Figure 1. Typical example of the steep slope terracing done on 15,000 acres of Boise National Forest.

Figure 2. Sloped terrace showing track berms. Furrows formed by berms are preferred planting spots.

Prescriptions vary in ponderosa regeneration

Plans based on individual area characteristics insure fast restocking

By DALE O. HALL

BOISE IDAHO—Nonproducing acres and unproductive years are both costly to timberland owners. These costs are reduced by restoring timber stocking with minimum delay. The proper prescription for regeneration can insure fast restocking. But the silviculturist prescribes slash disposal, site preparation, seeding, and planting only after he has carefully examined the site environment and diagnosed species' requirements.

Steep brush-covered slopes in central Idaho's batholith and young-growth patch cuttings in northern California are contrasted environments that illustrate need for radically different prescriptions.

The 1931 Quartzburg fire in Boise Basin (Boise National Forest) devastated 45,000 acres of timber cropland. Dense stands of willow, snowbrush ceanothus, and service and elderberry now cloak these areas. Our planting dilemma: How to remove the moisture-guzzling brush, yet protect the steep, erosion-sensitive slopes?

From studies at Town Creek (1954-58) we learned that stripping brush to mineral soil increased seedling survival from 25 to 80 per cent on gentle slopes. Survival was even better (95 per cent) when planting machines were used, but the lower cost of hand planting recommends it.

Short summer rainstorms in Boise Basin often have intensities of 2.5 to four inches per hour. Such storms rapidly erode the shallow soil mantle on devegetated slopes.

Stripping the steeper slopes (40 to 65 per cent) would require bank cuts and side casts giving a terraced look with considerable soil exposure. We had to consider protection against erosion in selecting the regeneration method.

The prescription we adopted was: (1) Contour terrace using bulldozers to strip off vegetation, provide a more level and accessible planting surface, and get more moisture to seedling roots; (2) leave brush-covered strips 10 to 18 feet wide for erosion control; and (3) hand plant ponderosa pine 2-0 stock.

Contractors terrace 1,500 acres each fall on this forest, using logging tractors (90 to 115 drawbar hp) equipped with angle dozers. Production varies most with size and amount of brush. Slopes of 60 to 65 per cent can be terraced when there is good soil depth. Only 40 to 50 per cent of the surface area is disturbed. Four to six acres are terraced each day (Fig. 1).

On sloped terraces, berms build up along the lower edges of the crawler tracks (Fig. 2). These berms entrench snow and rain and thus concentrate the water. In the spring, contractors plant seedlings in the trenches eight feet apart and staggered along adjacent berms. One crewman can plant 800 to 1,000 seedlings in a "long" day—two to 2½ acres. Experienced planters earn $20 to $25 a day.

Costs of terracing and planting vary greatly with differences in terrain, ground cover, equipment used, type of crew—contract or force account—and other factors. I believe my direct cost summary, based on Boise National Forest experience, is representative of the Intermountain Region (Table 1).

CCA is a new regeneration cost index that I find helpful. CCA stands for *C*ost per 100 (*C*) seedlings per *A*cre. A digit or fraction after the letters, e.g., CCA-2, indicates the number of years covered by the data (Table 1).

At Challenge, California (Plumas National Forest), broadcast burning and seeding prescriptions have been under study since 1963 in cooperation with the Soper-Wheeler Co. Here the summers are dry, but annual precipitation is much greater—68 inches vs. Boise Basin's 25. Winter storms often drop from three to eight inches within 12 hours. However, the clay-loam soils, some 50 feet deep, are very stable and resist erosion. Slopes rarely exceed 50 per cent.

Deep soils and abundant moisture make these sites some of the most productive and valuable in the nation. This high value precludes waiting several years for natural regeneration.

The 90-year-old stands average 20,000 board feet (Scribner rule) to the acre. Standing timber holds brush and herbs in check, but these species aggressively occupy openings after patch cutting and can reduce soil moisture below the seedlings' survival threshold. Fire was considered as a

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Figure 3. Broadcast burning a patch-cut compartment, under strict supervision.

Figure 4. Handsowing of patch cut takes place after broadcast burning.

Figure 5. Flags mark seedlings (2,500 per acre) on seeded and dragged plot.

tool for reducing the influence of logging slash (55 to 100 tons per acre) and brushy competition.

