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1948-1949 AERIAL SEEDING EXPERIMENTS

By

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PAGE

INTRODUCTION

By the fall of 1948 the results of the Cochran airplane seeding experiment (Research Bulletin No. 2, February 1949) were encouraging enough to justify further work in this field. Within certain limitations, aerial seeding seemed to be an answer to the problem of regenerating large areas of nonstocked forest land in the shortest possible time and at the least expense.

Some intermediate experiments to compare the airplane with the helicopter for baiting and seeding had been carried on subsequent to the Cochran experiment. By the winter of 1948-1949 definite advantages in favor of the helicopter had been demonstrated. The ability of the helicopter to take off and land almost anywhere and its greater maneuverability appeared to outweigh greatly the disadvantage of a lesser pay load. The helicopter companies, likewise, had conducted experiments which resulted in improvement of the seed disseminating devices.

PURPOSE OF THE EXPERIMENT

The purpose of these experiments was to test further aerial seeding as a practical method of artificial reforestation. At the time that the plots described herein were established, the only promising results which had been obtained through project scale aerial seeding were on the 1946 Cochran airplane seeding experiment. It was necessary to substantiate the results obtained in this prior experiment and at the same time try to solve some of the more obvious problems inherent in aerial seeding. More knowledge was desired concerning the

following questions:

1. What coniferous species can be successfully used in aerial seeding?

2. How much seed (within practical economic limits) should be used per acre?

3. What is the best bait to use and in what amounts; and how wide a buffer strip is necessary to secure adequate control of small seed eating mammals?

4. What is the best time of year to seed?

5. What are the results of sowing stratified seed?

PERSONNEL INVOLVED

John B. Woods, Jr., Assistant State Forester, was in general charge of the planning and conduct of the experiments. Dale N. Bever, Research Forester, directed the field work and Carwin A. Woolley did the majority of the surveying and plot layout work.

EXPERIMENTAL PROCEDURES

Project Plan

The plan decided upon was to establish four 500-acre plots and to cover as many of the problems as possible. Two of these plots (No. 29 and 34) were to be similar for the purpose of comparing fall sown seed with spring sown stratified seed of the same species.

Generally the plots were to be treated as follows:

1. Plot 28

   a. Douglas fir (1/3 lb. per acre) and Port Orford cedar (1 lb. per acre).
   b. Fall seeding, seed not stratified.
   c. Baited for control of small seed eating mammals.

2. Plot 29

   a. Douglas fir ($\frac{1}{4}$ lb. per acre), noble fir (1/8 lb. per acre) and white fir (1/8 lb. per acre).
   b. Fall seeding, seed not stratified.
   c. Baited for control of small seed eating mammals.

3. Plot 34

   a. Douglas fir ($\frac{1}{4}$ lb. per acre), noble fir (1/8 lb. per acre) and white fir (1/8 lb. per acre).
   b. Spring seeding, seed stratified.
   c. Baited for control of small seed eating mammals.

4. Plot 37

   a. Grand fir (2/5 lb. per acre).
   b. Spring seeding, seed stratified.
   c. Not baited.

Topography, ground cover and condition, and aspect were to be as nearly the same on all plots as possible. The method of seed distribution was to be the same on all plots. In this manner it was hoped that any differences in results would be because of species used, amount of seed per acre used, or whether fall or spring seeded (all spring sown seed was to be stratified).

Description of the Plots

Plot No. 28

Size: 500 acres.

Location: Tillamook county, Fractions of sections 7, 17 and 18, Township 1 North, Range 6 West, Willamette Meridian. (See Figure No. 2).

General topography: Smooth slopes and benches.

Elevation: 1200 to 2600.

Primary exposure: North.

Slope per cent: 0 to 60.

Soil: Deep.

Ground cover: Bracken fern, fireweed, Oregon grape and willow.

Original stand: Douglas fir, Western hemlock and Western red cedar.

Logging history: Logged 1936-37.

Fire history: Completely burned 1933, partially burned 1939, mostly burned 1945.

Natural stocking: Douglas fir, 6 to 10 years old, 1.5 per cent by milacre plots, averaging approximately 30 trees per acre. This plot was further subdivided into a 100 and a 400 acre block. The lower (most northerly) 100 acres were to be seeded with Port Orford cedar and the remainder was to be seeded with Douglas fir. (See Figure No. 2).

Plot No. 29

Size: 500 acres.

Location: Tillamook county. Fractions of sections 22 and 23, Township 1 North, Range 6 West, Willamette Meridian. (See Figures 3 and 4).

General topography: Rough and broken.

Elevation: 1600 to 3000.

Primary exposure: North.

Slope per cent: 0 to 60.

Soil: Deep.

