

Relation of Seeding Date to Germination of Douglas-Fir Seed

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FORESTERS IN the Pacific Northwest are developing techniques for aerial broadcasting of rodenticide-treated Douglas-fir seed as a promising regeneration practice. One critical question on the application of these techniques is: "At what time of the year will direct seeding of Douglas-fir be effective?" In 1953, the Weyerhaeuser Timber Company dealt with this question in its research on regeneration. A direct-seeding experiment was carried out in southwest Washington involving a series of seedings extending from January through May, 1953. The observed progress of germination into the first growing season provided the results reported in this paper.

The period of natural seeding of Douglas-fir extends from September until June, with about two thirds of the total seedfall occurring before the end of October (Isaac, 1943). Seeding experiments in the Northwest have resulted in foresters recommending fall seeding of coniferous seed except in a few cases involving stratified seed (Gartz, 1955; Rindt *et al.*, 1953; Schopmeyer, 1939, 1940; Stein, 1955*a*, 1955*b*). Kallander and Berry (1953), who summarized aerial seeding trials in Oregon, concluded that seeding of Douglas-fir should be done after the fall rains commence. Experimental seedings in February with Sitka spruce and western hemlock in southwestern Washington have proved successful (Carmichael and Dick, 1956). In British Columbia, Garman and Orr-Ewing (1949), in their summary of seeding experiments from 1923 to 1949, recommended fall seeding of Douglas-fir. This has been substantiated by Finnis (1955). Because of the dearth of experimental information available for seedings made later than December, the present study on winter and spring seeding was undertaken.

Materials and Methods

The study was located on a southeast slope of a cutover area on the McDonald Tree Farm about 15 miles southwest of Centralia, Washington. In January, 1953, two 3-by-5-foot rodent exclosures, constructed of western redcedar, ¼-inch mesh hardware cloth, and aluminum flashing, were installed. The exclosures were subdivided with strips of copper window screen into nine

¹The author wishes to give credit to the late Robert W. Rowe for the experimental design and to James Dick, Regeneration Project Leader, for guidance on conduct of the investigation.

compartments. In February, the experiment was expanded by the addition of nine more of these exclosures. Inside the 11 rodent exclosures, mineral-soil seedbeds, initially scalped, were maintained by clipping sprouting vegetation at semi-monthly and, later, at weekly intervals.

Three untreated lots of Douglas-fir seed, from the 1950 crop, were taken out of storage (36°F.) in December, 1952, and placed in a household refrigerator until seeded. Seeding dates were the first and middle of each month. On the first two dates, January 14 and February 2, single samples of 100 seeds of each seedlot were seeded. Later, triplicate samples of each seedlot were seeded on February 16, March 1 and 17, April 1 and 15, and May 4 and 18, 1953. Samples of each seedlot were assigned at random with the restriction that no seedlot was replicated on the same date in the same exclosure. In all cases, the seed was scattered on top of the soil to simulate broadcast seeding. Thus, a total of 69 samples of 100 seeds each were seeded inside 11 rodent exclosures on nine dates.

On each date of seeding, previously seeded compartments were examined. Germination was first noted on May 4, and observations were made on May 6, 12, and 18, and at weekly intervals thereafter until July 6, 1953. All seeds with a radicle of $\frac{1}{4}$ -inch or more were counted as seedlings, pulled, and destroyed. A final check of germination was made on August 8, 1953.²

Experimental Results

Germination started after April 15, 1953, and observations were initiated on May 6 when 175 seedlings were counted. In subsequent weekly observations, 711 seedlings were recorded. Two seedlings, found in the final check on August 8, brought the germination to a total of 888 seedlings. An analysis of germination data gave a standard deviation of 9.3 per cent. No significant variation between seedlots was found. Consequently, the data were pooled by date of seeding as presented in Table 1 and Figure 1.

Total first-year germination percentages are given for the nine dates of seeding in Table 1, and the significance of differences is indicated for all possible comparisons. The results are resolved into two distinct groups with the March 17 seeding being the latest that gave an appreciable amount of germination. For the five early seedings, only three out of 10 comparisons in Table 1 were significant, and, for the four late seedings, none of the six

² An observation made on August 7, 1954, discovered 175 surviving seedlings from second-year germination. These were distributed among the original dates of seeding as follows: January 14, 0; February 2, 3; February 16, 6; March 1, 9; March 17, 11; April 1, 41; April 15, 28; May 4, 29; and May 18, 48. Since observations were not made at weekly intervals, the data do not represent the complete germination and are not comparable with the first-year germination reported in this paper.

TABLE 1. TOTAL FIRST-YEAR GERMINATION PERCENTAGES BY DATE OF SEEDING IN 1953 AND SIGNIFICANCE OF DIFFERENCES BETWEEN THESE DATES

("ns" indicates nonsignificance; "S," significance at the 5 per cent level; and "HS," significance at the 1 per cent level of probability)

Jan. 14 29.7 percent	Feb. 2 36.0 percent	Feb. 16 21.0 percent	Mar. 1 24.1 percent	Mar. 17 17.1 percent	Apr. 1 7.7 percent	Apr. 15 6.2 percent	May 4 0.3 percent	May 18 0.3 percent
ns	ns	ns	ns	S	HS	HS	HS	HS
	S	ns	HS	HS	HS	HS	HS	HS
		ns	ns	HS	HS	HS	HS	HS
			ns	HS	HS	HS	HS	HS
				ns	S	S	HS	HS
						ns	ns	ns
							ns	ns
								ns

comparisons were significant. However, every one of the 20 comparisons between these two groups showed significant differences in total first-year germination.

