

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

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February 19, 1937

SEEDING EXPERIMENT
BURGESS SPRING EXPERIMENTAL RANGE
LASSEN NATIONAL FOREST

Field Study of Germination and Mortality to
Jeffrey and Ponderosa Pine Seedlings

By

L. D. Lloyd, Junior Forester
California Forest and Range Experiment Station



February 19, 1937

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Black's Mt.
Rungas Spring

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Approved:

_____ **Date**

_____ **Silviculturist**

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TABLE OF CONTENTS

	<u>Page</u>
Introduction.....	1
Purpose.....	2
Location.....	2
Time.....	2
Personnel.....	6
Description of Plot.....	6
Area.....	6
Topography.....	6
Soil.....	6
Weather.....	7
Site.....	8
General.....	8
Description of cover.....	8
Method of study.....	8
Survey.....	8
Seeding.....	9
Description of seed.....	10
Rodent control.....	11
Forms and classifications used.....	14
Pine seedling record form.....	15
Cover classification.....	17
Causes of mortality to seedlings..	17a
Results.....	18
Summary.....	27
Illustrations of causes of mortality.....	28
Appendix.....	30
Photographs.....	31
Distribution of quadrats on major exposures.....	33
Soil moisture determinations.....	37
Precipitation record.....	38
Recommendations for future work.....	39
Map showing location of quadrats.....	40

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Burgess Spring

February 12, 1937

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Introduction

Direct seeding of burned and cut-over forest land in California, for the purpose of artificially establishing tree reproduction, offers little hope for success at the present time. Rodents eat a large percentage of the seed after sowing, and the few seedlings that do germinate have such a difficult period to go through before they become established that not many survive even the first growing season.

During the year 1936 the pine management division of the California Forest and Range Experiment Station conducted a study to determine the feasibility of sowing poison-coated pine seed in an effort to reduce or eliminate the initial rodent damage; and to determine the causes of mortality to the seedlings that did germinate, in order that adequate control of at least some of the causes could later be accomplished. The study was made in conjunction with the range management division who were interested in determining the damage done to tree reproduction by cattle.

The study was made on the Burgess Spring Experimental Range, Lassen National Forest, California. Two of the important western yellow pines were used, ponderosa pine (*Pinus ponderosa* Laws.) and Jeffrey pine (*Pinus jeffreyi* "Cresg. & Con.").

This report combines the regular establishment report with the results of the first year of study. Some of the material under purpose, method of study, description of cover, and rodent control have been taken from R. pine ranges, report number 8, "Pine reproduction vs. livestock management", by M. D. Stowell and J. R. Bentley, with a supplement by W. Fair.

Purpose

Pine management: To determine the feasibility of sowing ponderosa and Jeffrey pine poison-coated seed to reforest a cut-over area in the pure pine type of northern California; and to determine the causes of mortality to the seedlings.

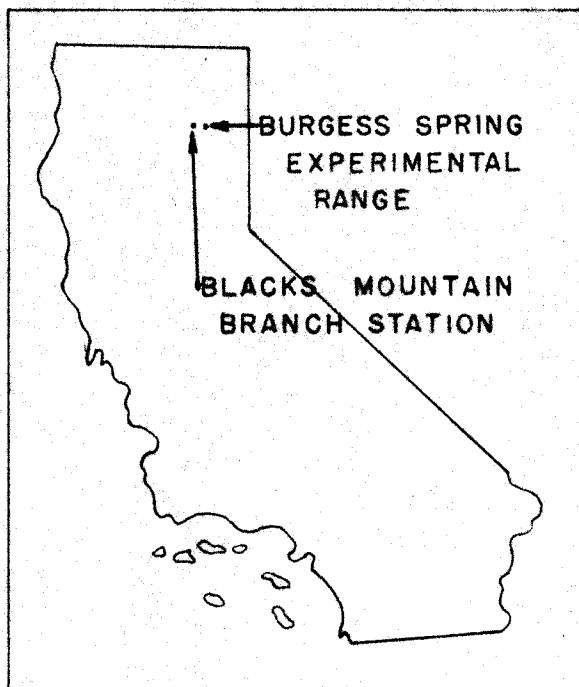
Range management: To establish quadrats every $2\frac{1}{2}$ chains apart over an area of approximately 550 acres, for the purpose of conducting carrying capacity studies, and to plant these quadrats with ponderosa pine and Jeffrey pine seed in order to determine the effect of cattle grazing on tree reproduction.

Location

The plot is located in Section 18 and 19, Township 35 North, Range 9 East, M.D.M. (See sketch map.) It is approximately 20 miles northwest of Susanville, California and 14 miles due east of the Black's Mountain Branch of the California Forest and Range Experiment Station. It is the area shown on the Lassen National Forest map as "Cone Troughs". By road, the plot is 35 miles from Susanville and 20 miles from the Black's Mountain Station. The plot is in Lassen County.

Time

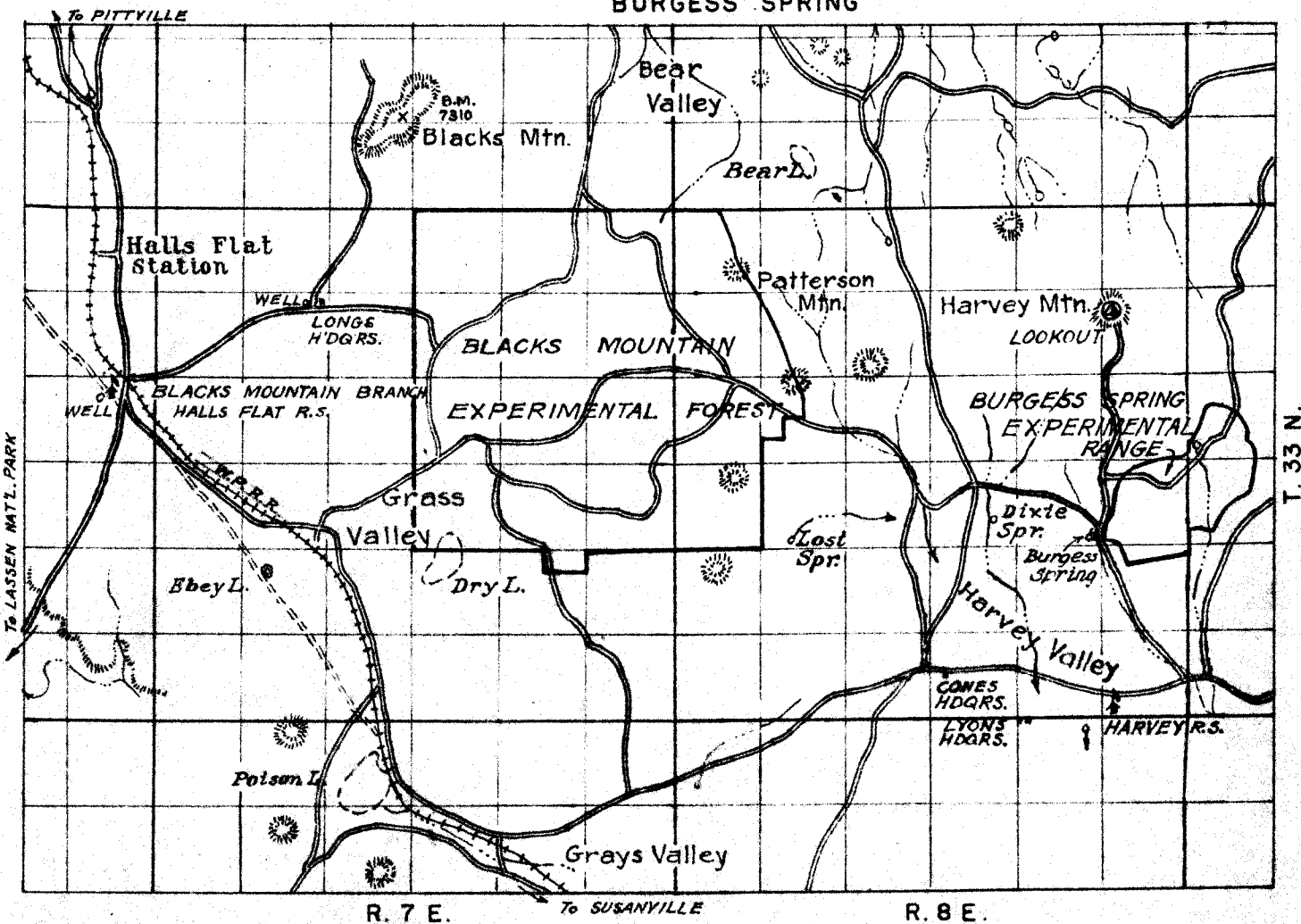
The plot was selected the fall of 1935 by A. L. Harvey and M. W. Talbot.



PLOT LOCATION U.S.D.A., FOREST SERVICE CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

RS
M-1
F

BLACKS MOUNTAIN
BURGESS SPRING



SCALE

1/2" = 1 MILE.

The Fruit Growers Supply Company logged the area in the summer and fall of 1934 with tractors and arches. United States Forest Service marking rules were used.

Surveying, laying out quadrats, and fencing the 550 acres were completed during the summer and fall of 1935.

Sowing of the quadrats was started October 23, 1935 and completed November 10, 1935.

On October 21 and 22, 1935 an area within the plot of 65 acres was treated with poisoned grain. This area is shown on the quadrat map in the appendix.

One-fourth, or 111 of the 557 quadrats, were fenced prior to the entrance of cattle to the range on June 19, 1936. The cattle were removed from the range on September 24, 1936.