Ground cover: Fireweed, grass, salal, blackberry and Oregon grape.

Original stand: Noble fir, Douglas fir, Western hemlock, Western red cedar.

Logging history: Logged 1935-40.

Fire history: Partially burned in 1933, completely burned in 1939 and 1945.

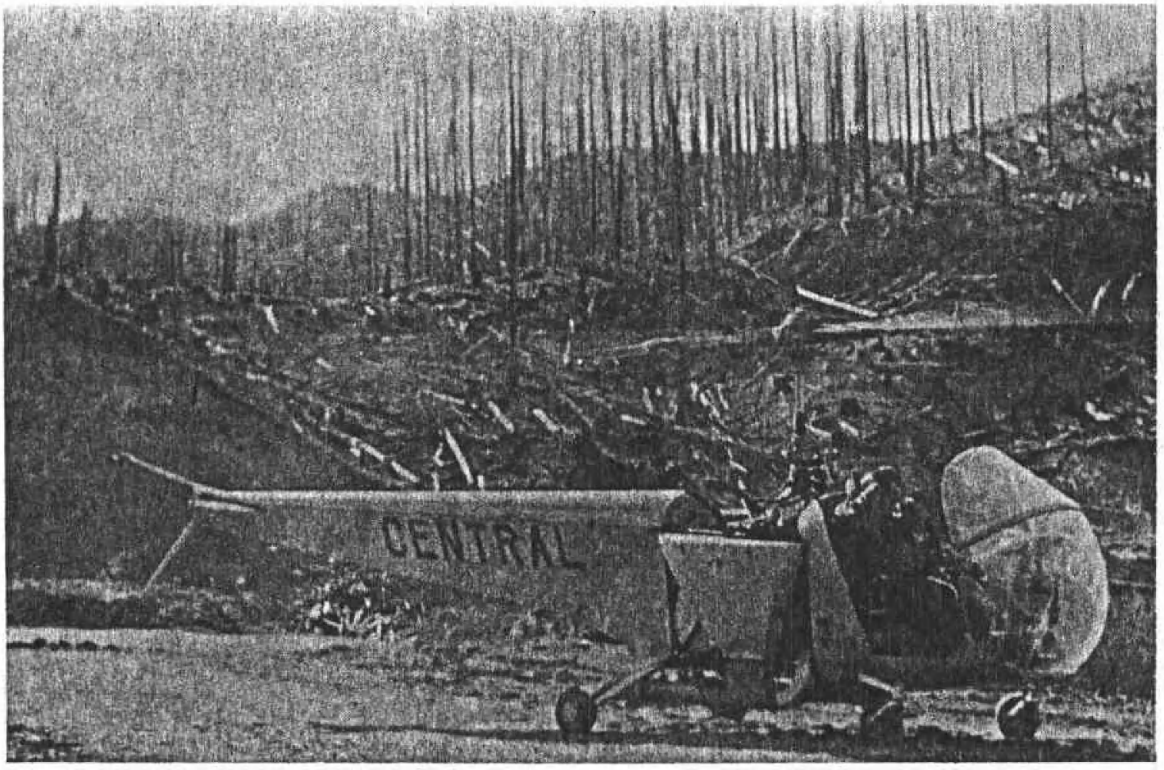

Figure No. 1. Helicopter with hoppers used in the baiting and seeding of plots 28, 29 and 34.

