Ret to

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

FOREST RESEARCH NOTES

Issued by the

PACIFIC NORTHWEST FOREST EXPERIMENT STATION

No. 3 (3) Portland, Oregon. Oct. 30, 1929

THE EFFECT OF FIRE ON DOUGLAS FIR SLASH

To obtain definite information which can be used in formulating slash disposal policies, the Pacific Northwest Forest Experiment Station has begun a study of the slash problem in the Douglas fir region. Although there are numerous related but widely different aspects to this study, only one phase is treated in this brief summary, namely, the effect of fire on the volume of slash.

As used here the term slash includes all forest material left on the ground after logging, i.e., the cull logs, tops, and branchwood, and also the windfalls, semi-rotten logs and other debris which is present in every forest. Standing snags and trees are not here included.

Data gathered during the course of the survey indicates that after logging is completed there are per acre from 5 to 140 cords (based on 100 cubic feet to the cord) of large pieces, i.e., broken logs, tops, down trees, large limbs, chunks, etc., larger than 3 inches in diameter and 3 feet long. The reasonably efficient logging operation leaves about 62 cords of this large material per acre--not all of which, however, is perfectly sound wood--representing, on an average, about 335 pieces. In addition, there are from about 40 to over 200 cords per acre of small pieces of wood, i.e., small limbs, twigs, and other material less than 3 inches in diameter and 3 feet long; the average amount of this small material is about 90 cords. The ordinary acre has also 3 or 4 cords of rotten (disintegrating) logs. All told, there are about 155 cords of wood debris of all kinds, per acre. Snags and unmerchantable trees not felled with the logging operation may blow down and materially increase these volumes.

The slash fire removes from 9 to 49 per cent of the volume of the large pieces, depending upon the severity of the fire and the age of the slash. Ordinarily, a fire in fresh slash probably consumes no more than 30 per cent of the total volume of these larger pieces. If the slash is over 10 years old, it will be drier than when fresh, much of the bark will have fallen, and the fire will remove about 50 per cent of its volume.

A heavy fire consumes at least 95 per cent of the volume of small material. Even a light fire in fresh slash removes about one-half of the branchwood and other small pieces. In slash left unburned for 5 or more years after logging, a light fire, if it passes over the entire area, will consume three-fourths of this small material.

The fire reduces only slightly the diameter of the larger pieces of slash, but burns entire sections from them. This occurs chiefly where cull logs and down trees or snags are crossed; the amount of wood which a slash fire will consume depends somewhat upon the number of large pieces which are cross-piled by the logging operation.

Since many of the larger pieces of slash are burned in two, there are more logs after the fire than before (averaging about 90 per cent more large pieces), and naturally there is a greater proportion of short lengths than before the fire. After the fire, the large pieces usually are more or less isolated from each other.

Cedar slash appears to burn more readily than any other species. In an area where there is mixed cedar, Douglas fir, and hemlock slash, about 40 per cent of the cedar volume, about 30 per cent of the Douglas fir volume, and perhaps 10 per cent of the hemlock volume will be consumed by the fire. About 15 per cent of the volume of the rotten (disintegrating) logs will be removed by a heavy slash fire.

This quantitative measure of volume reduction in Douglas fir slash by a broadcast burn is but one phase of the slash disposal problem. As the study progresses other factors will be evaluated in the belief that a knowledge of the actual results of various methods of slash disposal will be of practical use in determining the wisest treatment of logged-off lands.

SEEDLING SURVIVAL ON BURNED AND UNBURNED SURFACES

The article in the March 1929 issue of Research Notes, "Survival of One-Year-Old Douglas Fir Seedlings", shows the loss of seedlings from all causes while under various degrees of shade and lists heat as a major cause of death. The 1929 work brings out the variation in surface temperature, with the attendant loss of seedlings, on natural soil surfaces and on soil surfaces blackened by slash burning. The seedlings under observation germinated on two plots during the period of May 13 to 17 - one a specially prepared yellow mineral soil surface and the other a black charcoal surface - in a study area in the Wind River Valley, Washington; both plots were exposed to full sunlight. The first hot weather that developed killing surface temperatures occurred from May 20 to 24, inclusive. The temperatures recorded and losses of seedlings sustained during that period and later in the season are shown in the following table.

