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Naturally Seeded versus Planted Ponderosa Pine Seedlings in Group-Selection Openings

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ABSTRACT

The purpose of this article was to determine whether natural regeneration or planted seedlings should be used in group-selection openings. The answer depends on the survival and growth rate of both types of seedlings, and that could depend on the size of the openings and the effect of trees on their edge. In this side-by-side study, the natural pine seedlings originated from the 1988 seed crop and the 1–0 nursery-grown seedlings were outplanted in spring 1989. Openings ranged from 0.01 to 0.65 ha. The plant community consisted of many species of shrubs, forbs, and grasses with manzanita having the highest density and greatest development. After 9 years, manzanita had an average density of 13,870 plants/ha, 2,050 m^2/ha of foliar cover, and was 125 cm tall. From 1990 to 1997, planted ponderosa pine seedlings were taller ($P < 0.05$) than natural seedlings, and from 1995 to 1997, mean stem diameter at 30 cm of planted seedlings was larger than natural counterparts ($P < 0.05$). Development for 1 year in the nursery apparently gave the planted seedlings a growth advantage over the natural seedlings. For natural seedlings, distance from opening edge had little effect on pine height or diameter growth regardless of opening size. Planted seedlings, however, appeared to increase in height and diameter growth with both opening size and distance from edge.

Keywords: ponderosa pine, natural and planted seedlings, group selection, distance from edge, north central California

Sustaining ecosystems and not chronically disrupting ecosystem processes are the key features of modern forestry. The group-selection regeneration cutting method has some of these attributes. Indeed, Smith et al. (1997) noted that for this method "it becomes possible to accommodate the ecological requirements of almost any tree species." The group-selection method gives the appearance of continuous forest cover because the small openings created by timber harvest mimic natural disturbance caused by small high-intensity fires within a matrix of low-intensity surface fires (Fiske et al. 1992). In the northern California mountains, Weatherspoon and Skinner (1996) noted that group-selection silviculture promotes the process of maintaining a mostly ponderosa pine (*Pinus ponderosa* Dougl. ex Laws. var. *ponderosa*) forest having many ages. In the mixed-conifer forests of the Sierra Nevada in California, group-selection management also created species richness values that had a high proportion of late seral species and a low proportion of introduced exotic species when compared with even-aged or shelterwood regimes (Shlisky et al. 1999). Results from a large growth-model study in California suggested that uneven-aged management could match the productivity of even-aged systems (Liang et al. 2005). Slocum (1979) noted that owners of large or small amounts of land should consider group selection if looking for a sound investment that requires low capital expenditure, offers a periodic income and a respectable return, and benefits recreation and wildlife habitat.

Planted ponderosa pine seedlings are known for their ability to establish and grow well on a wide variety of sites, especially in environments that have full sunlight and are subject to drought (Laacke and Fiske 1983). But how well will they develop in small openings, typical of group-selection cutting, that have less than full sunlight and with competition from roots of surrounding trees? Will they grow faster than natural seedlings having an equal number of growing seasons in the field in this environment? The answer could partly depend on the early vigor of the seedlings, their adaptation to the environment, and how they interact with other species in the plant community. The answer, along with costs, also could help silviculturists decide, when dealing with small openings, whether to depend on natural regeneration or to plant.

In California, ponderosa pine seedlings typically direct most of their early energy toward developing a taproot (US Forest Service 1965) that often penetrates 75 cm or more into the soil the first growing season and gives access to a zone of adequate soil moisture. Natural seedlings in group-selection openings are likely to develop this taproot. Planted ponderosa pine seedlings, however, have at least one-third of their taproot removed when lifted from the nursery bed. They tend to develop a more fibrous root system than their natural counterparts.

In addition to the more shady environment in group-selection openings, another factor that differs somewhat from that in plantations in full sunlight is the plant community. In a clearcutting, for example, the first seed crop generally stocks the land and successive crops contribute few seedlings because most favorable microsites are already occupied. In group-selection openings and specifically in this study, several ponderosa pine seed crops occurred and seedlings become established each year. In group-selection openings, more plants in most categories of vegetation originate from root crowns or dormant seeds in the soil and fewer plants originate from wind-blown seeds. Consequently, fewer ephemeral forbs are present in group-selection openings than in larger disturbed areas. With time, the proportion of annual forbs in the openings decreases and that of perennial forbs increases (McDonald and Reynolds 1999).

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