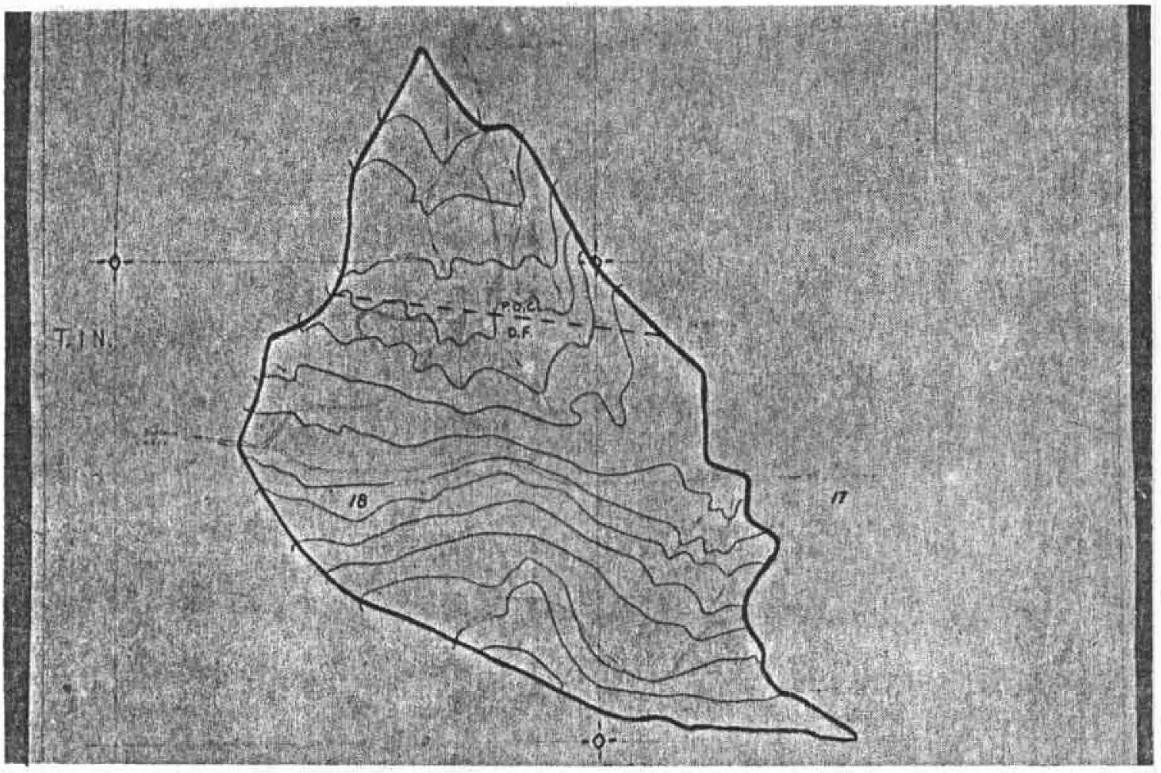

Figure No. 2. Contour map of plot 28, showing the areas seeded to Douglas fir and Port Orford cedar.

Natural stocking: Douglas fir, 2 to 8 years old, 1 per cent by milacre plots; noble fir 4 to 8 years old, 1 per cent by milacre plots; Western hemlock 4 to 8 years old, 3 per cent by milacre plots. Approximately 50 acres stocking to Douglas fir from 10 per cent to 30 per cent by milacre plots.

Plot No. 34

Size: 500 acres.

Location: Tillamook county. Fractions of sections 13, 14, 23 and 24, Township 1 North, Range 6 West, Willamette Meridian. (See Figures 3 and 4).

General topography: Rough and broken.

Elevation: 1600 to 3000.

Primary exposure: North.

Slope per cent: 0 to 60.

Soil: Deep.

Ground cover: Fireweed, bracken fern, grass and willow.

Original stand: Noble fir, Douglas fir, Western hemlock and Western red cedar.

Logging history: Logged 1935-40

Fire history: Partially burned in 1933, completely burned in 1939 and 1945.

Natural stocking: Douglas fir; 2 to 8 years old, 1 per cent by milacre plots; noble fir, 4 to 8 years old, 1 per cent by milacre plots; Western hemlock, 4 to 8 years old, 3 per cent by milacre plots.

Plot No. 37

Size: 500 acres.

Location: Washington and Tillamook counties. Fractions of sections 23, 24, 25 and 26, Township 2 North, Range 6 West, Willamette Meridian.

General topography: Rough and broken.

Elevation: 1000 to 2000.

Primary exposure: North.

Slope per cent: 0 to 60.

Soil: Moderate to deep.

Ground cover: Fireweed, bracken fern and brush.

Original stand: Douglas fir, Western red cedar and Western hemlock.

Logging history: Logged after 1933 fire.

Fire history: Partially burned in 1933 and 1945.

Natural stocking: Douglas fir, Western red cedar and Western hemlock, 1 to 10 years old, stocked 33.4 per cent by milacre plots.

Control of Small Seed Eating Mammals

Plot 37 was not baited. Plots 28, 29 and 34 were baited with wheat soaked in a two per cent solution of thallous sulphate and colored with green food dye. The bait was disseminated by helicopter at the rate of one-fourth pound per acre. Each of these three plots had a buffer strip one-fourth mile wide baited on all sides in addition to the baiting of the area to be seeded.

Plots 28 and 29 were baited on the 16th and 17th of December, 1948. Plot 34 was baited on the 8th and 9th of April, 1949.

Plot 34 was not trapped because the snow was so deep that access was difficult and trapping impractical. The results of trapping on plots 28 and 29, before and after baiting, are given in Table IX.

