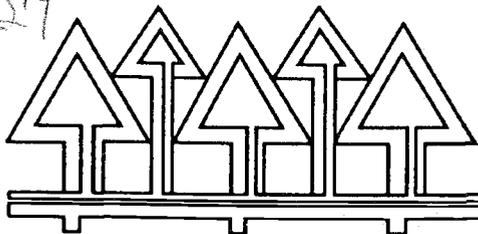


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FOREST RESEARCH LABORATORY

RESEARCH NOTE 82



Ravel Does Not Affect Reforestation of an Old Clearcut in Southwest Oregon

D. H. McNabb

Abstract

On a nonforested clearcut about 20 years old in southwest Oregon's western Siskiyou Mountains, less than 3 percent of the unprotected 2-0 bareroot Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] seedlings outplanted were buried by ravel after 2 years. Burial was sparse because movement of ravel was slow and seedlings were large. After 5 years,

seedling survival was only 48 percent, but 82 percent of the mortality was attributed to snow blight (*Phacidium infestans* Karst var. *abietis* Deam) forming in paper budcaps placed on seedlings to prevent browsing the first spring. Because few seedlings were buried, devices for protecting seedlings from ravel could not be evaluated conclusively.

Introduction

The downslope movement of soil, rock fragments, and organic debris by gravity, or such material after it has been moved, is termed *ravel* (Mersereau and Dyrness 1972, McNabb and Swanson 1990). Ravel may contribute to reforestation failure by burying seedlings (Berntsen 1958, Franklin and Rothacher 1962). Ravel burial of seedlings is most likely to occur on slopes greater than 60 percent; the amount of material moving on less steep slopes is minimal (Mersereau and Dyrness 1972, Bennett 1982). The highest rates of movement occur on nonvegetated talus slopes over 80 percent.

In southwest Oregon where shallow skeletal soils, dry summers, and competing vegetation make reforestation difficult (Hobbs *et al.* 1980, Atzet 1982,

Childs 1982), burial of seedlings by ravel might make the difference between reforestation success or failure on some sites. Reports of such burial, however, are primarily limited to field observations. Only one study has directly measured this process: Berntsen (1958) reported 23 percent of the 2-0 and 8 percent of the 3-0 bareroot Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] seedlings buried by ravel on a site in the Oregon Cascade Mountains. The 3-0 seedlings were less easily buried because they were larger.

The objectives of this study were to quantify the burial of outplanted seedlings by ravel on a nonforested clearcut in southwest Oregon and to determine whether various devices or planting treatments can protect such seedlings from burial.

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Site Description

The study area was in the northern portion of the western Siskiyou Mountains (123° 41' W., 42° 52' N.). The site was a 20-year-old clearcut where past efforts to reforest had failed. It was occupied by a few Pacific madrone (*Arbutus menziesii* Pursh) trees and a shrub cover of snowbrush [*Ceanothus velutinus* var. *laevigatus* (Hook.) T. & G.], poison oak (*Rhus diversiloba* T. & G.), and canyon liveoak (*Quercus chrysolepis* Liebm.). These species were temporarily controlled with herbicide the fall before planting, but the poison oak and canyon liveoak sprouted quickly to become the dominant competitors 2 years after the site was planted.

The slope of the plots averaged 65 percent and ranged between 50 and 75 percent. The aspect was southwesterly. Elevation was 700 m. The soil was a complex of loamy-skeletal, mixed, mesic Dystric and Lithic Xerochets varying in depth from less than 50 cm to more than 1 m. Rock fragments on the soil surface ranged from small rounded gravels, 2 to 10 mm in diameter, to cobbles up to 15 cm across. The depth of rock fragments on the soil surface ranged from about 1 to 15 cm. The litter layer was discontinuous but included some decaying logging slash—mostly larger branches and cull logs.

Study Design

Protected and unprotected seedlings were compared for survival and burial. Protection was afforded by one of three devices and one of two treatments of the soil surface. Douglas-fir seedlings (2-0) were planted in a 4 by 4 Latin square design with soil treatments as a split-plot (Snedecor and Cochran 1967). Each of the 16 plots in this design contained 48 seedlings planted in 8 rows; soil treatments alternated by row. A total of 768 seedlings were planted.

Unprotected seedlings provided a measure of the potential for seedling burial and served as a control to determine the effectiveness of protective treatments and devices. The protection devices were a shingle-V with the point of the V upslope, a 2- by 9- by 50-cm stake, and a 2- by 4.5- by 50-cm stake. The shingle-V was constructed by connecting two shingles with webbing and placing the shingles around a stake pointing upslope of the seedlings. Stakes were pointed and driven into the soil 5 to 8 cm upslope of the seedlings. For soil surface treatments, seedlings were either planted in the middle of a small bench or planted without benching. The bench was a 20-cm-deep level area excavated into the slope behind seed-

lings to catch ravel. All seedlings were protected from browsing with paper budcaps the first year.