The march of weekly germination, as diagrammed in Figure 1, shows in greater detail the same early and late groups that were distinguished in Table 1. In each of the five early seedings, some germination had occurred by May 6, 1953. For the two earliest seedings, this amounted to a major portion of their total germination; for the other three seedings in this group, germination occurred more uniformly over a longer period. Peaks in the diagrams of weekly

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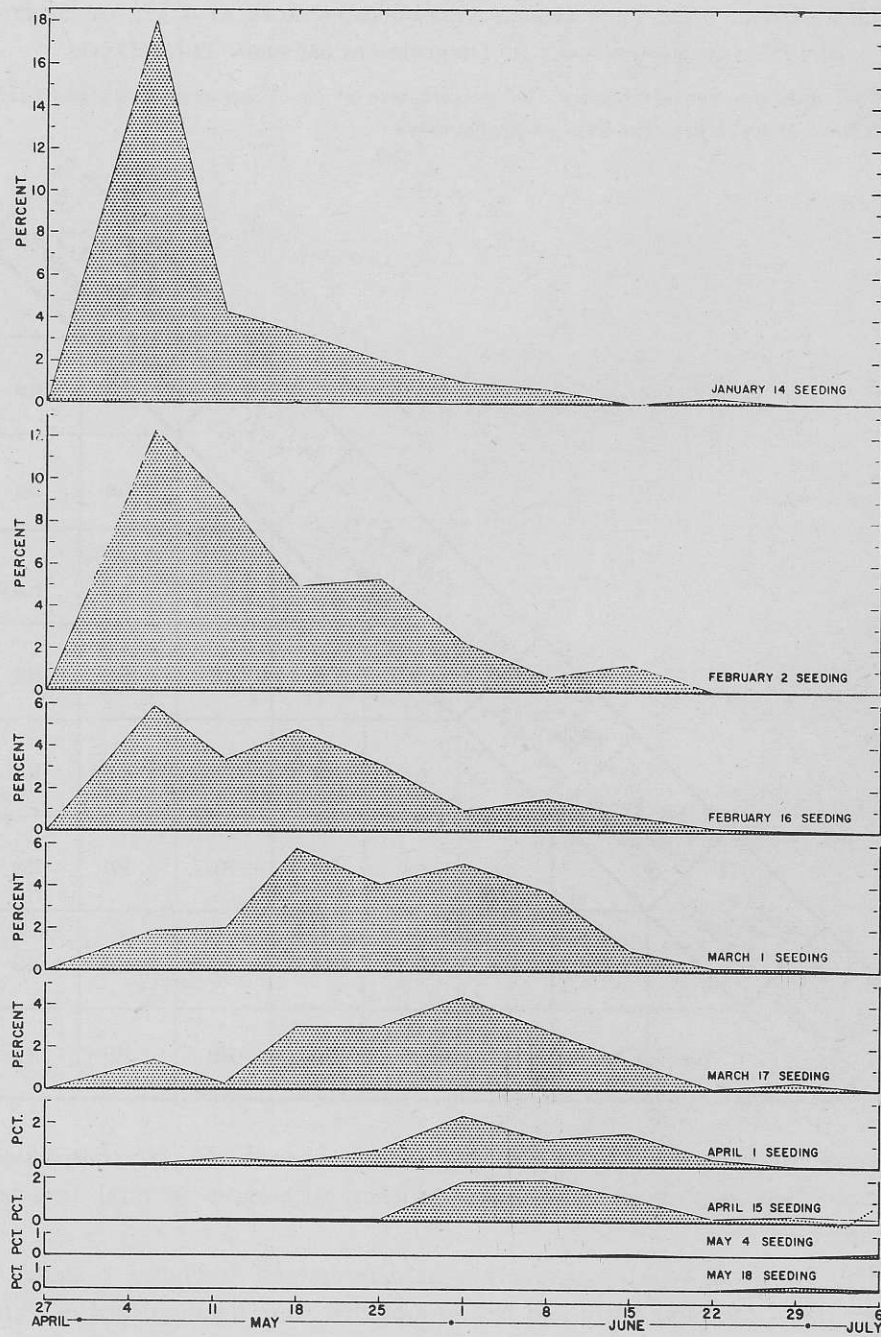


Figure 1. March of weekly germination percentages for nine dates of seeding in 1953.

germination percentages for this group moved from May 6 to June 1 with the advance of seeding date. All five of the early seedings had completed satisfactory germination by June 29, 1953. However, diagrams for the four late seedings show a very slow start of germination, low weekly percentages attained, and resultant unsatisfactory amount of germination. In fact, the seedings of May 4 and 18 showed their first germination on June 15 and 29, respectively, and yielded only three seedlings from each sowing of 900 seeds.

Summary

Untreated Douglas-fir seed was broadcast on mineral-soil seedbeds within small rodent exclosures on a southeast slope of a cutover area near Centralia, Washington. Seeding was repeated on nine dates at semi-monthly intervals from January to May, and germination counts were made at weekly intervals from May 6 to July 6, with a final check on August 8, 1953.

The study brought out the varying pattern of weekly germination from different dates of seeding. In general, the later the date of direct seeding the later the peak of weekly germination and the lower the total of first-season germination. Thus, the seeding of February 2 had a weekly peak on May 6 and a total of 36 per cent for the first season, while the May 4 seeding showed a peak on July 6 and totaled 0.3 per cent. Other highlights are: (1) Three different seedlots showed a consistent reaction to the influence of date of seeding, (2) total germination was satisfactory both in amount and time of occurrence for seedings made during the period January 14 through March 17, 1953. However, for seedings made after March 17, germination was at unsatisfactory low levels.

The timetable found in this seeding study of Douglas-fir could vary widely in other years or localities. However, these findings on the effect of date of seeding in the winter and spring period will be useful guides until further research delineates the optimum period for direct seeding Douglas-fir in the Pacific Northwest.

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