# *Spot Seeding*

## Ponderosa and Jeffrey Pine

by

J. W. Bruce Wagg

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State of Oregon
Forest Lands Research Center

# Forest Lands Research Center

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Develop the full potential of Oregon's timber resource by:

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- improving timber quality through intensified management and superior tree selection.
- reducing losses from fire, insects, and diseases—thus saving timber for products and jobs.

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Mammal damage and the controls to help regrowth.

Soils and their relationship to growth.

Development of improved forests through selection and breeding.

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One-year-old ponderosa pine from seed spot.

## *Acknowledgments*

This work was made possible through the cooperation of personnel of the Ochoco National Forest and Big Summit Ranger District who prepared and fenced the project seeding area. Special thanks are due Orville B. Cary and Bernard G. Duberow for their assistance.

Members of the Oregon Forest Lands Research Center staff who aided were: Dick Berry, William Eastman, Jr., Edward F. Hooven, and Fedor Kudrjavcev.

# Summary

A 10-acre area on Crystal Creek in the Ochoco National Forest was spot seeded with ponderosa and Jeffrey pine in October 1955.

The area was prepared by cultivating with a farm disc to destroy part of the sod. Tetramine (tetramethyl disulpho tetramine) treated pine seed was sown in spots spaced 4 x 8 feet apart or 1,361 spots per acre.

Survival counts were made on six staked plots each with 25 seed spots. At the end of the second growing season, 41 percent of the staked spots contained one or more living seedlings. This represents 558 stocked spots per acre. Of individual seedlings, 45.8 percent were alive at the end of the second year.

As nearly as could be determined, drought was responsible for death of 26.5 percent of all seedlings. Disease, cutworms, rodents, arrested germination, frost, and unknown factors accounted for another 27.7 percent.

The most abundant rodent on the area was the common western chipmunk, followed closely in numbers by the white-footed deer mouse. Apparently the rodents caused damage to very few seeds or seedlings.

Common errors in seed spotting were sowing too deeply or sowing in depressions holding free water in the loose sod.

Three common annuals provided shade for the seedlings during the first year: small-flowered collinsia, miner's lettuce, and spreading nemophila. Future years will indicate the influence on seedling survival of the second year invasion of the area by orchard grass, timothy, and smooth brome. General seedling vigor in grass was poor when compared with other areas.

It appears that direct seeding can be used to good advantage in this area for forest regeneration. A mineral soil seedbed combined with adequate rodent control are the two most important requirements for success.

**Figure 1.** Looking northwest over the Crystal Creek seeding area at the beginning of the project.

## The Crystal Creek Area

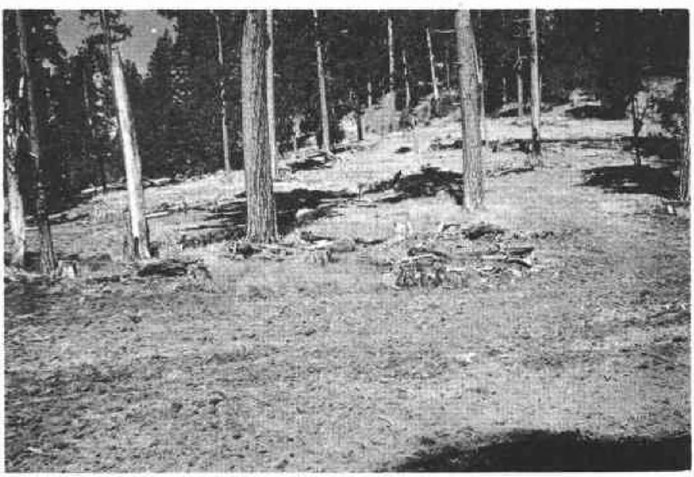

**Figure 2.** Crystal Creek area after cultivation.

# INTRODUCTION

The Crystal Creek drainage, S.6, T.13S., R.20E., of the Ochoco National Forest has been difficult to regenerate. It was first logged in 1945 and was relogged in 1951 to remove trees attacked by needle-blight fungus, *Elytroderma deformans*. There now remains a residual stand of about two mature ponderosa pines per acre. Plantings of ponderosa pine made within the area in May of both 1953 and 1955 were not successful. Ten percent of the 1953 planting survived after two years, but after one year 60 percent of the 1955 planting was left, with 30 percent after two years.