The pine seedlings were examined on the following dates during 1936:

Examination Date

Number

1	May 19-23, 25-27
2	June 15-18
3	July 7-9
4	July 21-23
5	August 5
6	August 19
7	September 3
8	September 15-17
9	October 1
10	November 8

Metereological and soil observations were taken from June 1, 1935 to November 15, 1936. Two soil moisture samples were taken after November 15; one on November 19, the other one month later on December 19, 1936. In table 1 will be found a complete list of instruments and observations with the period of observation.

TABLE 1. Instruments used and observations made during 1935 at the Burgess Spring site factor station.

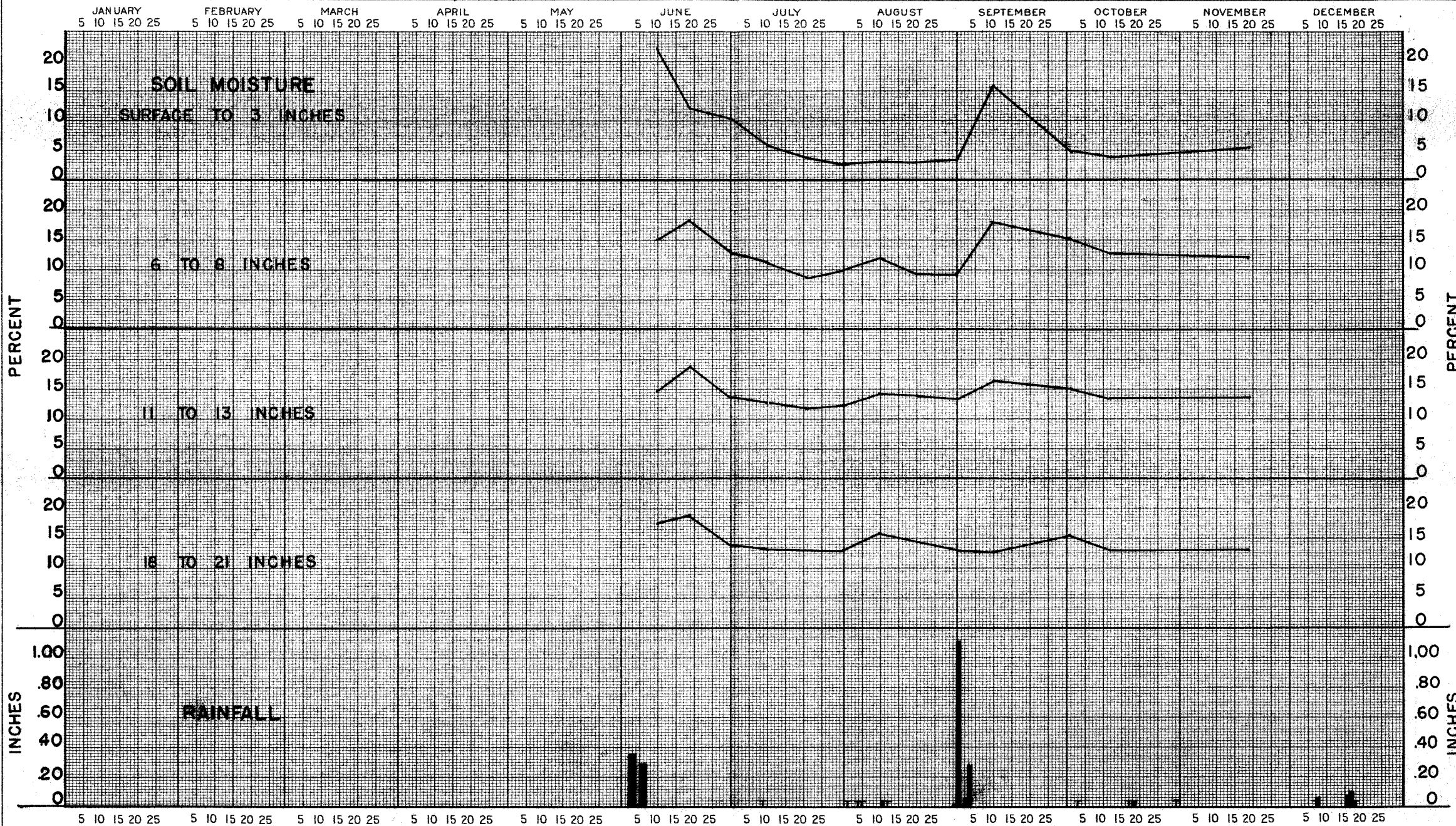
Observation	Instrument	Number	Period
Temperature & humidity	Friess hygro-thermograph	GREEN 1146	6/1 to 11/16 & 12/18 to 21
Maximum temp.	Maximum therm.	Green 77453	6/1 to 11/16
Minimum temp.	Minimum therm.	Taylor 469	6/2 to 11/16
Rel. humidity	Psychrometer	Green 7724445	6/1 to 11/16
Soil temp. $\frac{1}{2}$ "	Max.Min. recording	Prince 109	6/10 to 11/2
" " 3"	thermometers.	" 1140	6/10 to 11/2
" " 7"		" 135	6/10 to 11/2
Wind movement at 14" above ground.	5 Cup anemometer	Friess 3025	6/10 to 11/2
Character of day	By observation	-	6/1 to 11/16
Evaporation	Livingston spherical porous cup anemometer.	One numbered S 32-210 Coef .80	6/10 to 9/15
Soil moisture	None	None	6/10 to 12/19
Precipitation	8" rain gage.	None	6/1 to 11/16
Phenological Observations	Jeffrey & ponderson seedlings & saplings	10 each	6/10 to 11/5

BURGESS SPRING SITE FACTOR STATION

1936



BURGESS SPRING "B" 1936



Introduction

This experiment is under the direction of Duncan Dunning, Pine management phase; and A. L. Hornoy, range management phase.

Control was first established by F. Parker in 1934.

Surveying and staking out of quadrats was done by M. D. Stowell, R. W. Gardner, L. R. Short, and L. D. Lloyd.

Seeding was done by L. D. Lloyd, M. D. Stowell, R. W. Gardner, J. R. Bentley, M. Swensen, and K. A. Taber.

Poisoning and coating of the seed was under the direction of W. E. Fair of the U. S. Biological Survey.

C.C.C. labor from the Hall's Flat camp was used to fence the range and quadrats.

Seedlings were examined by L. D. Lloyd, R. W. Gardner, L. R. Short, J. R. Bentley, A. L. Hornoy, K. A. Taber, F. Hazel, and in a few cases by C.C.C. Technicians.

Meteorological and soil observations were made by A. L. Hornoy, J. R. Bentley, R. W. Gardner, L. R. Short, L. D. Lloyd, and in a few cases by C.C.C. Technicians.

Soil moisture tests and the phenological observations were made by L. D. Lloyd.

Description of plot

Area: The plot is irregular in shape and contains approximately 550 acres; of which 537 are in plot proper, and 13 acres are in a meadow, lane, corral, and water enclosure.

Topography: The plot has gentle slopes, averaging 3 percent, with a maximum of 20 percent. Five aspects are represented; southeast is the most general, followed by south, southwest, east, and west in the order named.

The elevation ranges from 5,675 to 6,190 feet above sea level. Surface drainage is to the southwest into Little Harvey Valley.

Soil: To date very little has been done with the soils of this plot. Field moisture determinations were made approximately every ten days from June 10 to October 12, plus two more sets on November 19, and one more set on December 19, 1936. These data are shown in figures 1 and 2. The significant fact brought out by these determinations is that the wilting point for the soil around the site factor station was reached by July 10 and lies between 10 and 15 percent of the total moisture, based on the weight of oven dry soil.^{1/} This can be checked by growing plants in pots. The samples were only taken down to 21 inches as at that depth large boulders were encountered.

^{1/}Percentage of moisture is based on the weight of an oven dry sample of 20 grams of fine earth. Samples were kept in the oven for 24 hours at 105 degrees Centigrade. Volumetric determinations were not possible because of the dry, loose, rocky nature of the soil.

No mechanical analysis has yet been made of the soils present on the area. The soil from 6 to 21 inches inside of the site factor station enclosure feels like a silt loam and the color is a light brown with a slight reddish tinge. Lava outcrops are present on the area and the nearby mountains are volcanic.

Litter and duff cover the majority of the ground; varying in depth from a fraction of an inch in the open, to several inches under the thickest of the pine stands. The skid trails were bare of litter the summer of 1935 following logging, but needles have accumulated on them since then.

A study of the soil horizons in several localities will be made during the summer of 1937 and the profiles shown in diagrams and photographs.

Weather: No long time weather records are available for this locality. Weather records taken since June 1, 1936 show a maximum air temperature of 95.0 degrees Fahrenheit on July 19 and a minimum air temperature of 12.1 degrees on November 2. Rainfall from June 1 to November 16 totaled 2.89 inches plus 7 traces. During that period rain fell on 20 days. The heaviest amount occurred on September 1 when 1.11 inches of rain fell during the 24 hours.

The following paragraph on climate has been taken from the U. S. D. A. Bulletin number 23, series 1931, "Soil Survey of the Alturas Area, California", by E. J. Carpenter and R. Earl Storie. The climate of the Alturas area is quite similar to that of the Burgess Spring plot. The area described lies in Modoc County, which borders Lassen County on the north, and in Lassen County.

