FOREST RESEARCH LABORATORY

RESEARCH NOTE 69

SURVIVAL OF NATURAL AND PLANTED SEEDLINGS UNDER A SHELTERWOOD IN SOUTHWEST OREGON

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ABSTRACT

The effects of naturally shaded microsites on survival and height growth of natural and planted seedlings were evaluated after an initial shelterwood harvest in the eastern Siskiyou Mountains of southwestern Oregon. After 2 years, the probabilities of survival for planted Douglas-fir (84 percent) and ponderosa pine (56 percent) were significantly greater than those for natural Douglas-fir (13 percent) and white fir (18 percent). Stress from heat and drought was the greatest cause of mortality for both planted and natural seedlings. Survival of natural seedlings was significantly greater on shaded then on unshaded microsites, but shading did not affect survival of planted seedlings. Survival of planted seedlings seemed to be associated with root size.

INTRODUCTION

In the Siskiyou Mountains of southwestern Oregon, conifers are difficult to regenerate. Neither natural regeneration nor planted seedlings have proved consistently successful after clearcutting or shelterwood harvesting. Failure can be ascribed to the harsh environment (Hobbs et al. 1980) and to inadequate knowledge of the techniques necessary for dealing with it. Among the area's environmental hazards for seedlings are a long, hot, dry growing season; well-drained skeletal soils; severe competition for water from grasses and sclerophyll brush; animal browsing; mechanical damage from ravel (unstable gravel and debris); and frost damage at higher elevations (Gratkowski 1961; U.S. Department of the Interior 1978; Hobbs et al. 1979).[1]

On a hot, dry site with similar conditions in northern California, natural shading had no effect on the survival of planted conifer seedlings (Strothman 1972). In the spring of 1979, we located a site in southwest Oregon on which we could compare survival and sources of mortality for natural and planted seedlings, both naturally shaded and exposed, after an initial shelterwood cut. Two-year results of the study are presented here.

[1]Waring, R.H., K.N. Johnson, and W.H. Emmingham. 1974. Tough site management: A discussion of timber management on public land in southwestern Oregon. Unpublished report on file at Forest Research Laboratory, Oregon State University, Corvallis. 26 p.

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STUDY AREA AND PROCEDURES

The study area is located within the Applegate District of the Rogue River National Forest (Township 40S, Range 2W, Section 23, Willamette Meridian) and is characterized by a moderately deep, skeletal soil (45 to 60+ percent gravel and cobble), 55 to 80 percent slopes, a southwest aspect, and an elevation of 1,160 m (3,800 ft). The regeneration cut in 1978 created 0.2- to 0.40-ha openings among the overstory trees. Broadcast burning for site preparation in the fall of 1978 initially controlled nearly all competing understory vegetation. Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] and ponderosa pine (*Pinus ponderosa* Laws.) 2-0 seedlings were planted over part of the area the following spring. Abundant natural seedlings of Douglas-fir and white fir [*Abies concolor* (Gord. & Glend.) Lindl.] with a few ponderosa pine and incense-cedar (*Librocedrus decurrens* Torr.) also appeared then.

Natural and planted seedlings scattered over the site were classified as being either shaded or unshaded on the basis of whether they were protected by large trees, logs, rocks, or woody debris. Mortality and its probable cause (heat and water stress, browsing, or other) were recorded monthly from May to September 1979 and April to October 1980. Heat stress was indicated by bark lesions near the root collar; water stress by severely wilted needles; and browsing by clipping of the shoots.

RESULTS

SURVIVAL

After 2 years, survival of planted Douglas-fir seedlings was significantly greater than that of natural Douglas-fir seedlings (Table 1). Of the planted seedlings, 84 percent (42/50) of the Douglas-fir and only 56 percent (28/50) of the ponderosa pine survived. Of the natural seedlings, only 13 percent (9/70) of the Douglas-fir and 18 percent (13/71) of the white fir survived. Over 80 percent of the mortality for both planted and natural seedlings had occurred at the end of the first growing season (September 1979).

TABLE 1.

