



Broadcast Seeding Ponderosa Pine on the Challenge Experimental Forest . . .

a progress report

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Is \$0.43 per 100 ponderosa pine seedlings (1 year old) per acre a reasonable regeneration cost? What about \$1.88? This was the range of costs for regenerating patch cuttings by sowing on the Challenge Experimental Forest, Yuba County, California, in 1964 and 1965. Milacre stocking levels associated with these costs ranged from 42 to 70 percent. Seedlings per acre ranged from 880 to 2,540.

The study was part of several direct-seeding experiments designed to provide answers to some specific questions. A helicopter sowing in March 1964, under conditions similar to those in the study, had provided only 400 seedlings (1 year old) per acre. Questions raised by this first trial included: (1) How do we get a soil covering over the seeds to increase germination? (2) How many seeds must we keep from rodents to restock an acre? (3) What really happens to seeds sown in broadcast burned patch cuttings?

Patch cuttings on the Experimental Forest totaling 114 acres were logged in winter and spring of 1963-1964.¹ The five compartments varied in size from 7 to 38 acres. Timber volumes ranged from 7 to 25 MBF per acre. All

ABSTRACT: Hand baiting for rodent control and sowing patch cuttings in December 1965 produced 880 to 2,540 pine seedlings per acre by July 1966. A tractor-drawn drag used to cover seeds in some areas significantly improved germination in one trial. Costs per hundred seedlings per acre for dragged compartments were \$1.08 and \$1.33; for other compartments: \$0.43, \$1.14, and \$1.88.

RETRIEVAL TERMS: *Pinus ponderosa*; seeding regeneration (artificial); site preparation; rodent control; regeneration costs.

merchantable logs were removed, including poles and pilings, to a 6-inch scaling diameter.

Slash Disposal

Slash was broadcast burned. Preparation for burning included "pushing" of any standing trees by a bulldozer, and fireline installation. Slash ranged from 55 to 110 tons per acre.²

The burning prescription permitted ignition only after 1-1/2 to 2 inches of rain. The first storm, in fall of 1964, deposited 4-1/2 inches of rain--effectively eliminating broadcast burning that season. Winter and spring drying periods did permit burning in February and April 1965.

Broadcast burning removed 60 to 85 percent of the fuel on the five compartments, and exposed ample mineral soil for seeding. Preparation and burning costs averaged \$41 per acre.

Rodent Control

Rodent control was conventional., A mouse census by the U.S. Fish and

¹U.S. Forest Service research on the Challenge Experimental Forest is conducted in cooperation with the Soper-Wheeler Company, Strawberry Valley, Calif.

²Sundahl, William E. *Slash and litter weight after clearcut logging in two young-growth timber stands.* U.S. Forest Serv. Res. Note PSW-124. Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif., 5 pp., illus. 1966.

Wildlife Service showed the need for baiting, and all compartments except one were baited.

Rodent baiting on November 31 and December 1 preceded sowing by 1 week. A 4-man crew was supervised by Frank Wetherbee, a biologist in the Division of Wildlife Services, U.S. Fish and Wildlife Service. The four men walked abreast carrying shoulder-slung sacks of oats treated with 2 ounces of 1080 (sodium fluoroacetate) per 100 pounds of grain. They threw 10 to 20 kernels along logs or other likely rodent haunts.

We required 35.5 man-hours to bait 175 acres, including buffer zones. But for cost computation, the total is applied to only 84.5 acres of seeded area. For 84.5 acres, labor costs averaged \$1.55 per acre and bait \$0.67 per acre--a total of \$2.22 per acre.

Seed Sowing

We attacked the question of seed covering from two separate and distinct angles. The direct approach involved a tractor towing 4-foot lengths of 8-inch channel iron over seeded compartments, in an attempt to drag soil over the seeds. A less direct approach concerned timing of the sowing operation. The helicopter sowings had taken place in mid-March. We felt that seeds sowed in late summer or early fall would be covered naturally by soil moved by subsequent rains. Accordingly, we planned to sow in late September or October, but actual operations were not begun until December.

Our ponderosa pine seed came from California Seed Zone II within 100 miles of the Experimental Forest. The Oregon Seed Testing Laboratory reported the seed had 95 percent germination or better. The seed was treated with the standard rodent repellent: an endrin-arasan-aluminum dust coat, applied with an asphalt emulsion sticker. (Safety accessories for seed handlers and sowers included rubber gloves,

nose-mouth respirators, and canvas aprons.)