Earlier experiences of Quintus* at Foley Butte indicated the main deterrents to direct seeding were damage by animals and cutworms, and competition with grass for moisture. Preliminary experiments by the author in 1954 on Ochoco Creek indicated that direct seeding might be successful with proper site preparation.

With the cooperation of personnel of the Ochoco National Forest, a 10-acre field experiment was established in 1955. The general purposes were to determine if direct seeding was a feasible method of forest regeneration in the area, and to observe the factors influencing seedling survival. Tetramine treated seed was used since it had been an effective control against rodents in other areas.

The area involved is a moderate southeast slope with a drainage outlet through the southeast corner. Water from snow-melt runs through this drainage and the soil remains wet long after the sidehill has dried. The original stand of ponderosa pine grew up to the edge of the swale.

Though variable in depth and horizontal development over the area, the soil is a clay loam. It is at least 3 feet deep, with a dark brown topsoil and a light brown subsoil.

The most abundant vegetation is northwestern sedge, *Carex concinnoides,* which has formed a sod up to 4 inches thick in the upper area. The foreground in figure 1 includes part of the swale where two moisture-loving plants are evident: California false hellebore, *Veratrum californicum,* and tall rough bedstraw, *Galium asperrimum.*

Activity of the Dalles pocket gopher, *Thomomys talpoides,* is evident over most of the area and the Belding ground squirrel, *Citellus beldingi,* is active in the grassy area about the swale.

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* Quintus, R. L. Direct Seeding Studies in the Eastern Oregon Ponderosa Pine Region. 1952. p 5-6. (Ore. State Board of Forestry. Res. Bul. No. 6.)

## STUDY TECHNIQUES

The primary purpose of the experiment was to determine factors influencing seedling survival from seed. This included careful attention to the role of the rodent population.

### Preparation of the area

The sod on an area of about 10 acres was cultivated in August 1955, by use of a farm disc weighted with railroad iron and pulled by a D4 "cat." Although this succeeded in breaking up and overturning much of the sod, it was an inefficient method. As many as four passes were required over parts of the area, and even then some portions of the sod remained unturned.

The result of cultivation is shown in figure 2. Ground cover around the trees was left undisturbed although this space was frequently used for the abundant slash. Slash in the open places was windrowed to facilitate cultivation.

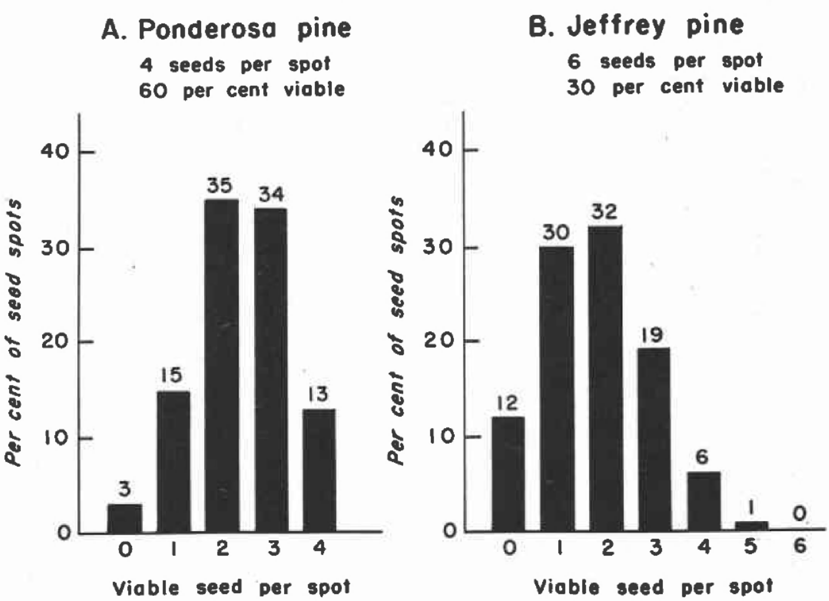


**Figure 3.** Probable percentage of seed spots with a given number of viable seed.

## Seeding

The entire cultivated area was seeded in October 1955. Seed spots were spaced approximately 4 feet apart in rows 8 feet apart, amounting to 1,361 spots per acre with slightly less than one man-day required to seed an acre. Ponderosa and Jeffrey pine seeds were used after treatment with tetramine (tetramethyl disulpho tetramine). The treatment consisted of:

1. Five-minute acetone wash,
2. One-hour soak in a 1% solution of pure tetramine in acetone, and
3. Twenty-hour air drying.