"The climate is characterized by cold wet winters and warm dry summers. The wet season begins in November and continues into May, and during this season about 70 percent of the normal precipitation is received. The days are generally cool, and freezing temperatures are recorded nearly every night. Occasionally temperatures several degrees below zero are experienced for several days at a time, although as a rule the extreme cold spells are of short duration. Much of the precipitation during the winter is in the form of snow which occasionally blankets the ground for periods of several weeks,..... Light snows are sometimes experienced as early as October and as late as May. The spring months are usually cool and wet, During the summer, daytime temperatures of 100 degrees F. or higher are experienced occasionally, although as a rule, the heat is not oppressive, and the nights are always cool. The fall months are cool and pleasant, with frosts at night and some snow on the higher elevations. (This is especially true at Burgess Spring.- Author). Cold and dry north winds occurring in April, May, and June may be followed by frost. Winds blowing from the southwest or west are of frequent occurrence during the spring and early summer, and these winds pick up an appreciable quantity of dust, They take up moisture from the soils during the summer, and at other times of the year they are generally cold and raw. Frosts may occur any month of the year, but as a rule the summer months are comparatively free."

Site: The site is class IV, cut-over ponderosa and Jeffrey pine with scattered white fir and juniper.

General: On the quadrat map in the appendix will be found the location of the quadrats, quadrats fenced, location of the site faster station, water troughs, and soil sample plot "E".

Description of cover

Before logging in 1934, the plot had an old growth stand of ponderosa and Jeffrey pine with scattered white fir and juniper. Logging, under United States Forest Service marking rules, removed a large part of the merchantable stumpage so that the remaining stand now consists of scattered seed trees, groups of pole size trees, and scattered advance reproduction. In the understory *Festuca idahoensis*, *Carex* sp., *Wyethia mollis*, *Sitanion hystrix*, *Stipa occidentalis*, *Oenothera prostrata*, *Artemisia tridentata*, *Artemisia arbuscula*, and *Chrysothamnus bloomeri* are conspicuous.

Method of study

Survey: Primary control consisted of a base line surveyed with transit and tape along the section line between sections 18 and 19. Stakes were set at every $2\frac{1}{2}$ chain point on this line and are numbered from 0 to 26, starting from the range line between R. 8 E. and R. 9 E. Elevations were carried between stakes with the transit, starting at the zero stake with a base elevation of feet, determined by F. Parker in 1934.

A random line was run with a transit, from the zero stake, south on the range line to intersect the corner common to sections 24 and 25, R. 8 E. and sections 19 and 30, R. 9 E. The angle between this line and the base line was determined to be 89 degrees 56 minutes. The angle was then turned off south of each stake on the base line and stakes were set on line as far as possible without excess brushing. An angle of 90 degrees and 2 minutes was turned off south of each base line stake and stakes set on line as before.

Secondary control consists of lines turned off from each base line stake projected to the fence line with a compass and chain, using backsights. Each line was checked across to the preceding line at every five chain mark. On these lines, which were turned off from the base line, quadrats were set $1\frac{1}{2}$ chain from the base line and each $2\frac{1}{2}$ chains thereafter, making a $2\frac{1}{2}$ chain grid of the area. No quadrats were set closer than $1\frac{1}{2}$ chain to the fence. Stakes were set $2\frac{1}{2}$ chains from the base line and every $2\frac{1}{2}$ chains thereafter. Elevations were carried along lines between stakes with a double Abney control.

Reference posts: On the even numbered lines stakes were set 4 feet north of each 5 chain point, marking the location of the reference points which were to be set later. Some of the posts were set during 1935 on the west side of the plot.

Topographic map: From the intense grid of elevations secured, a topographic map of the plot was prepared in the office after the field work was completed. The boundaries of the area were determined on a grid in the office by measurements made in the field from the last stake, or quadrat in each line, to the fence line. A copy of the topographic map will be found in the appendix.

The $\frac{1}{4}$ mileacre quadrats (3.3 feet square) were placed northeast of each quadrat stake. A redwood stake was set on the outside of each of the four corners of the quadrats. In some cases the stakes were held up by rocks piled around the stake, while in other cases they were driven into fallen trees and stumps. Where it was not possible to set stakes the quadrat corners were chipped or marked on rocks, trees, stumps, etc. All irregularities in the placement of the stakes were recorded.

Quadrat designations and quadrat elevations were recorded on the southwest stake of each quadrat unless otherwise noted. The designations used were line number and number of chains south or north of the base line. e. g. A quadrat $6\frac{1}{2}$ chains north of the base line on line 3 ($7\frac{1}{2}$ chains east of the range line) would be designated "3 - $6\frac{1}{2}$ N". The quadrats were all numbered during the spring of 1935. The numbers were placed on the redwood stake in the southeast corner of the quadrat in most cases.

Seeding: Thirty-six spots of 1 to 3 seeds each were planted approximately six inches apart inside each quadrat. The same number were planted outside so that the seedlings would not form an island, the boundaries of which were contained in or coincided with the edges of the quadrat. The south half was planted to ponderosa pine, California Forest & Range Experiment Station seed lot number 2064, and the north half to Jeffrey pine, seed lot number 2030. The 36 spots inside the quadrat were numbered like sections in a township and the spots outside were numbered in a similar manner. A record was made of all spots which could not be planted because of the presence of rocks, trees, etc. All these notes are in two Forest Service note books.

All the seed used was covered with a poison coat consisting of a mixture of plaster of Paris, cornmeal, gum arabic, and strychnine. The gum arabic solution was used as a binder medium to cement the coating to the seed. Strychnine, in proportion of 1 ounce to 2 quarts of seed, was incorporated in the outer layers of the coating, which averaged about $1/8$ inch in thickness.

The 557 quadrats needed required approximately 20 quarts of coated Jeffrey pine seed and 10 quarts of coated ponderosa pine seed. The planting was done with a remodeled corn planter. The lips of the planter were cut wedge-shaped and the seed disseminator set to plant from 1 to 5 seed in a spot. The seeds were placed approximately $\frac{1}{2}$ inch in mineral soil. Seeding was done after a few light rains and snows had fallen and moistened the ground.

Following is the quadrat seeding plan:

6	5	4	6	5	4	3	2	1	3	2	1	Jeffrey pine
7	8	9	7	8	9	10	11	12	10	11	12	" "
13	17	16	13	17	16	15	14	13	15	14	13	" "
19	20	21	19	20	21	22	23	24	22	23	24	Ponderosa pine
29	29	28	29	29	28	27	26	25	27	26	25	" "
31	32	33	31	32	33	34	35	36	34	35	36	" "

$\frac{1}{4}$ mileacre quadrat within stakes.

Stakes are set 5.5 feet apart.

1" X 2" redwood stake.

Spots are approximately 6" apart.

Spots were numbered as shown above.

Description of seed: Jeffrey pine (*Pinus jeffreyi* "Oreg. Com."). GYARES lot number 2030. Collected by the Long-Bell Lumber Company, December, 1933. Kept in cold storage at approximately 40 degrees Fahrenheit until used. Ponderosa pine (*Pinus ponderosa* Laws.). GYARES seed lot number 2064. Collected by the Long-Bell Lumber Company, September and October, 1933 on the north side of Mt. Hoffman, near Tennant, Shasta National Forest, California. Elevation approximately 7400 feet above sea level. Kept in cold storage at approximately 40 degrees Fahrenheit until used.

Of the 60,264 spots which theoretically could have been planted on the 557 quadrats, 58,906 were actually planted. 29,346 were Jeffrey pine and 29,560 were ponderosa pine.

Following is a summary of the establishment and seeding of the quadrats.

534 quadrats were staked out.

5 in the land.
15 in the meadow.
534 in pasture number 1.

537 quadrats were seeded including one which could not be seeded because of a large log which completely covered the quadrat and both edges.

5 in the land.
534 in pasture number 1.

17 quadrats were not seeded and are not included in the summary.

15 in the meadow pasture.
2 in pasture number 1. These two quadrats were overlooked. One, number 707 was staked but not planted; the other, number 578 was not staked and not planted.

211, or 25.21 percent of the 537 quadrats were fenced.

626, or 74.79 percent of the 537 quadrats were not fenced.

Rodent control: The following has been taken from a description of the rodent control experiments written by W. Fair and attached to the California Forest and Range Experiment Station Report number 6, "Pine Reproduction vs. Livestock Grazing", by M. D. Stowell and J. R. Bentley, dated November, 1935.

"Rodent Control Experiments - Cone Troughs Area".

"A preliminary survey of the area, which was made on October 16, 1935, showed that large-scale control measures would be very inadvisable at this time. The lateness of the season was an important factor working against successful poisoning operations in two ways; first, the danger of storms raising the baits before full effectiveness could be obtained from them, and second, seasonal inactivity among the rodents. The nature and density of cover on practically the entire area appeared to provide ideal habitat conditions for rodents, and would have made poisoning unusually slow and costly. Therefore, control operations were carried on a strictly experimental basis, and the area treated was only large enough to give significant results.

"An experimental area of approximately 65 acres was selected for treatment with poisoned grain. The cover and topography roughly represented that of the whole tract. Boundaries of the experimental plot were laid out as follows:

Western-- the fence along the main road which passes the water tanks and weighing corral.

Eastern-- the old railroad grade in gulch to east of rodent and deer enclosures.

Northern-- survey line $8\frac{1}{2}$ chains north from base line of quadrat survey. This boundary runs about 50 feet below the rodent and deer enclosures. (These enclosures were never completed - Author.)

Southern-- survey line $89\frac{1}{2}$ chains south from base line.

"Prior to the poisoning operations, 300 mouse traps, set across the area for one night, gave the following:

- 7 traps lost.
- 115 traps untouched.
- 55 sprung but empty.
- 11 *Reithrodontomys* (Chipmunks)
- 6 *Peromyscus* (White-footed mice)
- 2 *Microtus* (Meadow mice)
- 1 *Reithrodontomys* (Harvest mice)
- 20 rodents - total catch

"On October 21 and 22 the area was treated with wheat-strychnine, standard starch spreader formula, poison strength 1 ounce strychnine to 12 quarts of grain. Treatment of the 65 acres required 20 man hours of labor and 220 pounds of poisoned grain.

