

A Seeding of Sitka Spruce and Western Hemlock in Southwestern Washington

RALPH L. CARMICHAEL AND JAMES DICK
*Weyerhaeuser Timber Company, Forestry Research Center
Centralia, Washington*

RECENT YEARS have seen a rash of fires in Sitka spruce-western hemlock forests of western Washington. Many of the resulting burns will require long periods of time for natural restoration to forest production because of lack of seed source. Three such recent burns were selected to test immediate artificial regeneration of Sitka spruce and western hemlock. Since nursery seedlings of these species were not available, the test was limited to direct seeding.

The Seeding

The three test areas are located from 6 to 21 miles apart in Pacific County of southwestern Washington. They are identified as: Squally Jim burn of 1951 at an elevation of 800 to 1,100 feet; Wirkkala burn of 1952 at 1,400 to 1,800 feet; and Deep River burn of 1951 at 600 to 1,000 feet. Each area is isolated from natural seedfall.

Seeding was done by helicopter in February, 1954, on all test areas. The entire area of 516 acres was seeded to a mixture of spruce and hemlock seed. The seeding rate was based on limited research that indicated need for a greater number of seed per acre than with Douglas fir. Thus, Sitka spruce at the rate of 98,000 and western hemlock at 24,000 viable seeds per acre resulted in application of the mixture at the rate of 0.96 pounds per acre.¹ The need for seed treatment was evident from tests conducted by Crown Zellerbach Corporation in 1949. These tests indicated that acceptance by small rodents of seed of Sitka spruce was 87 per cent and western hemlock 72 per cent of the acceptance of Douglas fir. To control loss due to rodents, the seed was treated with a dextrin coating containing tetramethylene disulpho tetramine.² As a protection against bird damage, the seed was also coated with aluminum

¹ Sitka spruce collected in 1949, 1950, and 1951 from Weyerhaeuser Timber Company Tree Farms in the vicinities of burned areas cost \$7.60 per pound; the western hemlock collected south of Astoria, and east of Tillamook Head, Oregon, by Crown Zellerbach Corporation cost \$15.00 per pound.

² Formulation prepared by Donald A. Spencer of the U.S. Fish and Wildlife Service. Treatment effects on three lots of spruce and hemlock seed showed a 50-per-cent reduction in germination in one lot, but the other two were unaffected.

powder. Treatment costs totalled about 25 cents per pound of seed. Costs per acre were \$8.51 for treated seed, \$1.56 for helicopter dissemination, or a total of \$10.07.

Development of Seedlings

The seeded burns were examined three times: spring of 1954, spring of 1955, and winter of 1955. Each of the three areas was sampled by 100 permanent quarter-milacre (1/4,000-acre) circular plots spaced at one-chain intervals. The center of each plot was marked by a 1-by-4-inch cedar stake, and each seedling was marked by a wire pin.

In the first examination, June-July, 1954, the plots were classified by microaspect into one of eight compass points, or level. At this time, seedlings were found in all stages of development, from initial emergence to elongation of the stem above the cotyledons. Early germination amounted to 4.6 per cent for Sitka spruce and 2.5 per cent for western hemlock.

A second examination, in April-May, 1955, showed that additional germination had occurred. Each new seedling was marked with a wire pin. Dead seedlings were recorded, and their marking pins removed. Survival of seedlings was 53 per cent for Sitka spruce and 60 per cent for western hemlock. Additional germination had increased the estimate of first-year germination to

TABLE 1. COMPARISON OF FIRST-YEAR SURVIVAL, SECOND-YEAR SURVIVAL, AND TOTAL NUMBER OF TWO-YEAR-OLD SEEDLINGS PER ACRE BY ASPECT FOR A SEEDING OF SITKA SPRUCE AND WESTERN HEMLOCK

Aspect	First-Year Survival		Second-Year Survival		Two-Year-Old Seedlings Per Acre	
	Spruce (per cent)	Spruce and hemlock (per cent)	Spruce (per cent)	Spruce and hemlock (per cent)	Spruce (number)	Spruce and hemlock* (number)
Level	55	58	81	81	3800	4400
N and NW	68	69	84	83	6900	7800
E and NE	54	53	77	79	3400	4100
S and SE	57	45	56	59	1400	1600
W and SW	63	50	71	75	2100	2500
Minimum Difference for Significance at P=5%	39	26	33	30	1700	1100

* The values in this column are based on unweighted averages; hence, are not equivalent to other values given in the text for number of two-year-old seedlings per acre.

6.1 per cent for Sitka spruce and 3.9 per cent for western hemlock. The portion of first-year germination occurring after June, 1954, or not discovered in the first examination, was 23 per cent for Sitka spruce and 36 per cent for western hemlock.

A third examination in November, 1955, showed that second-year survival of seedlings was 75 per cent for Sitka spruce and 74 per cent for western hemlock. This examination discovered 75 unstaked seedlings that had germinated in the first year. These additional seedlings raised the estimate of first-year germination to 8.2 per cent for Sitka spruce and 5.8 per cent for western hemlock. Second-year germination had a negligible effect on stocking.