Germination tests indicated that the lot of ponderosa pine used had an expected germination of 60 percent and that of Jeffrey pine 30 percent. A large number of seeds were sown per spot to insure against excessive mortality during germination and the first two seasons of growth, since the proportion of seedlings likely to survive was unknown. Four ponderosa seeds and six of Jeffrey were used in each of their respective spots. According to germination tests and rate of sowing, the probable number of seeds germinating in spots for the two species is shown in figure 3.

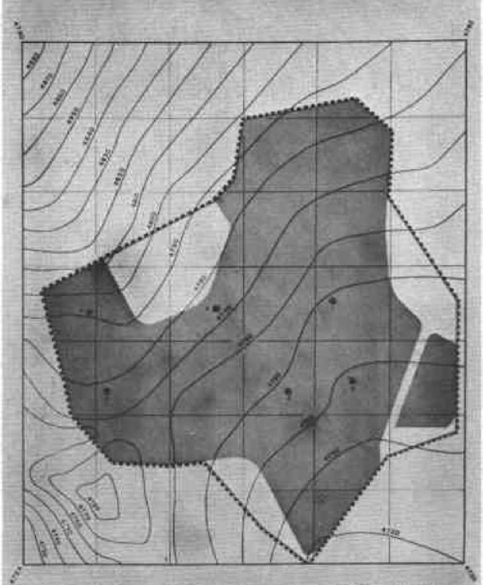


**Figure 4.** Topographic map of Crystal Creek seeding area.

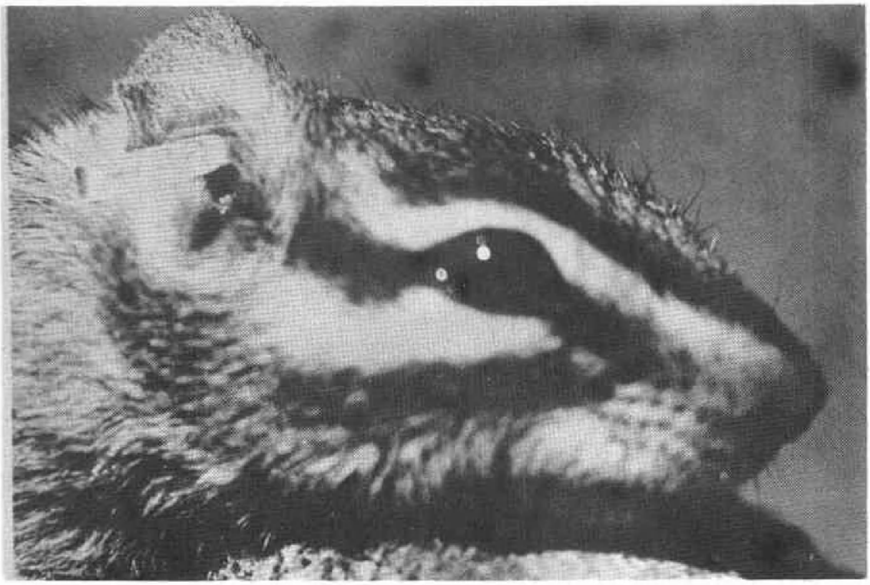

**Figure 5.** *Eutamias amoenus* with ear tag.

From the data, ponderosa pine will have 34 percent of its spots with three viable seeds and 19 percent of the Jeffrey pine spots will have three viable seeds.

Ponderosa seed was used at the rate of about ½ pound per acre and Jeffrey at about 2 pounds per acre. These figures were based on a reported average of 12,000 ponderosa pine seeds, and 4,000 Jeffrey pine seeds per pound.*

After preparation of a shallow furrow in the soil with a stick, seed was placed at a depth of about one-fourth inch. This depth was chosen because previous experience with clay soil indicated better germination if seed was left near the surface. Deeper sowing would result in decay of the seed.

Six sampling plots of 25 spots each were staked over the area. As in figure 4, plots III and IV were located on the upper part of the area, II and V on the sidehill, and I and VI through the swale. The germination and survival of seedlings on these spots were observed throughout two years.

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* Woody Plant Seed Manual. 1948. p. 261-262. U. S. Dept. of Agriculture, Miscellaneous Publication No. 654.