"Three days after the completion of poisoning, 100 traps were set across the poisoned area and left for two days. The catch for the first 24 hour period was one chipmunk, with one trap sprung, but empty. The second day, two chipmunks were caught, with one trap sprung, but empty. At the same time as this trapping check of the poisoned area, 100 traps were put out on adjacent unpoisoned territory. The first days catch from this series was one chipmunk and 3 white-footed mice, with 2 traps sprung but empty. The second day gave 3 white-footed mice, with 7 traps sprung but empty.

"In this sort of trapping, rodent catches are often figured on a basis of trap-nights - the number of traps times the number of nights exposed. Thus, in the first series of traps run before poisoning, 300 traps set for one night, or 300 trap-nights, caught 20 rodents, an average of one rodent to ten trap-nights. After poisoning, 100 traps set for 2 nights on the treated area, or 200 trap-nights, caught 5 rodents, an average of 1 to 40.0 trap-nights. The third series, run at the same time as the second, but on unpoisoned territory, caught 7 rodents, an average of 1 to 28.7 trap-nights.

"During the time of poisoning and for one day after, the weather was clear but very cold for this time of the year. Temperature at night dropped to 18 degrees F. at the Black's Mountain station, and were probably lower on the work area. A strong north wind blew throughout the days and temperatures did not rise sufficiently to melt frost in shady places. A comparison of trapping catches before and after this cold spell makes it appear that such temperature changes have an important bearing on the activity of small rodents. Because of this weather factor, the low catch on the poisoned area may not be attributed entirely to reduction by poisoning, as a somewhat similar reduction occurred on unpoisoned territory.

"Golden-mantled ground squirrels, which had been reported abundant on the area during the summer months, were almost entirely absent at this period. A single individual was picked up on a poisoned bait spot and no others were seen.

"Seeding of quadrats in the poisoned area was started within a week after the completion of poisoning. All of the seed used was coated with a mixture of plaster of Paris and cornmeal. Gum arabic solution was used as the binder medium to cement the coating to the seed. Styracine, in proportion of 1 ounce to 2 quarts of seed, was incorporated in the outer layers of the coating, which averaged about 1/8 inch in thickness. It was hoped that rodent damage to seed spots could be reduced by the use of a poison coating on the seed itself. However, these tests brought out certain mechanical faults in the coating material which will have to be corrected before further field trials are made.

"337 quadrats were seeded, requiring approximately 20 quarts of coated Jeffrey pine seed and 10 quarts of ponderosa pine. It was found that the mechanical planter is not entirely satisfactory for use with the coated seed as a certain amount of the coating material is cracked off during passage of the seed through the measuring cup and carrier tube. Another fault, from a rodent control viewpoint, lies in the fact that all of the seeds planted in a single spot are deposited in a very small group. In case of rodent digging, every seed in a spot would be uncovered at one time, and chances of overlooking part of the seeds would be more remote than if they were scattered during planting.

"The last check of this seeding was made about a week after planting and at that time no digging damage was observed.

"A total of 37 rodents were taken by trapping and poisoning. The following list of genera may give an indication of relative numbers at this time of the year:
Reithrodontomys, 18; Peromyscus, 14; Microtus, 2; Callospermophilus, 1; Dipodomys, 1; Reithrodontomys, 1."

A germination test of untreated Jeffrey pine seed, from the same lot as was used to seed the quadrats, gave 81 percent. The same seed poisoned coated gave 68 percent. These tests were made by H. T. Mirov at Berkeley in 1956. Uncoated ponderosa pine seed gave 80 percent germination.

Forms and classifications used: The mimeograph form GJHRES-888, shown as figure 3 on the next page, was used to record germination, mortality, and survival of the pine seedlings. Two forms were used for each quadrat, one for Jeffrey pine on the north half of the quadrat, the other for ponderosa pine on the south half of the quadrat. Figure 4 is an example of the form as used with explanations. This is being included here because similar forms will probably be used for the 1957 study.

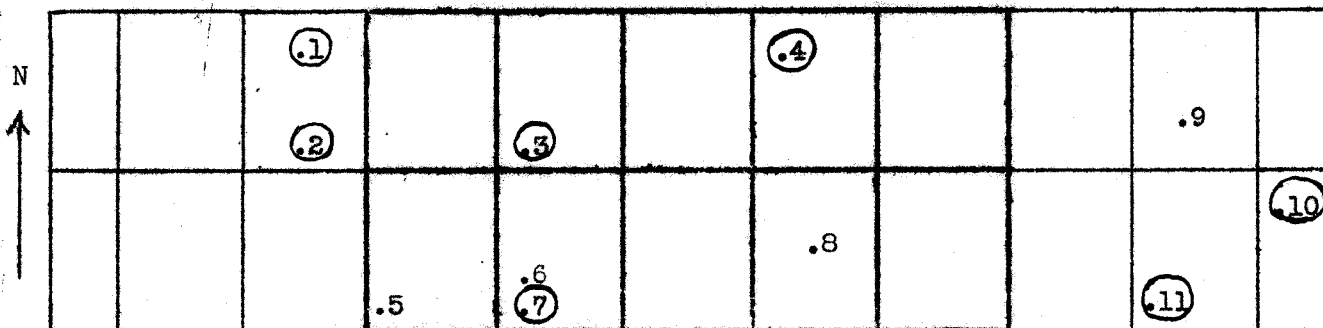
The causes of mortality as recorded on the pine seedling record forms are shown in figure 5. This form was used mainly to insure the recording of the same causes of mortality by the different examiners. If the examiner was in doubt about the cause of mortality, the appearance of the dead seedling was recorded by the plate number. Later, a discussion in the office by all examiners would fix the cause for that particular type of damage.

R
Burgess Spring
Lassen

PINE SEEDLING RECORD

Aspect _____
Cover type _____

Quadrat No. 70 Location 2-23⁸N Half North Species Jeffrey pine



Examination No., Recorder and Date

Seed-ling No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	5/25	6/15	7/7	7/21	etc.											
	L.L.	G.M.	R.G.	L.L.	etc.											

Seedling Record (germination and mortality by causes)

1	G	2Fk																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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Figure 4.

Classification used to show the different types of cover under which ponderosa and Jeffrey pine seedlings survived on the Burgess Spring Experimental Range.

<u>Class</u>	<u>Tally as</u>
Reproduction	Re.
Saplings	Sa.
Poles	Pe.
Standards and veterans	SV
High brush	Hb.
Low brush	Lb.
Mixed brush	Mb.
Ceanothus prostratus	Cp.
Log (under)	Log
Trash	Tr.
Open	Op.

Under the above tally whether growing in a skid trail, on bare ground, on burned ground, or in litter. Use the following abbreviations:

<u>Sub-class</u>	<u>Tally as</u>
Skid trail	Sk.
Bare ground	Bg.
Burned ground	Ba.
Litter	Give depth in inches or fraction.

e.g. The seedling is growing under a small tree (reproduction) and the litter is 2 inches deep. Tally as: Re-S".

Note: High brush includes one or more of the following: Ceanothus (all species except prostratus), Ribes, Arctostaphylos, Artemisia, Parahia, Castanopsis, and Chrysothamnus.

Low brush includes one or more of the following: Rosa, and Symporicarpos.

Mixed brush includes one or more low brush under one or more high brush and C. Prostratus.

Reproduction includes all trees not yet three feet high.

Saplings include all trees over three feet in height, but less than 4 inches in d.b.h.

Poles include trees 4 inches to 12 inches d.b.h.

Standards and veterans include all trees over 12 inches

d.b.h.

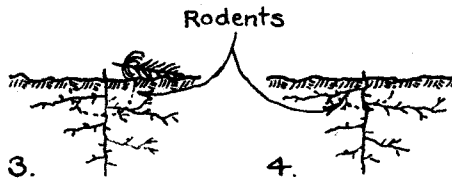
CAUSES OF MORTALITY TO PINE SEEDLINGS



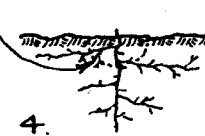
1.
C Competition
D Drought
Fk Frost killing
Fu Fungus
He Heat
I Insects
Ph Physiological
Ro Rodents
Sh Shade
So Soil
V Vitality



2.
A Animals
C Competition
D Drought
Fk Frost killing
Fu Fungus
Ha Hail
He Heat
L Livestock
M Man
Ra Rain
Ro Rodents
Sh Shade
Sn Snow
So Soil
W Wind



3.
A Animals
Fu Fungus
Ha Hail
I Insects
L Livestock
M Man
Ra Rain
Ro Rodents
Sn Snow
W Wind



4.
A Animals
Fi Fire
Fu Fungus
I Insects
L Livestock
Ro Rodents
W Wind
WaE Water erosion
WiE Wind
GrE Gravity



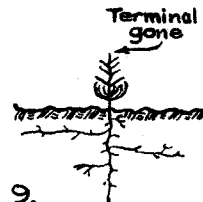
5.
A Animals
Fh Frost heaving
L Livestock



6.
I Insects



7.
A Animals
De Deposition
Wi Wind
Wa Water
Gr Gravity
L Livestock
M Man
Sn Snow



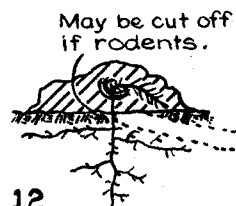
8.
A Animals
Fi Fire
Fu Fungus
I Insects
L Livestock
Ro Rodents



9.
A Animals
Fi Fire
Fu Fungus
I Insects
L Livestock
Ro Rodents



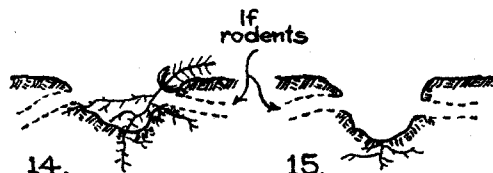
10.
A Animals
Fi Fire
Fu Fungus
I Insects
L Livestock
Ro Rodents



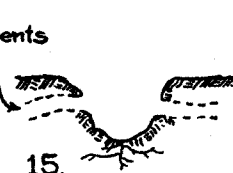
11.
A Animals
De Debris
L Livestock
Ro Rodents



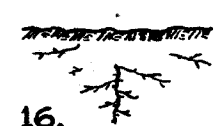
12.
De Deposition
Wi Wind
Wa Water
Gr Gravity



13.
A Animals
L Livestock
Ro Rodents



14.
A Animals
L Livestock
Ro Rodents



15.
? Unknown

Figure 5

Results

Range management: No attempt will be made here to interpret the results of the range management phase of this study as a complete summation of that work will be found in the 1956 progress report of the Burgess Spring Experimental Range.