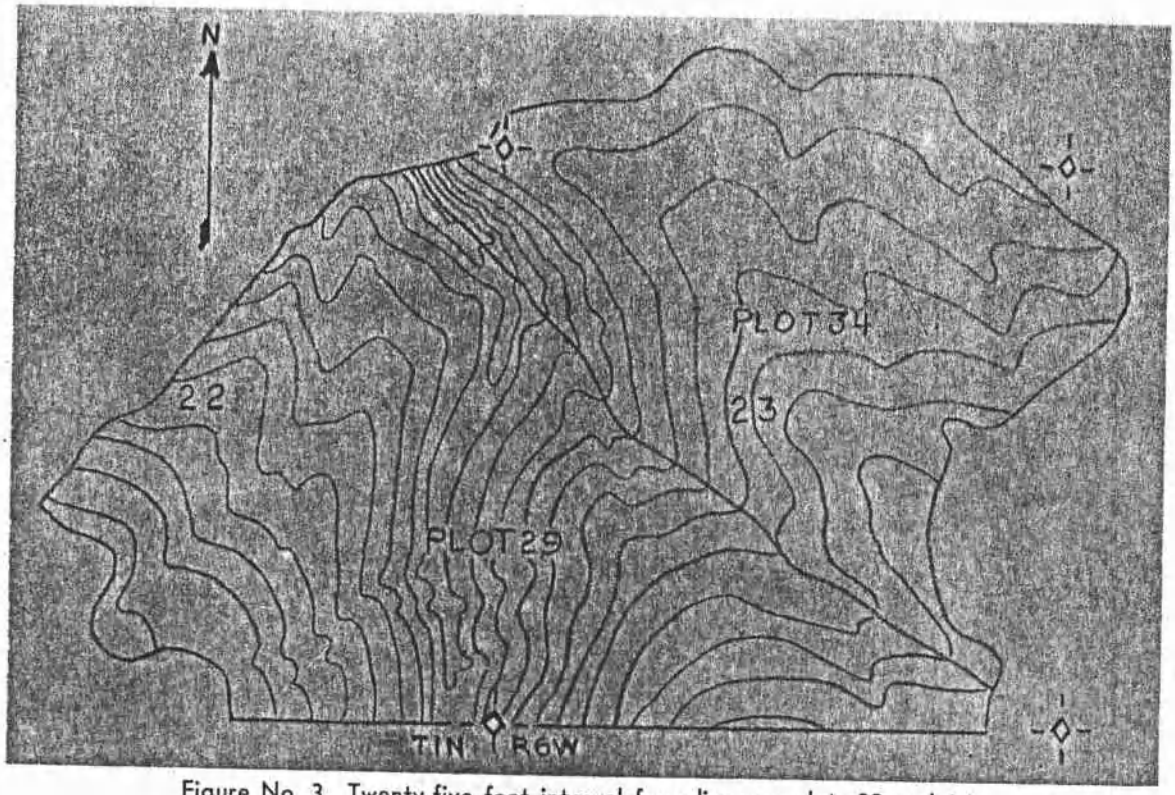

Figure No. 3. Twenty-five foot interval form lines on plots 29 and 34.