### Rodent census

In June 1955 the 10-acre area was set with Sherman live traps, 3″x3″x10″, spaced on a square grid of one chain (66 feet). One hundred traps on a grid of ten traps by ten traps were used to census the area and the area was trapped three nights per month. Captured animals were numbered by ear tags (figure 5) and released at each trapping with the last trapping made in June 1956.

## RESULTS

First and second year seedling survival and results of all rodent trapping on the area are presented in the following pages.

### Seedling Development

This discussion is based on observations made during the months May through October of the years 1956 and 1957.

*Percent of stocked spots*

Table 1 shows the percentage of spots on each study plot with one or more living seedlings at each time of observation.

Table 1. Seed Spots With One or More Seedlings, as Related to Date of Observation

| Date | Jeffrey pine plots | | | Ponderosa pine plots | | | |
|---|---|---|---|---|---|---|---|
| | Swale | Side-hill | Upper | Upper | Side-hill | Swale | |
| | I | II | III | IV | V | VI | All plots |
| | % | % | % | % | % | % | % |
| 1956 | | | | | | | |
| May 9 | 36 | 56 | 76 | 76 | 68 | 16 | 55 |
| May 18 | 44 | 64 | 72 | 76 | 72 | 28 | 59 |
| May 24 | 60 | 68 | 72 | 76 | 72 | 32 | 63 |
| May 31 | 68 | 72 | 72 | 76 | 76 | 36 | 67 |
| June 11 | 68 | 64 | 76 | 76 | 76 | 28 | 65 |
| July 8 | 68 | 56 | 76 | 68 | 68 | 28 | 61 |
| Aug. 10 | 68 | 56 | 68 | 64 | 68 | 28 | 59 |
| Sept. 11 | 68 | 56 | 56 | 56 | 56 | 28 | 53 |
| Oct. 10 | 68 | 56 | 56 | 56 | 56 | 28 | 53 |
| 1957 | | | | | | | |
| May 27 | 64 | 56 | 48 | 44 | 56 | 16 | 47 |
| Sept. 18 | 64 | 56 | 20 | 40 | 52 | 16 | 41 |