Pine management: The first objective, to determine the feasibility of sowing ponderosa and Jeffrey pine poison-coated seed to reforest a cut-over area in the pure pine type of northern California, was not achieved by this study. The poor results may be directly attributed to the following causes:

1. The destruction of a large percentage of the seed by rodents even though they were covered with a poison coat.

2. The death of the seedling that did germinate from frost, insect attack, and summer drought.

The following facts are significant: Of the 29,346 Jeffrey pine and 29,560 ponderosa pine seed spots which were sown, only 2,665 Jeffrey pine and 2,744 ponderosa pine seedlings actually germinated, and only 436 survived the first season. It should be remembered that the 58,906 seed spots each had from 1 to 3 seed in each spot. If we assume there was at least one good seed per spot (germination tests gave 88 percent for poison-coated Jeffrey pine, 50 percent for uncoated ponderosa pine), then the 5,627 seed that germinated represent only 9.55 percent of the spots sown, and the 436 survivors represent only 7.75 percent of the total germination, or only .74 percent of the total spots sown germinated and survived the first growing season. This small percentage will be further reduced by mortality in the seasons to follow.

The second objective, to determine the causes of mortality to the seedlings, has been achieved for the first growing season and the results will be found in the tables, charts, and plates which follow.

Fenced quadrats: Of the 5191 seedlings which died during the first year, only 55 deaths could be attributed to cattle. The 55 seedlings represent only 1.06 percent of the total mortality, or .98 percent of the total germination. It is quite obvious that fencing every fourth quadrat to the exclusion of cattle and deer (no deer tracks were found inside the fenced quadrats although they could have gained entrance had they cared to jump or crawl in) had no significant influence on the results. Table 2 will illustrate this point.

TABLE 2. Summary of quadrats fenced and those not fenced. Number of quadrats which were seeded, which germinated, and survived the first year. Burgess Spring Experimental Range - 1936.

	Seeded		Germinated		Survived	
	No.	Percent	No.	Percent	No.	Percent
JP - fenced	211	25.21	135	24.23	34	25.37
JP - not fenced	626	74.72	421	75.72	102	74.62
Total	837	100.00	556	100.00	134	100.00
JP - fenced	211	25.21	129	24.25	19	25.33
JP - not fenced	626	74.72	405	75.75	83	74.67
Total	837	100.00	532	100.00	92	100.00
JP & JP fenced	211	25.21	166	24.25	40	24.29
JP & JP not fenced	626	74.72	502	75.15	124	75.61
Total	837	100.00	668	100.00	164	100.00

Quadrats referred to as germinated or survived have one or more seedlings.

In table 3 the germination by periods for both species is shown. A few seedlings were found after July 23, but in every case it was quite obvious to the examiner that the seedlings were older than just 15 days (a few were noted as being at least one month old). Therefore, no new germination has been recorded after the fourth examination, July 23. Quadrats fenced and not fenced are grouped together.

TABLE 3. Germination by periods. Burgess Spring Experimental Range - 1936.

Examination:	1	2	3	4	
Date:	Previous to and May 22 to inc. May 27	June 15	June 19 to July 10 to July 9	July 15 to July 23 inc.	Total Number
Jaffrey pine					
Number	2175	533	121	21	2850
Percent	75.37	19.56	4.54	.75	100.00
Ponderosa pine					
Number	2678	534	116	18	3346
Percent	73.72	19.44	4.22	.82	100.00
JP & JP Total	4853	1067	237	39	5896
Percent	75.55	19.40	4.39	.66	100.00

The 2035 Jeffrey pine seedlings represent 51.34 percent of the total germination, while the 2744 ponderosa pine seedlings represent 48.75 percent.

Survival by periods was approximately in direct proportion to germination by periods, except that 9.09 percent of the Jeffrey pine survived as compared with 6.34 percent of the ponderosa pine. Total survival as recorded the tenth examination on November 10, 1936 amounted to only 436 seedlings, or 7.75 percent of the total germination of 5627 seedlings. Survival by periods of germination for the two species are shown in tables 4, 5, and 6.

Twenty distinct causes of mortality were recorded, plus the unknown factor. These causes are given for each of the two pines in table 7. The percentages are based on the total number of seedlings which died during the season. In table 8 and figure 5 the same data is presented except that the percentages are based on the total number of seedlings that germinated.

In table 9 are given the main causes of mortality by germination periods and by examinations. Total mortality is also shown by periods of germination and by examinations.

TABLE 4. Survival of Jeffrey pine seedlings by germination periods. Burgess Spring Experimental Range, 1936.

Examination:	Date	May 27	June 18	July 9	July 23	Total
	Number	1	2	3	4	
Germination	Number	2175				
May 27	1	1640				1640
June 18	2	1101	508			1709
July 9	3	871	512	151		1534
July 23	4	585	175	53	21	834
August 5	5	404	106	26	17	553
August 19	6	325	85	27	11	448
September 3	7	270	75	17	10	372
September 17	8	246	50	15	8	319
October 1	9	234	37	14	6	311
November 8	10	197	42	11	6	256
Total survival		107	48	11	6	172
Percent of:						
Survival		75.29	12.32	4.29	2.29	100.00
Germination		9.07	2.60	2.40	22.57	9.09

TABLE 5. Survival of *Pseudotsuga* pine seedlings by germination periods, Burgess Spring Experimental Range, 1936.

Germination:

	Date	May 27	June 18	July 9	July 23	Total
	Number	1	2	3	4	
	Number					
Date	Germination					
May 27	1	1400				1400
June 18	2	900	490			1390
July 9	3	670	320	100		1090
July 23	4	435	120	30	11	596
August 5	5	305	84	23	6	418
August 19	6	205	39	14	4	262
September 2	7	125	42	12	2	181
September 17	8	125	37	11	2	215
October 1	9	124	34	10	2	200
November 8	10	105	30	7	1	174
Total survival		1300	500	260	50	1910
Percent of:						
Survival		78.18	17.24	4.02	.23	100.00
Germination		6.54	2.62	0.05	0.25	6.54

TABLE 4. Survival of Jeffrey and Ponderosa pine seedlings by germination periods. Burgess Spring Experimental Range, 1954.

Germination		May 27	June 10	July 9	July 25	Total
Date	Number	1	2	3	4	
May 27	1	4303				4303
June 10	2	3150	1022			4172
July 9	3	1541	577	227		2345
July 25	4	990	505	82	25	1502
August 5	5	700	100	50	25	975
August 25	6	545	144	41	15	745
September 5	7	403	115	20	12	550
September 17	8	411	97	27	10	545
October 1	9	308	91	24	8	431
November 8	10	222	75	10	7	314
Total survival		3222	978	438	97	4735
Percent of:						
Survival		74.22	19.80	4.15	1.83	100.00
Germination		7.25	7.14	7.20	15.92	7.75