Date 1929 May	Air Temp.	Black Surface: Surface Temp.	Black Surface: Seedling loss Daily p.ct.	Black Surface: Seedling loss Total p.ct.	Yellow Surface: Surface Temp.	Yellow Surface: Seedling loss Daily p.ct.	Yellow Surface: Seedling loss Total p.ct.
20	89	143	47	47	125	--	--
21	85	144	6	53	135	16	16
22	89	144	47	100	137	--	16
23	83	134	--	---	122	16	32
24	81	133	--	---	121	--	32
Deaths from after effects of heat						10	42
" " insects						16	58
" " damping off						5	63
" " drouth						26	89
Total alive October 1, 1929				0			11

On the first hot day (89°F) the temperature on the charcoal surface rose to 143°F and took a toll of 47 per cent of the seedlings, while the surface soil temperature on the yellow soil rose to 125°F with no seedling loss. The loss of 100 per cent on the dark surface compared with a loss of 16 per cent on the yellow soil surface by the end of the third day is a striking difference. During the next two days the loss on the yellow soil mounted to 32 per cent, and an additional 10 per cent followed from the after effects of heat injury sustained during the foregoing period. Later in the season a 5 per cent loss was credited to damping off, 16 per cent to insects (nipping off seedlings), and 26 per cent to drouth, leaving 11 per cent alive on the yellow soil surface.

The heat injury mentioned consists of cooking the tender stem of the seedling at the soil surface. Many of the seedlings under observation, all of them less than 10 days old, showed evidence of heat injury to the stem at 125°F, but the first complete stem failure and death did not occur until a temperature of 135° was reached. Following the first hot spell, no critical weather occurred for a month and by that time the remaining seedlings on the yellow surface had hardened to a point where no further deaths were traceable directly to heat injury, even though much higher temperatures followed. The highest of the 1929 season occurred on July 30 when with an air temperature of 101° the surface temperature on yellow soil rose to 147°, and that on the charcoal surface to 165°.

The heavy loss of seedlings on the yellow soil surface from all causes combined is mute evidence of the severity of the struggle in seedling establishment, and the sudden killing of all seedlings by heat alone on the charcoal surface practically presages inevitably heavy losses for freshly burned areas, and demonstrates how the color of the surface alone may spell success or failure for a crop of Douglas fir seedlings. Shade from debris and vegetation will help to offset the superheating of exposed charcoal blackened surface soil, but lacking shade, the greatest survival is certain to be where the surface is not blackened by fire.

THE PROS AND CONS OF SEVEN METHODS OF TREATING WESTERN YELLOW PINE SLASH

The advantages and disadvantages of the several principal methods of slash disposal in the pine forests of eastern Oregon and Washington are summarized as follows in a manuscript recently prepared for publication by Munger and Westveld. These conclusions are based upon two years field study of the western yellow pine slash problem.

I. BROADCAST BURNING

Advantages

1. Low cost, usually less than 1 cent per thousand board feet.
2. Reduces slash fire hazard materially on cut-over lands.
3. Ease of execution on large scale.

Disadvantages

1. Great damage to advance growth, 55 to 91 per cent of reproduction and 31 to 100 per cent of reserve trees killed.
2. No reduction of slash hazard on current logging area.
3. Maximum damage to soil.
4. Kills without consuming small trees and undergrowth, which remain a fuel for future fires.

II. SPOT BURNING

Advantages

1. Low cost, 1 to 3 cents per thousand board feet.
2. Partial reduction of slash hazard on cut-over areas.

Disadvantages

1. Relatively large amount of damage to advance growth.
2. No reduction of slash hazard on current logging area.
3. Moderate damage to soil.

III. SWAMPER BURNING

Advantages

1. Eliminates slash fire hazard as fast as created on current logging area.
2. Very little damage to advance growth or reserve trees.
3. Facilitates horse logging.

Disadvantages

1. High cost, 55 to 60 cents per thousand board feet on the average.
2. Limited to short period of year because of climatic conditions.
3. Removes soil cover and plant food.