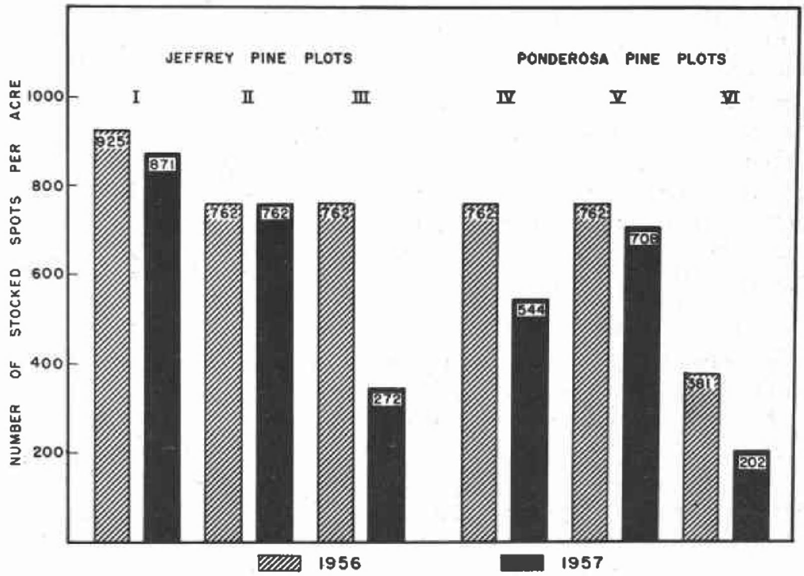


**Figure 6.** Number of stocked spots per acre at the end of 1956 and at the end of 1957.

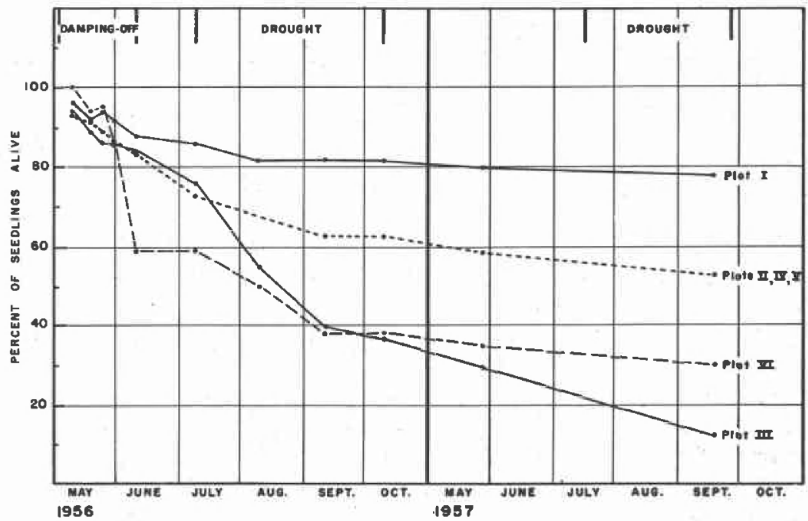


**Figure 7.** Percent of seedlings alive over the several plots during 1956-1957.

Results of examinations made during October 1956 and September 1957 are expressed in the number of stocked spots per acre. These data are illustrated in figure 6.

For all plots a mean of 701 stocked spots per acre was observed at the end of the first year and 558 at the end of the second year. No outstanding differences were evident between the performances of Jeffrey and ponderosa pines. The poor results in this study with ponderosa pine, 381 stocked spots per acre at the end of the first year, do not reflect on the species, but were due to the location of the plot. The low, wet swale conditions caused much of the seed to rot before germination could take place.

*Survival of individual seedlings*

The survival of individual seedlings is discussed here without reference to species since no significant variation between them was observed. Data from Plots II, IV, and V are combined since little difference was observed between them. The average survival of all plots in September 1957 was 45.8 percent of the germinated seedlings. Plot I had the best survival of all plots—78 percent. This was apparently due to higher soil moisture without the inundation that caused disease of the seed and seedlings in Plot VI. Plot III's survival of 12 percent was apparently due to the droughty condition of the plot. The data are illustrated in figure 7.

*Mortality of individual seedlings*

The apparent cause of mortality of seedlings is recorded in table 2.

Table 2. Mortality of Individual Seedlings

| Year | Drought | Disease | Cutworms | Rodents | Misc. | Total |
|---|---|---|---|---|---|---|
| | % | % | % | % | % | % |
| 1956 ............ | 20.7 | 6.5 | 5.2 | 3.5 | 5.5 | 41.4 |
| 1957 ............ | 5.8 | 0.6 | 0.0 | 1.6 | 4.8 | 12.8 |
| Total ............ | 26.5 | 7.1 | 5.2 | 5.1 | 10.3 | 54.2 |

Seedlings retarded by excessive heat, yet not killed, are probably more susceptible to drought than those not retarded. Other seedlings injured by excessive heat may die in late summer as if from drought, even though adequate moisture conditions exist. That no definite loss due to heat is apparent, may possibly be due to the development of herbs on the area. These herbs protected the seedlings in their tender stage and will be discussed later.

For the 1956 season, drought was the most important factor in seedling mortality. From July onward drought was important in combination with earlier heat injury; hence the difficulty of evaluating the heat factor influence on mortality.

Drought losses during the second growing season were mostly confined to Plot III. This plot, on the upper prominence of the area was driest of the six, and showed an 18 percent mortality. The soil in this plot became baked and fissured, but whether death resulted from low soil moisture, air drying, or the rupturing of the root systems in the fissured soils was not determined.

During the 1957 season the area was invaded by grass species commonly used in seeding skid roads and landings to prevent soil erosion. These were orchard grass, *Dactylis glomerata;* timothy, *Phleum pratense;* and smooth brome, *Bromis inermis.* Vigor of the tree seedlings in the grass was poor and their growth was very limited during the second season. As grasses can only aggravate the drought condition of any plot, their total influence will be observed in succeeding years.