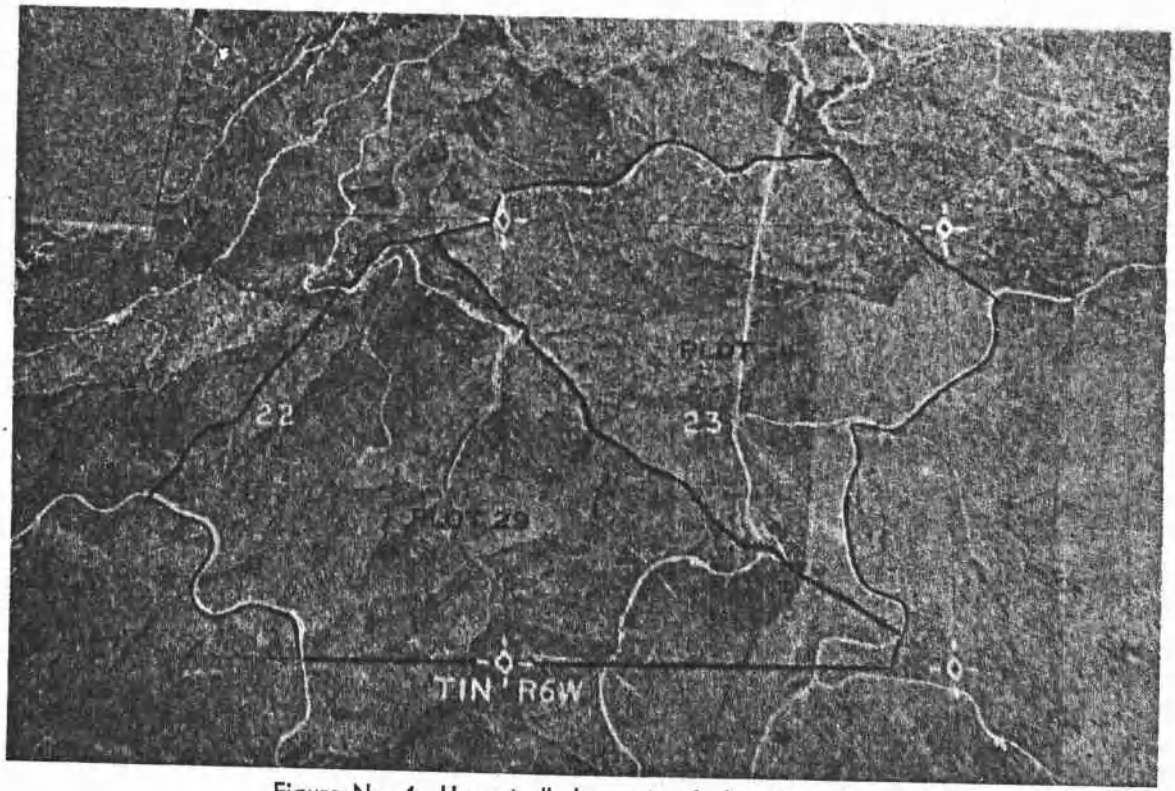

Figure No. 4. Uncontrolled mosaic of plots 29 and 34.

TABLE I

Seeding Data

Plot No.	Species Seeded	Pounds of Seed Used	Germination Per cent	No. Acres Seeded	Approx. No. Viable Seeds Per Acre	Remarks
28	Douglas fir (Pseudotsuga taxifolia)	130	69	400	9,000	Seeded on March 2, 1949 Douglas fir - medium elevation seed
	Port Orford cedar (Chamaecyparis lawsoniana)	103½	42	100	56,500	Port Orford cedar - Coos Co.- low elevation seed
29	Douglas fir (Pseudotsuga taxifolia)	135	65	500	7,000	Seeded on March 2, 1949 Douglas fir - medium elevation seed
	Noble fir (Abies procera)	50	56	500	900	Noble fir - high elevation seed
	White fir (Abies concolor)	50	37	500	600	white fir - medium elevation seed
34	Douglas fir (Pseudotsuga taxifolia)	135	65	500	6,000	This seed was stratified and suffered approximately a 15% loss due to pregermination in containers before seeding. Seeded on April 30 and May 3 1949. Seed source same as Plot 29.
	Noble fir (Abies procera)	50	56	500	800	
	White fir (Abies concolor)	50	37	500	500	
37	Grand fir (Abies grandis)	200	43	500	2,300	This seed had the same treatment loss as that used on plot 34 Seeded on April 29, 1949. High elevation seed.

Seeding

Plot No. 28

The plot was seeded by helicopter on March 2, 1949. At the time of seeding the lower elevations had patches of snow remaining and the higher elevations were almost completely covered with snow. The upper (in elevation) 400 acres of the plot were seeded with Douglas fir. The lower 100 acres of the plot were seeded with Port Orford cedar.

Distribution was checked on the snow and appeared to have satisfactory uniformity. The seed disseminating device in use at that time metered the seed out with a grooved rotor. This rotor was driven by belts and pulleys. By changing the size of the pulleys the rate of flow of seed could be regulated. This metering system proved cumbersome to use and difficult to regulate. There was also a tendency for balls of pitch and seed to cause a stoppage in the hopper when seeding Douglas fir. This is illustrated by the flight data for plot 28 shown in table II.

Table II

Flight Data For Plot 28

Flight No.	Load	Takeoff	Land	Elapsed Time	Remarks
March 2, 1949					
1	130 lbs. D.F.	1:27	2:09	:42	Seed clogged hoppers. approx ½ area flown
2	Remainder of flight 1	2:25	2:56	:31	Seed clogged hoppers approx 3/4 area flown
3	Remainder of flight 2	3:13	3:41	:28	D.F. area completed
4	103½ lbs. P.O.C.	3:55	4:20	:25	No hopper trouble
				2:06	

Plot No. 29

This plot was seeded by helicopter on March 2, 1949. The mixture of Douglas fir, noble fir, and white fir was used. The same helicopter was used to seed this plot as was used on Plot No. 28, but less trouble was experienced with the seed disseminating device.

Table III

Flight Data For Plot 29

Flight No.	Load	Takeoff	Land	Elapsed Time	Remarks
March 2, 1949					
1	135 lbs. Mixture	10:45	11:23	:38	Cloudy Wind 5 to 10 (Mph.)
2	100 lbs. Mixture	11:30	12:07	:37	
				1:15	

Plot No. 34

This plot was seeded by helicopter on April 30 and May 3, 1949. It was seeded to Douglas fir, noble fir and white fir in the same amounts by weight as was plot No. 29. The plots did not receive the same amount of viable seed, however, for some viable seed (approximately 15 per cent of the total number of seeds) was lost due to germination in containers while awaiting flying weather. The same helicopter was used on this plot as on plots 28 and 29.