SURVIVAL OF PLANTED AND NATURAL SEEDLINGS AFTER 2 YEARS.

	Comparison of --		Comparison of --		Comparison of --	
Status	Total planted	Total natural	Planted Douglas-fir	Natural Douglas-fir	Planted Douglas-fir	Planted ponderosa pine
	- - - - - - - - - - - - No. - - - - - - - - - - - -					
Alive	70	22	42	9	42	28
Dead	30	119	8	61	8	22
Total	100	141	50	70	50	50
	$x^2 = 71.09$***		$x^2 = 57.53$***		$x^2 = 8.05$*	

***Significant at the 0.005 level, corrected for continuity.

*Significant at the 0.05 level, corrected for continuity.

SOURCES OF MORTALITY

Heat and drought together caused the greatest mortality for both natural and planted seedlings. Mortality from the various sources was not significantly different for planted Douglas-fir or ponderosa pine (Table 2). The greater overall mortality of the planted ponderosa pine could have been caused by poorer seedling quality. These seedlings seemed to have smaller and less fibrous root systems than did those of Douglas-fir. Douglas-fir seedlings that died also had smaller

roots. Among the natural seedlings, mortality from the various sources differed significantly between species, with Douglas-fir being less affected by heat and drought and more affected by browsing than was white fir. Unlike the natural Douglas-fir seedlings, none of the planted seedlings of this species were killed by browsing.

TABLE 2.

PERCENT MORTALITY BY SOURCE FOR NATURAL AND PLANTED SEEDLINGS AFTER 2 YEARS.

	Natural		Planted	
Source	Douglas-fir	White fir	Douglas-fir	Ponderosa pine
	- - - - - - - Percent - - - - - - -			
Heat and drought	64 (39/61)	84 (49/58)	88 (7/8)	86 (19/22)
Browsing	31 (19/61)	9 (5/58)	0	5 (1/22)
Other	5 (3/61)	7 (4/58)	13 (1/8)	9 (2/22)
	$x^2 = 7.85$*		$x^2 = 1.86$ N.S.	

* Significant at the 0.05 level.

N.S. Not significant.

SHADING

Shading significantly increased survival of natural Douglas-fir and white fir seedlings (Table 3) but not that of planted Douglas-fir and ponderosa pine (0.05 level).

TABLE 3.

EFFECT OF SHADING ON MORTALITY OF NATURAL DOUGLAS-FIR AND WHITE FIR SEEDLINGS AFTER 2 YEARS.

	Douglas-fir		White fir	
Status	Shaded	Unshaded	Shaded	Unshaded
	- - - - - - - - *No.* - - - - - - - -			
Alive	7	2	12	1
Dead	18	43	15	43
Total	25	45	27	44
	$x^2 = 6.01$*		$x^2 = 17.20$***	

* Significant at the 0.05 level, corrected for continuity.

*** Significant at the 0.005 level, corrected for continuity.

CONCLUSIONS

The results suggest that under shelterwoods in southwest Oregon, planted seedlings offer greater certainty of achieving adequate regeneration than does reliance upon survival of natural germinants. Although heat and drought were ranked together as the major cause of mortality for planted seedlings, shading did not affect their survival. Thus, planting of nursery-grown seedlings in naturally shaded microsites to increase survival may be unnecessary.

The beneficial effect of shading on natural but not on planted seedlings is intriguing. The larger nursery seedlings may not have received enough shade to be affected, or thay may have been hardier than the smaller natural germinants, or both. Their response suggests that seedling quality as determined by nursery practice may be more important to seedling survival than is microsite. That the Douglas-fir seedlings were larger and had greater survival than those of ponderosa pine suggests that seedlings with better developed root systems offer a greater potential for survival.

Testing these tentative conclusions with further research should yield substantial increases in regeneration success in southwestern Oregon. Specific questions to be answered are:

1. Can nursery stock be produced that can consistently achieve high survival rates under shelterwood cuts and on clearcut sites without shade?

2. Which seedling and site characteristics, if any, require the use of shading to achieve adequate survival after clearcuts and shelterwood cuts?

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