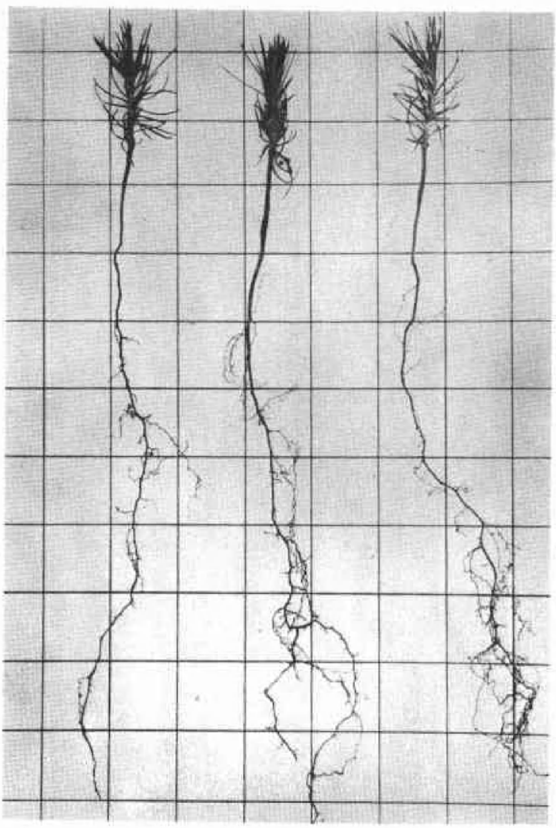

**Figure 8.** One-year-old ponderosa pines from experimental area. Grid is in one-inch squares.

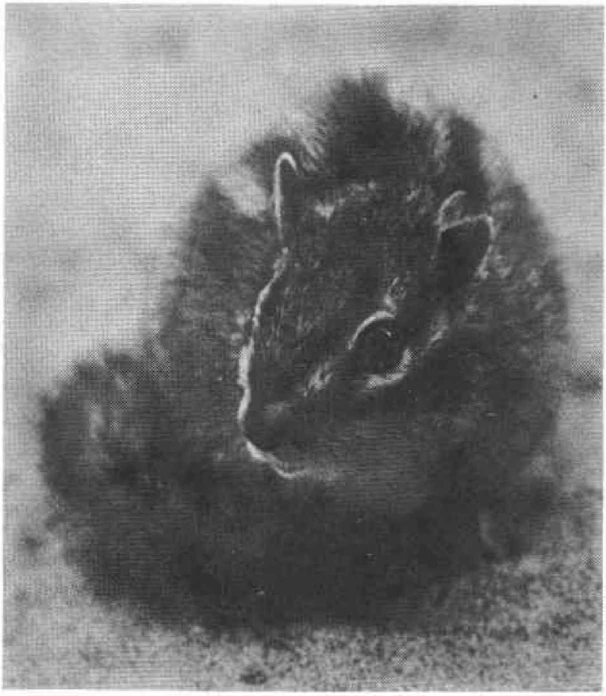

**Figure 9.** Common western chipmunk, *Eutamias amoenus.*

Disease was important on Plot VI as a result of excessive moisture during May and June of 1956. Pre-emergence disease of the seed and germinating seed was more important than disease of the emerged seedling. No numerical evaluation was made of this problem.

Cutworms, a potential threat in grassy areas, destroyed 5.2 percent of the seedlings.

Seedling-eating rodents or birds caused a loss of 5.1 percent of the seedlings by eating stems just above the ground. Other damage in which the cotyledon and primary needles were eaten did not result in seedling death. This damage was apparently caused by birds.

The losses listed as miscellaneous during the first year were largely due to seed that germinated "upside down." The radicle became exposed to the sun and was killed before it could properly contact the soil. This type of loss is one of the risks of surface or shallow seeding in which the seed may not be completely covered. Other losses in this class were due to seedings that could not be found.

Frost was responsible for the death of a few seedlings, particularly in Plot III, where germination occurred earlier than in the other plots.

*Root development of seedlings*

The maximum root development of one-year-old ponderosa pine seedlings was 8 to 9 inches. In most cases root penetration stopped as the soil profile changed from dark brown to light brown clay. Figure 8 illustrates typical root systems.

**Rodent census**

Figure 9 pictures the common western chipmunk, *Eutamias amoenus,* which was the most abundant rodent on the area. Following in order of decreasing numbers caught, are the white-footed deer mouse, *Peromyscus maniculatus;* Belding ground squirrel, *Citellus beldingi;* and golden mantled ground squirrel, *Citellus lateralis.* The number of different individuals caught during each 3-day trap period or 300 trap nights are shown in figures 10 and 11 for the four species. This represents the absolute or trapped population on the 10-acre area.

Four individual Peale's meadow mice, *Microtus montanus,* and one Great Basin pocket mouse, *Perognathus parvus,* were caught during the trapping.

The data shows only the numbers and species of rodents trapped and any further extension of the data is unjustified.