Table IV

Flight Data For Plot 34

Flight No.	Load	Takeoff	Land	Elapsed Time	Remarks
April 30, 1949					
1	78 lbs. Mixture	10:29	11:07	:38	All seed out
May 3, 1949					
2	78 lbs. Mixture	10:09	10:45	:36	Right hopper empty Left hopper full

Table IV - continued

Flight No.	Load	Takeoff	Land	Elapsed Time	Remarks
May 3, 1949 - continued					
3	Remainder of flight 2	11:15	11:50	:35	Snow forced landing Left hopper still not feeding correctly.
4	Remainder of mixture (78 lbs.)	12:29	12:55	:26	35 lbs. (wet weight) seed not seeded, left in hopper.
				2:15	

Plot No. 37

This plot was seeded by helicopter on April 29, 1949. The grand fir used on this plot was stratified and suffered the same loss (approximately 15 per cent) through early germination in the container as did the seed used on plot no. 34. The same helicopter was used on this plot as was used on plots 28, 29 and 34. No trouble was experienced with the seed distributing mechanism but there were some delays caused by bad weather.

Table V

Flight Data For Plot 37

Flight No.	Load	Takeoff	Land	Elapsed Time	Remarks
April 29, 1949					
1	100 lbs.	2:39	2:50	:11	Forced down by snow and rain
2	Remainder of flight 1	3:29	3:57	:28	
3	100 lbs.	4:22	4:37	:15	Forced down by snow and rain
April 30, 1949					
4	Remainder of flight 3	9:00	9:20	:20	Completed plot
				1:14	

RESULTS

Costs

Listed in Table VI are the costs incurred on plots 28, 29, 34 and

TABLE VI

Project Costs

Plot No.	Survey and Control	Bait	Bait Application	Seed	Seed Application	Seed Stratification	Total Cost	Cost Per Acre
28	40 man hrs. @ $1.50 per hr. $60.00	275 lbs. @ .65 per lb. $178.75	1100 acres @ .75 per acre $825.00	130 lbs. D. F. @ $10.00 per lb. $1300.00 100 lbs. P.O.C. @ $5.00 per lb. $500.00	500 acres @ $1.00 per acre $500.00	-	$3,363.75	$6.73
29	40 man hrs. @ $1.50 per hr. $60.00	275 lbs. @ .65 per lb. $178.75	1100 acres @ .75 per acre $825.00	135 lbs. D.F. @ $7.50 per lb. $1012.50 500 lbs. N.F. @ $4.25 per lb. $212.50 50 lbs. W.F. @ $4.25 per lb. $212.50	500 acres @ $1.00 per acre $500.00	-	$3,001.25	$6.00
34	40 man hrs. @ $1.50 per hr. $60.00	275 lbs. @ .65 per lb. $178.75	1100 acres @ .75 per acre $825.00	135 lbs. D.F. @ $7.50 per lb. $1012.50 50 lbs. N.F. @ $4.25 per lb. $212.50 50 lbs. W.F. @ $4.25 per lb. $212.50	500 acres @ $1.00 per acre $500.00	235 lbs. @ $1.00 per lb. $235.00	$3,236.25	$6.47
37	40 man hrs. @ $1.50 per hr. $60.00			200 lbs. G.F. @ $3.75 per lb. $750.00	500 acres @ $1.00 per acre $500.00	200 lbs. @ $1.00 per lb. $200.00	$1,510.00	$3.02

37. Costs are listed in man hours, supplies and equipment as well as in dollars. This will facilitate future estimates where changing costs must be considered.

Germination

In the spring of 1949 the plots were examined for germination. On each plot, and with each species involved, where appreciable germination was found seedlings were staked and numbered to facilitate later survival checks. As a result of this search for germination three Douglas fir survival check areas were established. The search indicated almost a total failure of the following species:

Plot 28 - Port Orford cedar
Plot 29 - Noble fir
White fir
Plot 34 - Noble fir
White fir
Plot 37 - Grand fir

Of all these species only Port Orford cedar appeared in any numbers in subsequent stocking surveys. The 1950 survey showed Port Orford cedar to be present in the amount of approximately 150 trees per acre. This indicates that either the cedar seedlings were too small to be found in 1949 or that there was considerable delayed germination.

The true firs on plots 34 and 37 could have failed to germinate because of the trouble encountered during seed stratification, but the same seed used on plot 29 was not similarly damaged and it also failed to provide favorable results.

Survival

The checks made on survival (See table VII) showed that the seedlings did remarkably well during the first summer. The lowest survival of the three check plots was 94 per cent.