IV. PILING AND BURNING

Advantages

1. Eliminates the slash fire hazard after burning is completed.
2. Moderate damage to advance growth, ordinarily not over 10 per cent of advance reproduction and rarely over 2 per cent of reserve trees killed.

Disadvantages

1. High cost, average 45 to 55 cents per thousand board feet.
2. Does not reduce slash fire hazard on current logging area.
3. Limited by climatic conditions.
4. Removes soil cover and plant food.
5. Danger that investment in piling may be nullified by unsuccessful destructive burning.

V. NO BURNING METHODS

Advantages

1. No damage to reproduction or reserve stand through fire.
2. Maximum benefit to soil.
3. Very cheap, unless lopping, pulling, or piling is practiced.

Disadvantages

1. No immediate reduction of fire hazard on cut-overs.
2. No reduction of hazard on current logging areas.
3. If lopping, pulling, or piling is practiced cost is high.

VI. STRIP BURNING WITH INTENSIVE PROTECTION

Advantages

1. Low cost, 5 to 12 cents per thousand board feet.
2. Reduction of slash hazard to low point on old cut-over lands.
3. Presupposes intensive fire prevention on the logging operations and adjoining it for a term of years.
4. Preserves much of soil cover and plant food.

Disadvantages

1. Serious damage to advance growth and reserve trees on the burned strips, removing these areas from production.
2. No reduction of slash hazard on current logging area.
3. Requires intensive protection through a term of years to be effective.

VII. PARTIAL PILING AND BURNING WITH INTENSIVE PROTECTION

Advantages

1. Moderate cost, estimated at 22 cents per thousand board feet.
2. Reduction of slash hazard to low point on cut-over lands.
3. Presupposes intensive fire prevention on the logging operations and adjoining it for a term of years.
4. Very little damage to advance growth through burning.
5. Preserves much of soil cover and plant food.

Disadvantages

1. No reduction of slash hazard on current logging areas.
2. Its effectiveness in preventing fires depends upon the efficiency of the protective system through a term of years.

COLD STORAGE PROLONGS THE LIFE OF NOBLE FIR SEED

Experimental storage tests of noble fir seed have demonstrated that this seed if kept in cold storage loses its viability very gradually and will be usable for 3 to 5 years, as compared with seed stored at room temperature, which loses its viability in a single year.

This discovery makes it possible to maintain a constant supply of noble fir seed, and probably other Abies seed, by collecting a surplus every third or fourth year when the bumper crops occur and storing it for use during the intervening years.

A series of tests started in 1921 with seed that was found to be 58 per cent sound (by cutting tests) gave after cold storage a germination of 34 per cent in 1925 and 13 per cent in 1926. A second series of tests started in 1926 with seed that was 38 per cent sound showed a germination of 21 per cent in 1927, 17.5 per cent in 1928, and 13.5 per cent in 1929. Neither test showed germination after the first year for comparable lots of seed stored at room temperature. The temperature of the cold storage where the seed was kept was approximately 15°F, but probably need not be so cold.

As a result of this study the Forest Service in District 6 has now made cold storage a standard practice for seed of the balsam firs.

OBSERVATIONS MADE IN THE COURSE OF THE STUDY OF GROWTH ON CUT-OVER WESTERN YELLOW PINE LANDS

A second summer has now been spent on gathering information upon the growth that takes place in western yellow pine stands after partial cutting or selection cutting. Study plots were located on both public and private lands on and in the vicinity of the Deschutes, Crater, Fremont, Ochoco, Malheur, Whitman, and Umatilla National Forests, Oregon. Areas which had been cut over as recently as 10 years and as long as 65 years ago were visited. Some have been cut under the National Forest selection system, others on private land have been culled for the best trees or cut to a diameter limit. In all, 134 plots were measured in detail, covering a total area of approximately 220 acres. Detailed measurements of about 4000 standing trees of all sizes and conditions were taken and almost 6000 increment borings were collected and measured.

Though the measurements have not as yet been worked up, some of the field observations of those conducting the study have interest and are presented here.