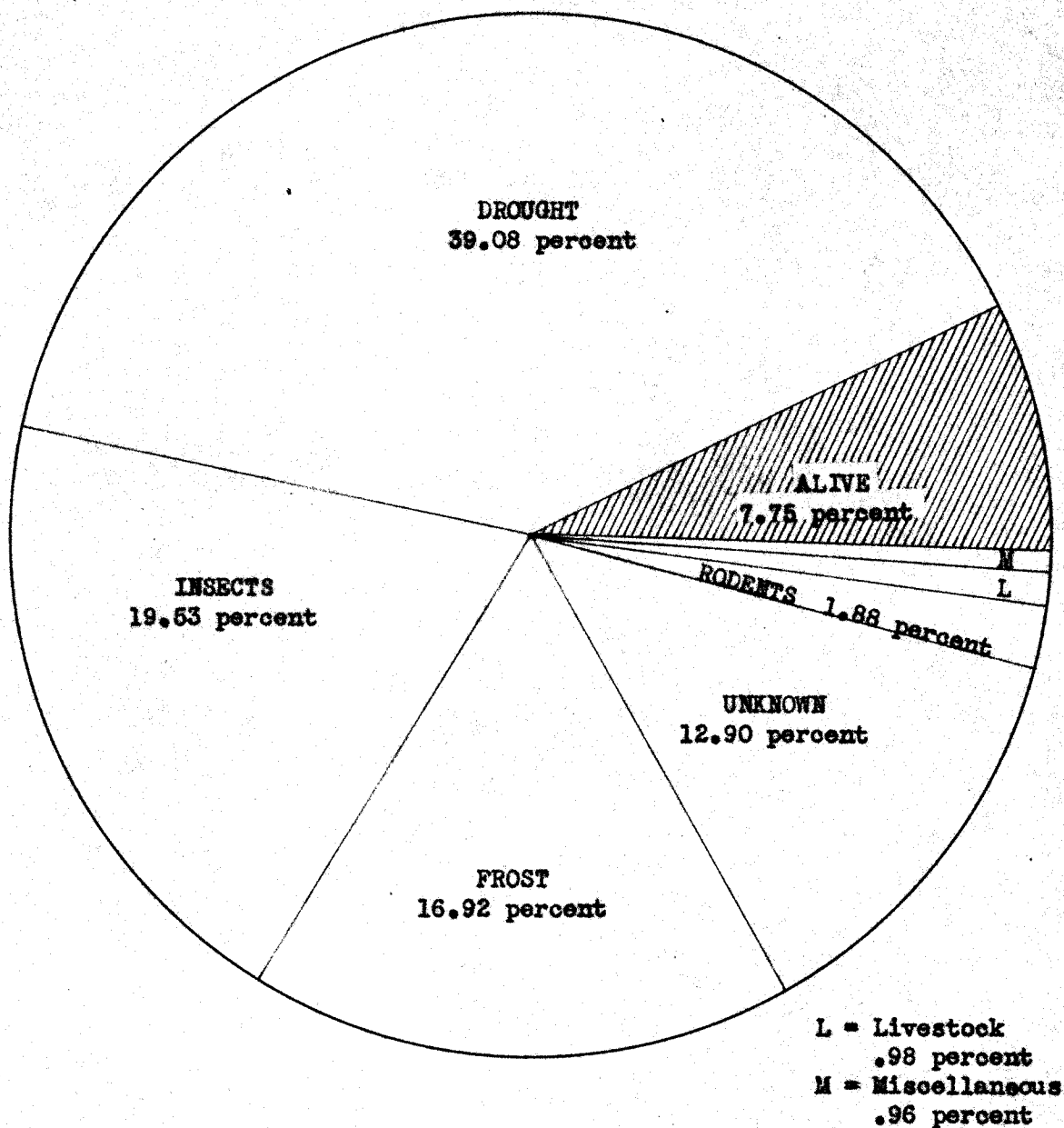
TABLE 7. Causes of mortality. Percentages based on total number of seedlings killed. Burgess Spring Experimental Range - 1938.

Cause	Jeffrey pine		Ponderosa pine		Jeffrey and ponderosa pine combined.	
	Number	Percent	Number	Percent	Number	Percent.
Drought	1157	44.14	1042	40.34	2199	42.34
Insects	503	22.45	511	19.85	1014	21.17
Frost killing	432	16.71	514	20.00	946	18.34
Rodents - eating	41	1.54	32	1.42	73	1.48
" - digging	12	.45	15	.58	27	.58
Livestock - trampling	24	.92	25	.97	49	.94
" - grazing	4	.15	2	.08	6	.12
Heat	8	.30	12	.47	20	.39
Hail, rain and snow	3	.11	-	-	3	.06
Shade	-	-	2	.08	2	.04
Man - trampling	5	.20	4	.16	9	.17
" - examining	1	.04	-	-	1	.02
Animals - trampling	4	.15	-	-	4	.08
" - grazing	1	.04	1	.04	2	.04
" - digging	1	.04	-	-	1	.02
Lack of seed vitality	5	.19	2	.08	7	.13
Fungus	2	.08	-	-	2	.04
Poison seed coat too heavy	1	.04	-	-	1	.02
Debris	1	.04	-	-	1	.02
Deposition	-	-	1	.04	1	.02
Unknown	225	12.42	401	15.60	726	13.99
Total mortality	2581	100.00	2579	100.00	5161	100.00
Percent of total	50.47		49.52		100.00	

TABLE 8. Causes of mortality. Percentages based on the total number of seedlings which germinated. Burgess Spring Experimental Range - 1936.

	Jeffrey pine		Ponderosa pine		Jeffrey and Ponderosa pine combined	
	Number	Percent	Number	Percent	Number	Percent
Alive - 10th June.						
Nov. 8, 1936	242	9.09	174	6.34	416	7.75
Drought	1157	43.14-	1042	37.99-	2199	39.08
Insects	508	20.41-	511	18.62	1019	19.55
Frost killing	432	15.19	514	18.75	946	16.92
Rodent - eating	41	1.42	33	1.20	74	1.40
" - digging	12	.42	15	.55	27	.48
Livestock - trampling	24	.85	25	.91	49	.89
" - grazing	4	.14	2	.07	6	.11
Heat	3	.33	12	.44	15	.28
Hail, rain and snow	3	.10	0	-	3	.06
Shade	0	-	2	.07	2	.04
Man - trampling	5	.17	4	.15-	9	.16
" - examining	1	.03	0	-	1	.01+
Animals - trampling	4	.14	0	-	4	.07
" - grazing	1	.03	1	.04-	2	.04
" - digging	1	.03	0	-	1	.01+
Lack of seed vitality	5	.17	2	.07	7	.12
Fungus	2	.07	0	-	2	.04
Poison seed coat too heavy	1	.03	0	-	1	.02-
Debris	1	.03	0	-	1	.02-
Deposition	0	-	1	.04-	1	.02-
Unknown	<u>222</u>	<u>11.52-</u>	<u>401</u>	<u>14.61</u>	<u>723</u>	<u>13.50</u>
Total mortality	2225	100.00	2764	100.00	5627	100.00

**SURVIVAL AND MORTALITY TO PINE SEEDLINGS - 1936.
BURGESS SPRING EXPERIMENTAL RANGE, LASSEN NATIONAL FOREST.**



This chart represents 5627 seedlings of Jeffrey and Ponderosa pine that germinated the spring of 1936 on the Burgess Spring Experimental Range, Lassen National Forest, California. An accurate check was kept of all the seedlings and at the end of the first growing season only 7.75 percent of the total were alive, with drought, insects (outworms), and frost accounting for 75.53 percent of the mortality, based on the total number of seedlings that germinated.

TABLE 9. Mortality to Seedlings by Germination Periods - Ponderosa and Jeffrey Pine Combined.

Burgess Spring Experimental Range - 1936

Cause of Mortality

Drought							Insects						Frost						Unknown						Rotants								
Exam. No.	May 27	June 18	July 9	July 23	Per-Total cent		1	2	3	4	Per-Total cent		1	2	3	4	Per-Total cent		1	2/3	3	4	Per-Total cent		1	2	3	4	Per-Total cent				
May 27 1	-	-	-	-	-		1	458	-	-	458 10.78		1	800	-	-	-	800 14.11		1	41	-	-	41 0.95		1	19	-	-	19 0.43			
June 18 2	-	-	-	-	-		2	205	35	-	239 5.44		2	280	64	-	-	344 6.15		2	451	-	-	451 10.21		2	25	1	-	24 0.56			
July 9 3	383	221	44	-	648 18.95		3	151	92	15	258 6.00		3	5	2	-	-	5 0.15		3	90	72	-	-	162 4.74		3	8	7	-	15 0.44		
July 23 4	453	211	75	8	747 31.27		4	44	37	10	91 3.88		4	-	-	-	-	-		4	28	17	11	-	56 2.59		4	10	5	-	15 0.56		
Aug. 5 5	238	86	27	5	356 25.18		5	17	9	1	27 1.91		5	-	-	-	-	-		5	14	5	-	-	19 1.34		5	9	10	4	23 1.65		
Aug. 19 6	139	38	14	8	199 20.30		6	8	1	-	9 0.92		6	-	-	-	-	-		6	5	3	3	-	9 0.92		6	2	2	1	5 0.51		
Sept. 3 7	67	19	12	1	99 13.22		7	24	8	-	33 4.43		7	-	-	-	-	-		7	-	2	-	1	3 0.40		7	5	-	-	5 0.40		
Sept. 17 8	32	17	2	1	52 8.54		8	4	1	-	5 0.92		8	-	-	-	-	-		8	2	-	-	-	2 0.33		8	2	-	-	2 0.33		
Oct. 1 9	21	6	3	2	32 5.97		9	-	-	-	-		9	-	-	-	-	-		9	1	-	-	-	1 0.18		9	-	-	-	-		
Nov. 8 10	48	15	4	1	68 12.92		10	2	-	-	2 0.59		10	2	-	1	-	3 0.59		10	1	-	1	-	2 0.39		10	2	-	-	2 0.39		
Total-	1381	611	121	25	2199		Total	893	181	24	1 1099		Total	1285	64	1 - 982		Total	611	99	15	1 726		Total	78	25	5 - 108		Total	78	25	5 - 108	
Percent of "	62.80	27.79	8.23	1.25	100.0			61.26	16.47	2.18	0.09 100.0			92.96	6.93	0.11- 100.0			84.16	13.64	2.07	0.15 100.0			75.59	21.70	4.71	-100.0					