The plot 28 check plot was damaged by the construction of a firebreak

so that no further survival counts could be made after September 1949. Checks in 1951 on plots 29 and 34 showed that second and third year mortality was much greater than first year mortality. Plot 29 survival had dropped to 64 per cent and plot 34 survival had dropped to 55 per cent.

TABLE VII

Survival Checks

Plot 28 Douglas fir 50 Seedlings staked in June, 1949

Date Examined	Number Checked	Number Alive	Survival Per cent
Aug. 9, 1949	50	50	100
Aug. 29, 1949	50	50	100
Sept. 23, 1949	50	49	98

Plot 29 Douglas fir 100 Seedlings staked in June, 1949

Date Examined	Number Checked	Number Alive	Survival Per cent
Aug. 9, 1949	100	97	97
Aug. 29, 1949	100	97	97
Sept. 30, 1949	99	95	96
Oct, 1951	91	58	64

Plot 34 Douglas fir 50 Seedlings staked in June, 1949

Date Examined	Number Checked	Number Alive	Survival Per cent
Aug. 9, 1949	48	48	100
Aug. 29, 1949	48	48	100
Sept. 30, 1949	49	46	94
Oct 9, 1951	47	26	55

Plot 37

No survival checks could be made since no seedlings were found.

Stocking Surveys

Table VIII shows the results of stocking surveys which were made in 1949, 1950 and 1951. It is interesting to note that while survival on plots 29 and 34 was dropping approximately 50 per cent, the stocking surveys taken the same two years, 1949 and 1951, showed an increase from 9 and 6.25 per cent in 1949 to 23.6 and 17 per cent, respectively, in 1951, (See Table VIII). Obviously, as there was very little delayed germination on these plots, the apparent discrepancy is due to the difficulty in finding first year seedlings. From this it would seem unwise to decide the success or failure of a direct seeding project from surveys taken the first year after seeding. The third or fourth year after seeding will give a better indication of what to expect. By that time the first heavy losses in seedling mortality have taken place and the seedlings are large enough to be found readily.

The results of the Douglas fir stocking on plots 28, 29 and 34, three years after seeding, do substantiate the results obtained from the 1946 Cochran plot. Their milacre stocking per cents of 22.4, 23.6 and 17.0 respectively compare very closely with the third year milacre stocking per cent of 19.4 found on the Cochran plot.

Approximately 60 per cent of plot 34 was relogged from 1950 to 1952 and 25 per cent of plot 29 was relogged in 1951 and 1952. This undoubtedly destroyed some of the stocking which resulted from the aerial seeding so that the data shown for these plots for the 1950 and 1951 surveys are probably low.

TABLE VIII

Stocking Surveys

Douglas fir

Plot 28

Date Examined	STOCKING					
	Number Four Milacre Plots	Number Four Milacre Stocked	Per cent Four Milacre	Number Milacre Stocked	Per cent Milacre	Number Trees Per Acre*
Nov. 30, 1949	93	20	21.5	31	8.3	105
Sept. 28, 1950	99	55	55.5	89	22.4	320

Large portion of this plot interplanted in 1951 with Douglas fir stock of same size as seeded trees.

Port Orford cedar

Nove. 30, 1949	18	0	0	0	0	0
Sept. 28, 1950	44	12	27.2	20	11.3	150
Dec. 15, 1952	83	4	4.8	6	1.8	15

Plot 29

Douglas fir

Nov. 29, 1949	134	34	25.3	48	9	110
Sept. 27, 1950	136	93	68	148	27	395
Nov. 9, 1951	151	85	56.4	145	23.6	335

No noble fir or white fir found.

Plot 34

Douglas fir

Dec. 7, 1949	160	31	19.4	40	6.25	70
Sept. 24, 1950	116	61	53	87	19	265
Nov. 8, 1951	113	45	34.7	77	17	230

Plot 37

Grand fir

Dec., 1949	88	5	5.6	6	1.7	15

Subsequent spot checks showed no seedlings, so further stocking surveys have not been made.

*From curve in Oregon State Board of Forestry Research Note No. 9 "The Relationship of Stocking Per cent to Number of Trees Per Acre On Artificially Seeded Areas."

Comparative Results in Stocking

Although there can be no really accurate comparisons among these plots because of the many uncontrolled variables it is interesting to note that a statistical analysis of the Douglas fir stocking between any two of the plots containing Douglas fir (28, 29 and 34) shows that there is no significant difference in the stocking. This might be construed to mean that the amount of seed, which varied from 6,000 viable seeds per acre on plot 34 to 9,000 viable seeds per acre on plot 28, did not materially affect the number of seedlings found. Such an assumption can not be depended upon as there are too many other variables involved. No two plots were exactly alike in all other respects. The fact that there was no significant difference in stocking may be due to differences in several of the unmeasured variables. Differences in stocking due to a variation in amount of viable seed used could have been offset by variations in stocking due to time of year seeded or whether the seed was stratified.