Planting pine seedlings has succeeded well in California, but costs are relatively high—$35 to $55 per acre. Direct seeding could be less expensive.

Based on these considerations, our regeneration prescription was: (1) Harvest all merchantable material; (2) broadcast burn the patch cuts when weather permits; and (3) direct seed, testing hand and helicopter sowing.

Cutting units ranged from two to 50 acres. Boundaries were laid out to facilitate broadcast burning. Ridges, draws, and roads provided effective fire boundaries.

Logging continued from November to July. Upon completion, logging bulldozers (110 to 120 drawbar hp) pushed over residual stems and scraped 16- to 30-foot firelines around each patch cut. This combined operation cost about $20 per acre harvested.

High fire consciousness in this pine type dictated careful planning of the burn. Fuel moisture, wind, and fire buildup factors controlled ignition timing.

Weather records show that fire prescriptions may be met in the fall, after the first 1½ to two-inch rainstorm, and in midspring after several weeks of sunny weather. Fall burns eliminate more fuel. Spring burning is safer.

Experts supervised each burning operation. A radio net insured continuous contact with firing and suppression crews.

We used drip torches and fusees for ignition. Typically we'd strip burn 10 to 50 feet along the top edge, work down both sides and through the center. Finally, we'd fire the bottom. A strong central convection column, drafting vertically, helped control perimeter fires as they flashed off (Fig. 3). In two to three hours, a 30-acre compartment was reduced to smoldering logs.

Burning costs per acre ranged from a low of $8.50 to a high of $61.00. Our first fire was the most expensive. With experience our costs dropped to a two-year average of $26.25 per acre for 313 acres. Wages were 75 to 90 per cent of our direct cost. In accounting for the burn I have expensed $2 per MBF for slash disposal. The regeneration investment will vary inversely with the amount expensed.

In direct seeding, rodents are generally conceded to be the greatest problem. Before sowing, we baited mice with 1080 on wheat and treated our pine with an endrin-arasan repellent.

Helicopter sowing seems most advantageous for steep terrain and winter accessibility. It is fast. With a short break in weather, we sowed 75 acres in three hours.

Hand sowing, using a Cyclone[1] cereal seeder (Fig. 4), can be done well by small crews of permanent employees. One man can seed a swath of 25 to 30 feet—12 to 18 acres per day—even in light snow or rain. We sowed 1½ to 2½ pounds per acre.

After a March, 1964, sowing, July tallies showed only 240 seedlings per acre. Late fall sowings (1965) produced four to eight times more seedlings (Fig. 5, Table 1). We know that rodent populations ebb in fall and winter; winter rains churn the seeds into the soil, hiding them from rodents and improving the moisture and temperature conditions required for germination.

Recognizing the importance of a soil covering of one-fourth to one-half inch, we developed the Challenge-drag—five 4-foot lengths of channel iron drag from a 20-foot railroad rail held over the tractor drum by the butt hook. As the tractor dodges stumps and pushes logs aside, the channel irons angle across the ground, scraping a light soil covering over the seed. We dragged 42 acres at a cost of $14.70 per acre.

On dragged acres, first year seedling stocking was greater than where we did not drag (Table 1). By the second year the differences were slight.

Regeneration prescriptions must recognize area differences to be successful and to minimize costs. Continued research will help develop new, less expensive practices. ■

Table 1.—Costs and stocking (per acre) and cost index by regeneration prescription, 1967

Method	Site preparation	Rodent control	Planting stock or seed	Planting or sowing	Total	First year stocking	Cost index: CCA-1
			Dollars			Trees	Dollars
TERRACING AND HAND PLANTING—BOISE NATIONAL FOREST							
Contract	25	..	7	19	51	350	14.55
Force account	40	..	7	19	66	380	17.35
Contract site preparation	25	..	7	19	51	380	13.15
BURNING AND SEEDING—CHALLENGE EXPERIMENTAL FOREST[1]							
Helicopter sowing (spring)	6	2	8	2	18	240	7.50
Hand sowing (fall)	6	2	9	2	19	1,090	1.75
Dragged	6	2	9	16	33	2,150	1.55

[1] Cost of slash disposal averaged $40 per acre.

[1] Use of this trade name is for identification only and does not imply endorsement by the U.S. Department of Agriculture or the Forest Service.