Livestock						Heat						Miscellaneous						Total Mortality						Seedlings by Periods										
1	2	3	4	Per-Total cent		1	2	3	4	Per-Total cent		1	2	3	4	Per-Total cent		1	2	3	4	Per-Total cent		1	2	3	4	Per-Total cent						
1	-	-	-	-		1	-	-	-	-		1	5	-	-	-	5 0.07		1	1121	-	-	-	1121 25.37		1	4251	-	-	4251 75.38				
2	-	-	-	-		2	2	-	-	2 0.05		2	9	2	-	-	11 0.26		2	980	100	-	-	1080 24.87		2	3130	1092	-	4222 75.05				
3	14	6	-	-	20 0.93		3	5	10	15 0.47		3	5	5	-	-	10 0.29		3	639	415	58	-	1112 32.58		3	2160	992	947	5419 60.76				
4	14	6	-	-	20 0.93		4	1	-	1 0.08		4	1	-	-	-	1 0.04		4	581	274	97	8	960 33.67		4	1541	577	159	57 2544 41.86				
5	5	3	-	-	8 0.35		5	-	-	-		5	1	2	1	-	4 0.28		5	221	115	35	5	434 30.69		5	990	305	92	29 1414 25.15				
6	7	-	-	1	8 0.32		6	-	-	-		6	1	2	-	-	1 0.10		6	160	44	18	8	231 23.57		6	709	189	59	23 980 17.42				
7	1	-	-	-	1 0.13		7	-	-	-		7	1	-	-	-	1 0.15		7	96	29	12	3	140 18.69		7	549	144	41	15 749 13.51				
8	1	-	-	-	1 0.16		8	-	-	-		8	1	-	-	1	2 0.33		8	42	18	2	2	64 10.51		8	453	135	39	12 609 10.82				
9	-	-	-	-	-		9	-	-	-		9	1	-	-	-	1 0.18		9	25	6	3	2	34 6.23		9	411	97	27	10 545 9.68				
10	-	-	-	-	-		10	-	-	-		10	-	-	-	-	-		10	53	13	6	1	73 14.68		10	288	91	24	8 511 9.09				
Total -	59	15	-	1	85		Total	8	15	2 - 20		Total	23	9	1 1 34		Total	5918	1614	239	36 8191		Total	333	78	18	7 436 7.75		Total	333	78	18	7 436 7.75	
Percent of "	70.91	27.27	-	1.82	100.0			40.00	50.00	10.00	- 100.0			67.65	26.47	2.94 2.94 100.0			75.48	1953	4.41	.58 100.0			75.38	12.89	4.13	1.60 100.00						

1/ Percentage is based on the number of living seedlings at the start of each period.
 2/ Originally found and recorded May 18-23; not found and recorded as being killed by an unknown factor May 23-27.

Table - 9

724 seedlings could not be found after once being recorded and are listed as being killed by an unknown factor (167 in the records). However, because 431 of the seedlings so listed germinated the first examination and were recorded as missing the second, the probable cause of destruction was by insects. No damage by drought or livestock was recorded the second examination and rodents, heat, and miscellaneous factors took only 34 seedlings. Damage by frost and insects were the two main causes of mortality and seedlings killed by frost were easy to see as the tops were still visible, whereas those killed by insects in many cases had only a short stem remaining which was in many cases not visible above the ground.

Summary

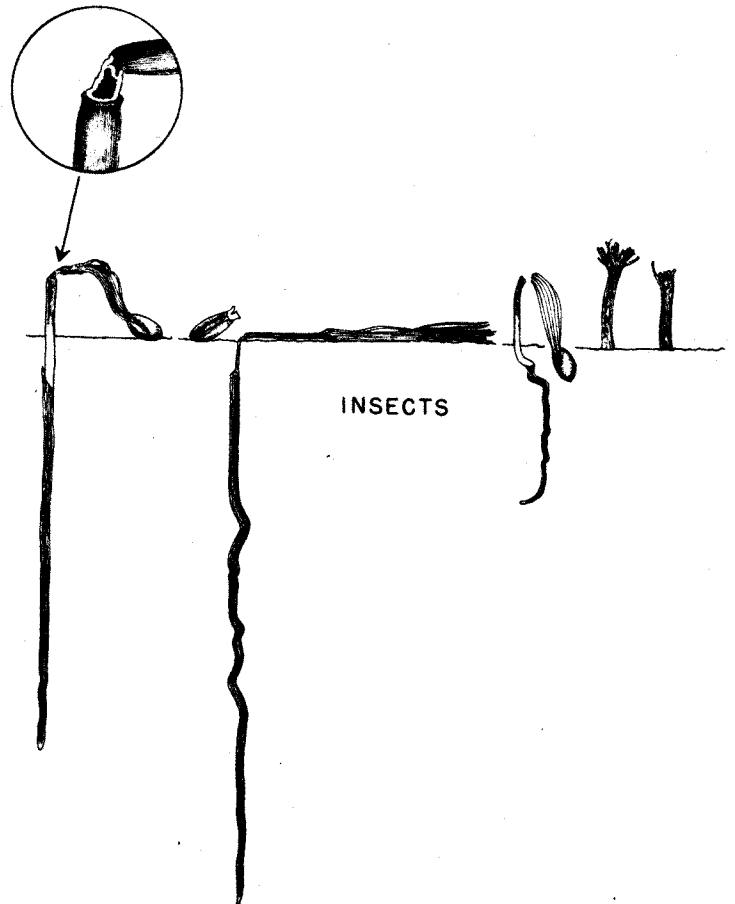
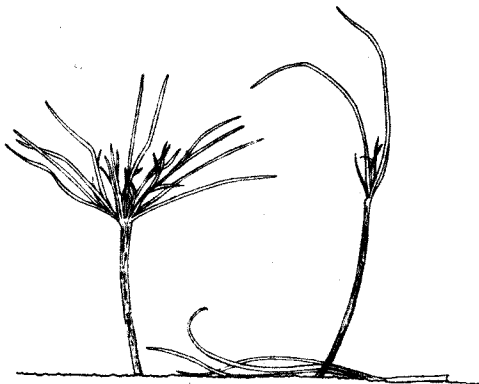
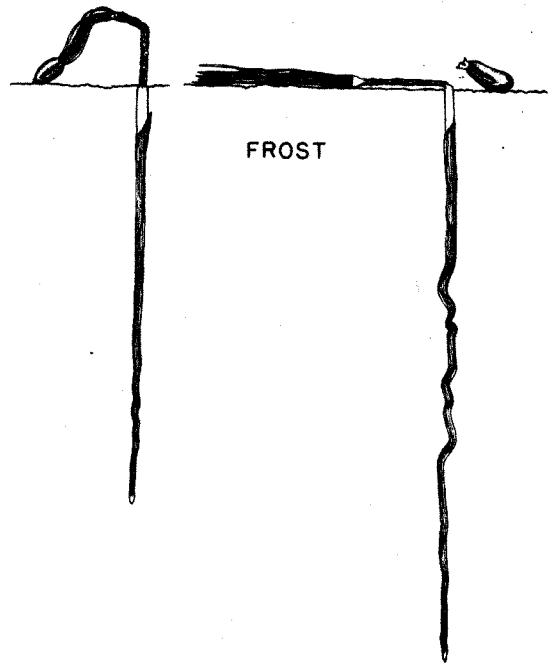
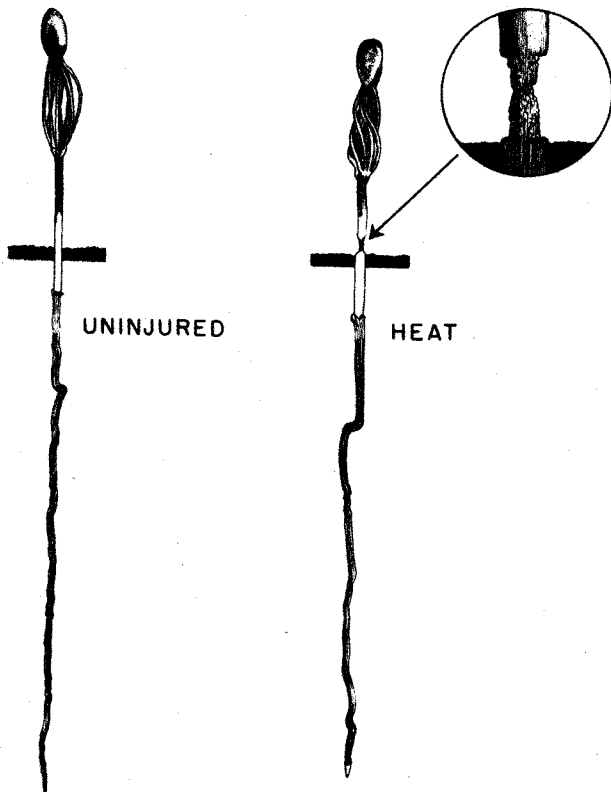
On a cut-over area in the pure pine type of Northern California during the fall of 1936, 837 .5 acre quadrats were sown with Jeffrey and ponderosa pine poison-coated seed. Using modified corn planters having sharp planting lips and dropping from 1 to 5 seed each time, 38,906 spots in all were sown. The next spring and summer 5,637 seedlings germinated, or 9.55 percent of the spots sown assuming one good seed per spot.

Each seedling as it germinated was mapped and recorded and if it died the cause of mortality was determined and recorded. In this manner twenty distinct causes of mortality were recorded. Only 436 seedlings survived the first year, which represents 7.75 percent of the total germination, or .74 percent of the total number of spots sown.

Plates were drawn to illustrate the important causes of mortality such as was caused by drought, insects, frost, rodents, livestock, heat, and a few miscellaneous factors.

Drought was the most important single factor of mortality to the seed that germinated, having escaped the far greater initial destruction of seed by rodents, accounting for 39.08 percent of the total germination. The other important causes of mortality were caused by insects, 19.55 percent; frost, 14.92 percent; rodents, 1.88 percent; livestock, .88 percent; and miscellaneous, .96 percent.

The following plates are illustrative of the damage done to first year Jeffrey and ponderosa pine seedlings at the Burgess Spring Experimental Range - 1939



Appendix

Photographs.

Distribution of quadrats on major exposures.

Soil moisture percentages.

Precipitation.

Map of quadrats.

Photomontage



Temporary number LBL 65. Site factor station, Burgess Spring
Experimental Range. September 11, 1936.