Western yellow pine's growth responds readily to a partial release from competition with its neighbors as a consequence of selective cutting. Not only the healthiest trees, but also the poorest, slowest growing forms accelerate in growth. All classes if given increased room, which in turn means increased available moisture, respond almost immediately. A diameter growth 3 to 5 times the previous rate is very common. Occasionally the acceleration is tenfold. Not only does the diameter growth improve, but the appearance of the tree changes considerably for the better; the crown becomes denser and the foliage turns a darker green, The improvement in health plus the more adequate water supply have a double effect in increasing growth.

The rate of diameter growth following cutting is not constant. On well released trees diameter increment accelerates the first year following the cutting. The next year the increase is greater, and within 3 to 5 years the tree has attained its maximum growth, which may endure into the second and third decade, sometimes even longer. In trees which have not been released sufficiently the start is delayed and the lag is longer. Unfortunately in recent years the well recognized shortage of precipitation has caused an evident retardation of diameter growth on many areas for a period of 7 to 11 years. Naturally this obscures the effect of release on sustaining accelerated growth. It will take further study to properly account for this climatic variable.

The largest radial growths measured amounted to about 2.5 inches a decade, or a diameter growth of 5 inches, but these instances are extremely rare in Oregon. More commonly the rate of radial growth is between .75 and 1.50 inches per decade, or a diameter growth of 1.5 to 3.0 inches.

The growth of the individual tree alone means little unless reduced to terms of forest production on an acreage basis. This is done in this preliminary analysis by means of stand tables and stand maps. In using stand tables, however, a puzzling factor is the mortality from natural causes, during the period under consideration. Windfall has been found to be serious only in localized areas, though some undoubtedly occurs in all stands. The loss due to this cause in places has been very disquieting, but observations covering the whole region in Oregon tend to allay this fear. Fire may be disastrous at times, but even if not fatal to large trees it tends to reduce growth pronouncedly for a period of 3 to 4 years, as well as to kill many of the seedlings and saplings. The increase in defect of the standing large trees is also an inevitable accompanying result.

In the last issue of the Forest Research Notes, the diameter increments of three sample areas in southern Oregon were given. Two of the series of data representing the growth increment in the Pokegama region and in the Fort Klamath region have recently been tentatively applied to cruise tallies of limited cut-over stands on the Crater National Forest and resulted in growth predictions for the first 30-year period after cutting of 24.7 cubic feet on a reserve stand of 1,275 cubic feet, and an increment of 18.2 cubic feet on a reserve of 833 cubic feet. In terms of board feet, by use of a board foot-cubic foot ratio of 6 to 1, the increments would be 148 and 109 board feet on reserves of 7,650 and 5,060 bd. ft. respectively. A ten per cent reduction for probable losses throughout the period is assumed. These increments are higher than the increments used in some recent forest management plans for pine working circles in Oregon, chiefly because these Crater National Forest areas are better than average growth sites, but partly because the total cubic volume of all trees down to 4 inches in diameter B.H. is included in the above computation, and allowance is made for increased growth which inevitably follows release.

STATION NEWS ITEMS

Associate Silviculturist Walter H. Meyer has returned to the Station after nine months furlough at Yale in post-graduate study. He received the degree of Doctor of Philosophy, the title of his thesis being "Diameter Distribution Series in Even-aged Forest Stands".

Assistant Silviculturist R. E. McArdle has again gone on furlough for the school year to complete his graduate work for the Ph. D. degree at the University of Michigan.

Several technical men are being added to the Station's force to conduct the Forest Resource Survey authorized by the McSweeney-McNary Forest Research Act, for which $30,000 is available to start this economic study in the Douglas fir region of Oregon and Washington. Already the following have been engaged: Associate Forest Economist R. W. Cowlin, Junior Forester F. L. Moravets, and Junior Forester P. A. Briegleb.

The Bureau of Entomology has established a forest insect field station at Portland to serve the states of Oregon and Washington with advice regarding forest insect pests and to conduct research. This office will be in charge of Mr. F. P. Keen who for many years has been connected with bark-beetle projects in Oregon and California; his assistant is Mr. J. A. Beal. They have established their office adjoining the Forest Experiment Station at 501 Lewis Building, Portland.