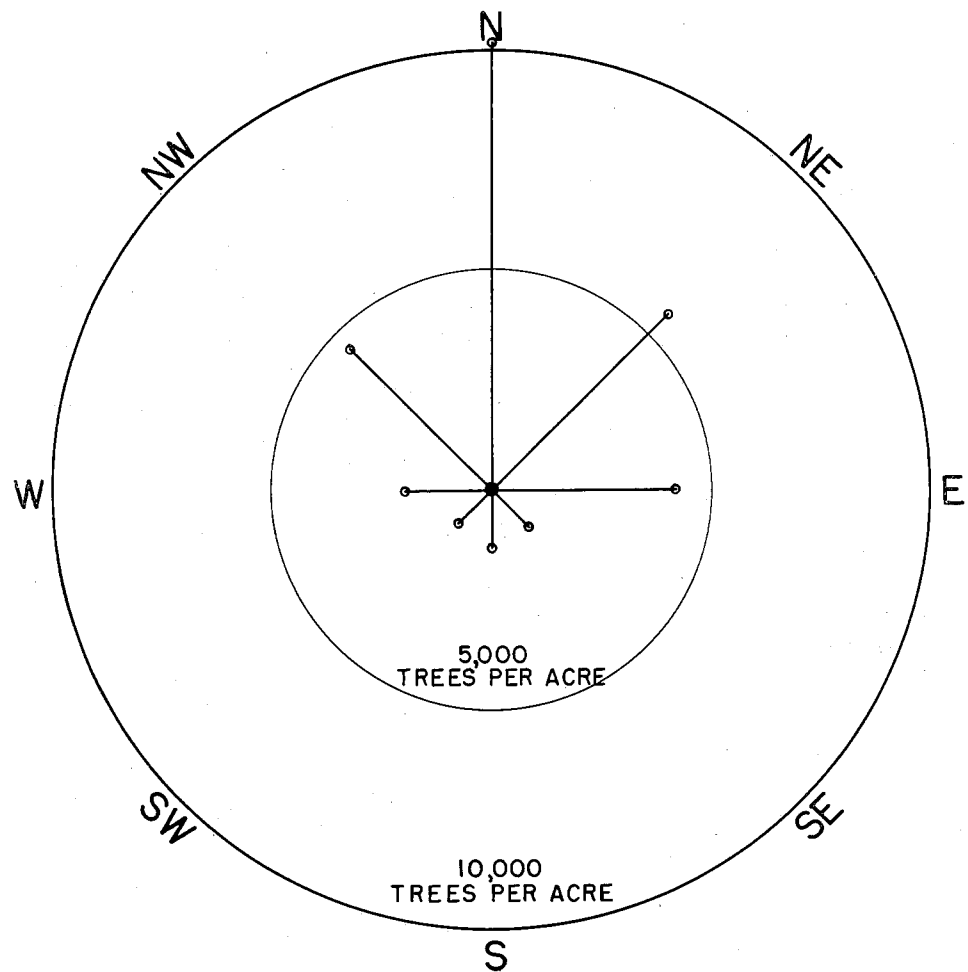


Figure 1. Number of surviving two-year-old Sitka spruce and western hemlock seedlings per acre by aspect.

Outcome After Two Years

The outcome of the seeding can best be considered in terms of the seedlings that survived from the germination that has already been described. For all three burned areas, an average of 3,800 seedlings per acre survived at the end of the second growing season. By individual areas, the seedlings per acre averaged as follows: Squally Jim, 2,600 (71 per cent spruce); Wirkkala, 6,400 (87 per cent spruce); and Deep River, 2,400 (90 per cent spruce). These averages exceeded the minimum standard in reforestation practice and indicated that the two-year outcome of the seeding was successful.

When the outcome was compiled by the microaspect recorded for each of the 300 plots, considerable variation occurred in number of seedlings per acre as shown in the following tabulation. The number of seedlings per acre was diagrammed by compass points in Figure 1. This brings out the consist-

Aspect	Number of two-year-old seedlings per acre	Number of plots, basis
Level	4,500	32
Northwest	4,600	21
North	10,200	31
Northeast	5,700	36
East	4,200	44
Southeast	1,200	27
South	1,300	39
Southwest	1,100	29
West	2,000	41
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All	3,800	300

ent pattern of relationships. From both of these presentations, it is apparent that the northerly aspects far exceeded the southerly aspects in number of two-year-old seedlings per acre.

To help determine the underlying causes for these differences, data on first- and second-year survival, in per cent, and number of surviving two-year-old seedlings per acre were grouped for statistical analysis into five major aspects by considering each area as a block. The results, summarized by microaspect in Table 1, indicate that microaspect had no appreciable effect on the per cent of first- or second-year survival, but that northerly aspects showed a marked superiority over southerly aspects in number of surviving seedlings per acre. From these facts, microaspect had exerted its primary influence on germination rather than survival. These effects were consistent for Sitka spruce alone and for Sitka spruce and western hemlock combined.

Summary

A study of an experimental seeding by helicopter of Sitka spruce and western hemlock on three accidental burns in southwestern Washington showed that: (1) Field germination for each species was a very low per cent of the number of viable seed sown, and (2) microaspect had no significant effect on per cent of survival, but a major influence on the number of surviving two-year-old seedlings per acre, which is attributed to influence on germination. In view of the number of surviving seedlings per acre, this seeding has been successful on each of the burns. Therefore, broadcast seeding of Sitka spruce and western hemlock can be recommended as an effective method of artificial reforestation for recent burns in the Sitka spruce-western hemlock type of southwestern Washington.

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