Temporary number JRE 22. Seeding quadrats with modified corn planters. Burgess Spring Experimental Range. December 21, 1936.



Temporary number ALE 337. Fenced quadrat on the Burgess Spring Experimental Range. Summer of 1936.

Temporary number ALE 506. Cattle grazing on the Burgess Spring
Experimental Range. Summer of 1956.

Temporary number ALE 506. Seed trees and advance reproduction
two years after logging. Burgess Spring Experimental Range -
1956.

Temporary number A1H 231. Sapling and pole stand of Jeffrey and
ponderosa pine in the southeast corner of the Burgess Spring Ex-
perimental Range - 1954.

DISTRIBUTION OF QUADRATS ON MAJOR EXPOSURES
 PASTURE I
 BURGESS SPRING EXPERIMENTAL RANGE

Exposure	Exposure unit 1/	Area of exposure unit (acres)	% exposure unit of total pasture area 2/	No. of quadrats	% of total No. in pasture	Area of quadrats (No. x .00025 acres)	% sampling of exposure unit
East	5	6.44	1.20	11	1.32	.00275	0.043
	8	23.32	4.34	39	4.66	.00975	0.042
	25	12.17	2.27	16	1.91	.00400	0.033
	Total	41.93	7.81	66	7.89	.01650	0.039
Southeast	1	68.42	12.74	110	13.16	.02750	0.040
	7	5.23	0.97	6	0.72	.00150	0.029
	11	85.32	15.89	130	15.55	.03250	0.038
	14	36.08	6.87	57	6.82	.01425	0.039
	16	3.12	0.58	4	0.48	.00100	0.032
	21	27.95	5.20	45	5.38	.01125	0.040
	20	10.99	2.05	12	1.45	.00300	0.027
	Total	237.09	44.50	364	43.54	.09100	0.038
South	2	4.49	0.84	9	1.08	.00225	0.030
	4	0.90	0.17	2	0.24	.00050	0.024
	6	13.37	2.49	20	2.39	.00500	0.037
	9	8.25	1.54	13	1.56	.00325	0.039
	10	5.13	0.95	9	1.08	.00225	0.044
	17	2.01	0.37	2	0.24	.00050	0.025
	18	5.23	0.97	9	1.08	.00225	0.043
	20	42.80	7.97	65	7.77	.01625	0.038
	22	9.65	1.80	15	1.79	.00375	0.039
	24	3.42	0.64	5	0.60	.00125	0.037
	26	6.94	1.29	9	1.08	.00225	0.032
	31	15.78	2.94	23	2.75	.00575	0.036
	32	7.14	1.33	11	1.31	.00275	0.039
	Total	125.11	23.30	192	22.97	.04800	0.035
Southwest	3	1.17	0.22	6	0.00	.00000	0.000
	12	46.84	8.72	75	8.97	.01875	0.040
	15	16.38	3.05	26	3.11	.00650	0.040
	19	5.63	1.05	10	1.20	.00250	0.044
	23	25.13	4.68	42	5.02	.01050	0.042
	27	4.46	0.83	9	1.08	.00225	0.030
	33	4.22	0.78	6	0.72	.00150	0.036
	Total	103.83	19.53	168	20.10	.04000	0.040
West	13	28.24	5.26	46	5.50	.01150	0.041
(A) Total		537.00	100.00	634 2/	100.00	.20500	0.039

1/ See map for location of these units.

2/ Total acreage is 537.0 acres exclusive of meadow, lane, corral, and water enclosure. All calculations were made with these exclusions.

3/ Only 535 were planted with pine seed.

Miscellaneous Data

Area	No. of acres	No. quadrats	Area of total quadrats	Area sampled by quadrats
Meadow	11.5	15	.00075	0.002
Lane, canal and water enclosure	2.5	5	.00075	0.002
(B) Total	14.5	15	.00150	0.002
Grand Total (A + B)	251.5	251	.21250	0.009

Soil Moisture Determinations - Burgess Spring Experimental Range 1936

Percentage of moisture based on weight of oven dry sample.

Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	June	June	June	July	July	July	Aug.	Aug.	Aug.	Sept.	Sept.	Oct.	Oct.	Nov.	Dec.
Burgess Spring Exp. Range	10	19	30	10	21	31	10	20	31	10	21	1	12	19	19

Site Factor Station

Location A S-S"	8-3"	22.1	10.4	8.3	5.9	5.0	1.2	3.6	2.9	3.2	8.5	5.5	8.3	4.1	4.1	10.6
	6-8"	20.8	13.6	15.4	12.3	12.4	11.5	11.4	10.7	10.4	17.3	12.1	13.1	11.9	10.7	9.9
	11-15"	20.8	13.8	16.5	12.6	12.9	13.7	12.8	14.9	12.5	17.8	11.0	12.4	12.5	12.6	10.7
	18-21"	21.4	20.6	-	15.3	-	13.7	12.9	13.8	12.5	12.0	11.0	13.1	12.2	12.7	10.8
																Dec. 20
Location B	8-3	22.5	12.2	10.9	6.2	3.9	3.0	3.3	2.9	3.2	16.1	-	5.2	4.1	5.4	-
	6-8	18.3	18.3	13.3	11.4	8.6	10.0	12.5	9.7	9.6	17.9	-	15.1	12.7	12.3	-
	11-13	14.8	19.0	13.8	12.8	12.1	12.3	14.4	14.1	13.5	16.4	-	15.2	13.5	13.6	-
	18-21	17.3	18.8	14.1	13.2	-	12.7	16.1	-	13.0	12.3	-	15.8	13.4	13.5	-

Note: Percentage of moisture is based on the weight of oven dry soil (24 hours at 105°C). A field sample of 20 grams of fine earth was used throughout the entire series. Volumetric determinations were not possible because of the rocky, dry, loose nature of the soil.

Precipitation - Inches

Burns Spring Experimental Range 1935

June 5 & 4	.70
" 5	.02
" 6 & 7	.02
July 9	T
Aug. 1	T
" 4	.01
" 5	T
" 10	.05
" 11	T
" 20	.02
Sept. 1	1.11
" 2	.01
" 3	.05
" 4	.27
Oct. 3	T
" 17	T
" 18	.05
" 20	T
Oct. 21 - Nov. 16	<u>None</u>
Total	2.09 + 72

Future work

The 456 seedlings which survived the first year of growth should be examined and a record kept of growth and/or mortality. These examinations should preferably be made on the following dates:

Examination		
Number	Season	Year
11	Spring	1937
12	Summer	1937
13	Fall	1937
14	Spring	1938
15	Fall	1938
16	Fall	1938
17	Fall	1940

Damage to Tree Reproduction by Livestock in The Eastside Ponderosa-Jeffrey Pine Type

	I	II			III
Class of trees studied	1 ^{1/} to 5' high	Seedlings ^{2/}			Seedlings
Location of study area	Blacks Mt. For	Burgess Spring			Hall's Flat
Class of stock using range	C & S	C			sheep
Forest condition	Virgin	Cutover (1934)			Virgin
Year of study	1933	1936	1937	1938	1938
Size of area (acres)	3,290	537	269	537	15
Number of quadrats	329	836	1,292	1,676	449
Size of quadrat	4 milacres	$\frac{1}{2}$ mil.	$\frac{1}{2}$ mil.	$\frac{1}{2}$ mil.	100 sq. ft.
Percent sampling by quadrats	.04	.08	.24	.16	6.87
Number of trees observed	2,168	2,544	1,123	483	3,379
Percent damage to trees by stock	<i>Age of trees (yrs)</i>	1	2	3 3/	4/
Trampled	negligible	1.9	3.8	1.7	16.4
Grazed	2.7	.2	.5	0	9.6
Total mortality due to stock %	none	2.1	4.3	1.7	18.6

1/ Well established trees 2 to 3 years old or older.

2/ First year seedlings.

3/ Ending August 31, 1938

4/ Grazed once by sheep.

R.S.
M-1
F, B.S.E.R.
1936

*Causes of Mortality,
percentage based on
total number of seedlings killed
1936*

Cause	Jeffrey pine		Ponderosa pine		Jeffrey and Ponderosa pine combined		
	No.	Percent	No.	Percent	No.	Percent	
Drought	1157	44.14	1042	40.54	2199	42.36	} 81%
Insects	588	22.43	511	19.88	1099	21.17	
Frost killing	438	16.71	514	20.00	952	18.34	
Rodents - eating	41	1.56	38	1.48	79	1.52	
" - digging	12	.46	15	.58	27	.52	
Livestock - trampling	24	.92	25	.97	49	.94	
" - grazing	4	.15	2	.08	6	.12	
Heat	8	.30	12	.47	20	.38	
Hail, rain & snow	3	.11	0	-	3	.06	
Shade	0	-	2	.08	2	.04	
Man - trampling	5	.20	4	.16	9	.17	
" - examining	1	.04	0	-	1	.02	
Animals - trampling	4	.15	0	-	4	.08	
" - grazing	1	.04	1	.04	2	.04	
" - digging	1	.04	0	-	1	.02	
Lack of seed vitality	5	.19+	2	.08	7	.13	
Fungus	2	.08	0	-	2	.04	
Poison seed coat too heavy	1	.04	0	-	1	.02	
Debris	1	.04	0	-	1	.02	
Deposition	0	-	1	.04	1	.02	
UNKNOWN	325	12.40	401	15.60	726	13.99	
Total mortality	2621	100.00	2570	100.00	5191	100.00	
Percent of total	50.47		49.53		100.00		

81
14
95

L.D. Loyd - 2/8/37 From summary
made by Statistical Dept - L.D.L.