. Our objective was to determine the efficacy of post-planting treatments for establishing Oregon white oak seedlings on sites characterized by low growing season precipitation and coarse-textured soils. We evaluated the effects of control of competing vegetation, tree shelters, fertilization, irrigation, and planting date on growth of planted seedlings. Survival was generally high (90%), but growth rate varied substantially among treatments. Plastic mulch increased soil water content and increased annual seedling height growth by an average of 56% relative to one-time manual removal of competing vegetation. Solid-walled tree shelters reduced browse damage and increased mean annual height growth compared to mesh shelters and no shelter by averages of 7.5 and 10.9 cm, respectively. Controlled-release fertilizer applied at planting did not consistently increase seedling growth. Weekly irrigation (3.8 L/seedling) increased first-year seedling growth only where mulch also was applied. Seedlings planted by late February had greater root growth by summer than those planted in early April. Soil water management was necessary for best seedling growth, and the improved height growth in solid-walled tree shelters allowed the terminal shoot to grow more quickly above the height of animal browse. Our results indicate effective methods for establishing Oregon white oak seedlings, but these results may also be applicable to establishment of other tree species on similarly droughty sites.

Key words: ***Quercuo garryana*, oak savanna restoration, tree shelter, mulch, irrigation, fertilization, planting date.**

Introduction

Oregon white oak or Garry oak (*Quercus garryana* Dougl. ex Hook.) is a shade-intolerant, deciduous species, native to western North America. It occurs from southern California to British Columbia, and in the northern part of its range, it is the only native *Quercus* (oak) species (Stein 1990). Prior to European settlement in the mid-1800s, Oregon white oak savannas, woodlands, and associated prairies were maintained in the Pacific Northwest by frequent, low-intensity fires set by native peoples (Habeck 1961; Agee 1993). During the past century, the extent of Oregon white oak woodlands and savannas has been dramatically reduced and fragmented by conversion of lands to agricultural and urban uses and by the absence of fire, which has resulted in encroachment of coniferous forests (Sprague & Hansen 1946; Thilenius 1968; Crawford & Hall 1997).

Restoration of Oregon white oak savannas and woodlands in the Pacific Northwest is motivated by their cultural legacy, the number of associated plant and animal species that are at risk as they decline, and their uniqueness in a landscape dominated by conifers (Hanna & Dunn 1997; Bayrakci et al. 2001; Fuchs 2001). However, there has been little research on techniques for establishing Oregon white oak on sites from which it has been extirpated. Because sites available for restoration may have few or no trees to serve as a seed source, natural regeneration of Oregon white oak is often ineffective in these areas. Regenerating from planted acorns may be difficult due to high mortality rates from animal predation or insufficient soil moisture (Fuchs et al. 2000; Regan 2001; Regan & Agee 2004). For planted seedlings, variable survival (Bell & Papanikolas 1997; Papanikolas 1997) and low growth rates have been reported (Dunn & Grosboll 2002).

Although shade intolerant at maturity, Oregon white oak may regenerate in sun or in shade. Germination occurs in autumn, and the seedling forms a dominant taproot that elongates rapidly (Stein 1990). Because the species often occurs in a Mediterranean climate with droughty summer conditions, seedling roots must penetrate deep enough in the soil profile by midsummer to access sufficient soil water

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