Pine seed sowing took place during the second week of December 1965, after 16-1/2 inches of seasonal rainfall. Conventional hand-operated Cyclone³ seeders were used for sowing (fig. 1). Three to four men walked abreast, each seeding a swath about 30 feet wide. A steady rate of progress was maintained although numerous charred logs and other obstacles prevented an absolutely uniform distribution.

Seeding rates ranged from 1.4 to 2.3 pounds per acre. The sowing rate was controlled by the orifice setting on the Cyclone seeders and how fast the crew walked.

Sowing required 0.44 man-hours per acre--a cost of \$1.33. Preparation and cleanup charges increased labor cost to \$1.60 per acre (no travel time is included). Ponderosa pine seed coated with repellent cost \$5.35 per pound.

Seed Movement

Simultaneously with the tests of baiting and sowing, we started a study of seed movement and disposition. Individual seeds were tagged with radioactive scandium and placed at marked locations in the patch cuttings, in October 1965. Through the fall, winter and spring months sodium-iodide scintillators were used periodically to relocate each seed (fig. 2). Vertical and horizontal seed movements were measured.

Some rodent and bird wildlife activities can be deduced from tagged seeds. When seed embryos are eaten and only seed coat fragments are found, the agent who ate the seed often can be identified. In some cases rodent seed-caches were located

³Commercial names and enterprises or products are mentioned solely for information. No endorsement by the U.S. Department of Agriculture is implied.

Figure 1.--Seed was sown after the patch cutting had been prepared by broadcast burning.



Figure 2.--Radio-tagged seed was located by a sodium-iodide crystal scintillator. Seed is at the tip of the 6-inch plastic marker half way between hands.

Figure 3.--Flags were used to mark the more than 2,500 ponderosa pine seedlings per acre on the dragged plot.



because they contained one or two radio-tagged seeds.

Dragging Operation

The dragging operation took place between Christmas and the first week of January, 3 to 4 weeks after sowing. Operational delays had prevented earlier dragging. A 20-foot railroad rail was held atop the drum of a D-7 tractor by the winch line. Equidistant along the rail were five clevises from which hung chains or cables 6 to 8 feet long. A 4-foot drag of 8-inch channel iron was fastened at the end of each line. We fastened the drags off-center so that they angled across the ground as the tractor proceeded. About 42 acres were dragged at a cost of \$14.70 per acre.

Seedlings were tallied on randomly located milacre plots. Sampling intensity was planned to produce a significant difference between the dragged and untreated units if the difference in stocking was as great as 20 percent.⁴

Variability in seedling stocking levels precluded any conclusions in

⁴Assumes a type I error of 5 percent and a type II error of 1 percent.

sowing rates (table 1). Milacre stocking on the dragged subcompartment was 72 percent (fig. 3) and on the untreated subcompartment--48 percent. The difference is significant at the 1 percent level.

Regeneration Costs

Comparison of various treatments is described in terms of cost per 100 seedlings per unit area (CCA), with cost in dollars and area in acres. Why CCA? Regeneration costs expressed solely as cost per acre omit part of the picture--the stocking level. Assuming regeneration method "A" yielded 500 seedlings per acre at a cost of \$20, and method "B" gave 800 seedlings per acre for a \$24 investment, which method would you prefer? CCA for method "A" is \$4--for method "B", \$3.

The promising results obtained in this study have led us to a continuing evaluation of direct seeding problems. Studies scheduled or in progress include radio-tagged seed movement and disposition; seeding rates which are needed because of the limited supply and high cost of seed; "drag" and other seed covering techniques; and severe site seedings mainly on shallow rocky soils.

Table 1.--Comparison of regeneration treatment costs and stocking levels

AREA NOT DRAGGED									
Comp. No.	Sowing rate	Cost per acre					Seedling stocking level		Costs/100 seedlings/acre
		Rodent baiting	Pine seed	Sowing ¹	Dragging	Total	Stocked milacres	Seedlings per acre	
	Pounds per acre	Dollars					Percent	Number	Dollars
23	1.4	1.98	7.49	1.41	--	10.88	70	2,540	0.43
39(A)	1.6	2.40	8.56	1.52	--	12.48	48	1,090	1.14
37	2.1	2.43	11.24	2.83	--	16.50	42	880	1.88
AREA DRAGGED									
36	2.3	--	12.30	1.50	14.70	28.50	65	2,150	1.33
39(B)	1.6	2.40	8.56	1.52	14.70	27.18	72	2,510	1.08

¹Sorting, weighing, sowing, and cleanup.

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