Seedling survival was measured the fall of the first year, the spring and fall of the second year, the spring of the third year, and the fall of the fifth year. The cause of mortality was estimated the spring of the third year. If a seedling was covered by ravel, burial was assumed to be the cause of mortality unless the seedling had been recorded as dead during an earlier measurement. The survival data were subjected to an analysis of variance and the data on cause of mortality to a Chi-square test (Snedecor and Cochran 1967, SAS Institute Inc. 1987).

Ravel was measured by catching material moving downslope in eight, 2-m-long, open-top boxes buried in the soil so that the upper edges of the boxes were level with the surface of the soil. These boxes were randomly placed around the perimeter of the replications. The material caught was periodically removed from the boxes, dried, and weighed to provide an estimate of the organic and inorganic material moving downslope during the study.

Results and Discussion

The rate that ravel moved was low, averaging 3.61 g per linear meter of box edge per day. This rate is equivalent to $<1.5 \text{ cm}^3/\text{day}$ of material crossing a 1-m length of slope measured along the contour. The area from which the ravel originated could not be determined but varied from a few centimeters to several meters away, depending on location of the box and size of the material. Therefore, reporting movement on a mass per area basis was not practical.

Eighty percent of the ravel was rock fragments greater than 4.76 mm in diameter. No annual trend in the rate of movement was apparent. Most of the variation in ravel was attributed to an occasional large rock fragment falling into a box or to an increased deposit in the spring when deer were most active and the surface of the soil was soft and loose.

Survival of seedlings averaged less than 50 percent after the first summer (Table 1). Survival did not

change during the second year and only decreased another 2 percent by the fifth year. The differences in survival among treatments were not statistically significant.

Table 1. Percentages of seedling survival after 1 and 5 years, seedlings buried after 2 years, and living and dead seedlings infected with snow blight after 2 years, by treatment against ravel.

Treatment ¹	Seedling survival		Seedlings buried	Seedlings infected	
	Year 1	Year 5		Dead	Living
-----Percent-----					
Control	58.9	57.8	2.6	76.8	16.1
2- x 5-cm stake	33.8	31.8	2.0	80.5	25.4
2- x 9-cm stake	55.2	52.6	1.6	83.7	13.9
Shingle-V	51.0	47.9	0	87.0	7.5
Average	49.7	47.5		82.0	15.7

¹ 192 seedlings in each treatment.

After 2 years, less than 3 percent of the unprotected seedlings were buried by ravel, and even fewer seedlings protected by stakes and the shingle-V were buried (Table 1). The differences among treatments, however, were not statistically significant ($\chi^2 = 4.74$, d.f. = 3). Benching had no effect on seedling survival or burial.

Much of the first-year mortality was attributed to the formation of a fungus, snow blight (*Phacidium infestans* Karst var. *abietis* Deam.) (Boyce 1961), on foliage covered by paper budcaps. A heavy, wet snow fell about 2 weeks after planting and covered the seedlings for about 2 weeks. The snow blight was limited to foliage covered by budcaps. Snow blight was much less common on seedlings that were missing the budcap after the snow melted. During a survey the second year, evidence of snow blight was found on 82 percent of the dead seedlings but on only about 16 percent of the living seedlings (Table 1). The difference in number of dead and living

seedlings with snow blight was statistically significant ($\chi^2 = 86.04$, d.f. = 1, $p = 0.05$).

Although paper budcaps are less expensive to install than plastic mess tubes, they are also less effective at protecting the leaders of seedlings from browse (Campbell *et al.* 1988). The possible formation of snow blight in such caps must also be considered in selecting devices to protect seedlings from browse.

The high mortality from snow blight in this study confounds burial by ravel as a cause of seedling mortality. At least half of the buried seedlings were infected with the fungus and probably would have died anyway. The fungus reduced the size of the live crown and slowed seedling growth.

Burial of seedlings was a potentially more serious threat to reforestation of this site immediately after harvesting than two decades later (Crawford and McNabb 1988). The movement of ravel is greatest during the first months after harvesting or prescribed burning (Bennett 1982, McNabb and Crawford 1984). Establishment of vegetation on the site would also have contributed to a decrease in the movement of ravel (Mersereau and Dyrness 1972). If Berntsen's (1958) observation that large seedlings are less easily buried by ravel than small ones is extrapolated to this study, then few of these seedlings would be expected to be buried by ravel: The 2-0 seedlings planted in this study were two to three times taller than those planted by Berntsen (27.5 cm compared to 9.7 cm for 2-0 seedlings and 12.5 cm for 3-0 seedlings).

Burial of seedlings by ravel was not an important factor affecting the reforestation of this old clearcut. These results indicate that ravel is unlikely to be a serious problem affecting reforestation on any but the steepest, most recently cut sites in southwest Oregon. However, more information is needed to identify the locations on recently harvested, steep slopes where the movement of ravel is highest and to determine the potential for seedling burial in these locations.

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