In spite of the fact that no statistical analysis of number of seedlings found can be made to prove or disprove either the superiority of fall sown dry seed over spring sown stratified seed there was some information of definite value gained from the experiment. The inconsistency of the weather caused flying delays which resulted in pregermination of approximately 15 per cent of the viable seed in the containers. This points out the risks which must be taken when using stratified seed on an aerial seeding project. At least it should be necessary to have cold storage facilities at, or reasonably near, the aircraft loading point to circumvent the hazard of excessive delays in seeding caused by weather (or aircraft breakdown) after the seed has been removed from stratification

and transported to the loading point. In addition stratification of seed entails slight additional expense which can only be justified by an increase of seedlings produced. To date there is no proof of such an increase through use of stratified seed; but rather the evidence tends to point toward reduced stocking. The use of stratified seed in a nursery where at least the moisture conditions can be controlled is far different from use of the same seed sown where it is often subject to the unfavorable weather. Seed in the latter case has not reached the point of germination through natural weathering but has been forced artificially. Several weeks of hot dry weather immediately after aerial dissemination of stratified seed would probably produce failure in germination and survival. Whether such a condition would prove equally fatal to seed which had weathered normally in the field and was also ready to germinate is at present unanswerable. The most puzzling problem, however, to one faced with spring sowing of stratified seed is when exactly to do it. Would it be best to seed at a time when seed weathered in the field is ready to germinate? If so how may this exact time be determined? Would it be better to stratify the seed a shorter period of time, distribute it early to insure some rain after seeding and depend upon natural moisture and favorable temperature to complete the job of preparing it for germination? Until answers are found to some of these questions it would seem to be advisable to restrict aerial seeding to the fall.

TABLE IX

Trapping Data on Plots 28 and 29

	Prebaiting November 2, 3, 4, 1948	Post baiting March 15, 16, 17, 1949
Plot 28	Catch: 29 mice 3 shrews Per cent catch - 29.6	Catch: 3 mice 3 shrews Per cent catch - 5.5
Plot 29	Catch: 10 mice 2 shrews Per cent catch - 11.1	Catch: 0 mice 0 shrews Per cent catch - 0

Both these areas were trapped with 36 snap traps set in a square pattern to cover one acre. This resulted in 108 trap nights for the three day period. It was not possible to trap plot 34 because of snow.

Control of small seed eating mammals seemed adequate by existing standards. The one-fourth mile buffer strip proved quite effective and there was apparently no appreciable loss of seed on any of the baited plots due to mice or shrews.

Some mice and shrews did survive the baiting. This could have been due to not accepting a toxic dose at first and then refusing more of the bait, refusing the bait at the outset, or to some other, now unknown, cause. It was concluded that the use of two different baits at the same time, or at two different times, might provide more complete control.

SUMMARY

The report covers the results of four 500-acre aerial seeding plots established in 1949. The project was undertaken to augment available information on the various problems involved in attemoting to establish stands of timber in Western Oregon by aerial seeding.

Five species of trees were seeded but only one, Douglas fir, showed any promise. The use of noble fir, white fir, grand fir and Port Orford cedar offered no encouraging results. Control of seed eating mammals was generally satisfactory but could have been better. The one-fourth mile baited buffer strip appeared to be adequate to prevent reinvasion. The bait used was wheat soaked in a 2 per cent solution of thallous sulphate.

Costs varied from $3.02 per acre on the unbaited area to $6.73 per acre on the baited plots. Major variations in costs were due to species and amounts of seed used.

Survival checks on the Douglas fir showed that approximately 50 per cent of the original germination survived the third summer. Stocking surveys taken in 1951, three years after seeding, indicated that there were from 230 to 335 trees per acre resulting from the aerial seeding. This places most of the area in the poorly stocked class with a small amount in the medium stocked class. These results, of course, need improving but it must be emphasized that they were obtained from using only 6,000 to 9,000 viable seeds per acre.

Some of the observations which were made on these plots that were of help in planning subsequent aerial seeding projects were:

1. The helicopter is practical aircraft to use in direct

seeding work and does a creditable job on large areas.

2. The seed disseminating device in use at the time of the study needed improvement to eliminate clogging.

3. Thallous sulphate treated wheat was a good bait but not the final answer. More research in control of seed eating mammals was indicated.

4. The one-fourth mile baited buffer strip seemed adequate to prevent early reinvasion of seeded areas by small seed eating mammals.

5. Of the species tried only Douglas fir provided encouraging results.

6. Fall seeding has at present appeared less expensive and more productive of seedlings than spring sown stratified seed.