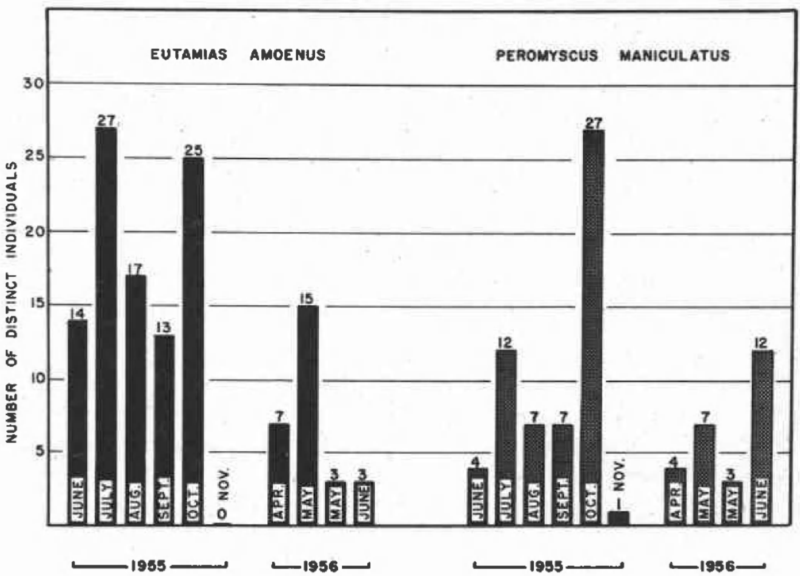


**Figure 10.** Number of individual common western chipmunks, *Eutamias amoenus,* and white-footed deer mice, *Peromyscus maniculatus,* caught during each trapping period.

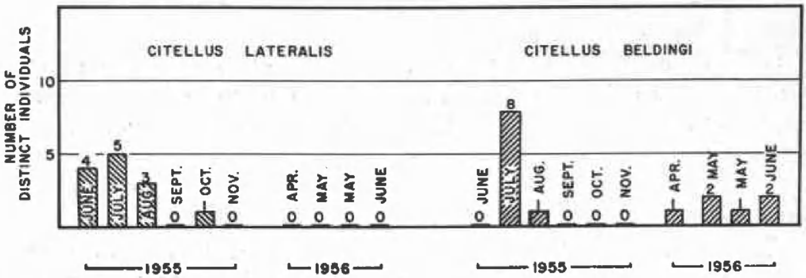


**Figure 11.** Number of individual golden mantled ground squirrels, *Citellus lateralis,* and Belding ground squirrels, *Citellus beldingi,* caught during each trapping period.

The area was trapped October 6, 7, and 8, and seeded on October 25 and 26. Of the important seed eaters, 25 *Eutamias,* 27 *Peromyscus,* and one *Citellus lateralis* were caught on the 10-acre area during the trapping. It may be assumed that this was an adequate population to destroy the seed, but little of the tetramine treated seed was lost to rodents.

*Citellus beldingi* and *Microtus* are more important as vegetation feeders. Only 5.1 percent (table 2) of the seedlings could have been lost to rodents. Of these, 3.5 percent resulted from the seedling stem being clipped just above the ground while during the second season 1.6 percent of the seedlings were buried by the excavated dirt from the burrows of *C. beldingi.*

## OBSERVATIONS AND COMMENTS

This study should not be considered a designed experiment; it was primarily an application of the best known techniques toward solving the problem of tree establishment from seed. A number of important results developed, some of which were unforseen at the beginning of the work. Three of these will be discussed: the placement of seed and seed spots, development of herbaceous plant cover, and movements of the rodent population.

### Placement of seed spots

The recommendations of Stein, 1955* were used in selecting seed spot locations. Seeding was done in the loosely scarified soil with the most common faults in the seed spotting technique resulting from working in loose soil. In many cases seeds were placed in deep depressions (figure 12) made by kicking away the undecomposed sod. In the well-drained areas this had

* Stein, W. I. Preliminary recommendations for seed spotting sugar pine in southwest Oregon. 1955. p. 5-6. U. S. Dept. of Agriculture Forest Service, Pacific Northwest Forest and Range Experiment Station. Research Note No. 118.

# Ponderosa Pine Seedlings

**Figure 12.** One-year-old ponderosa pine seedling in depression in sod with *Collinsia parviflora*, the most abundant new vegetation.

**Figure 13.** One-year-old ponderosa pine seedlings in a well drained seed spot.

**Figure 14.** One-year-old ponderosa pine seedlings from seed sown too deeply. The seedling on the right is dead.

no apparent influence on survival, but in the especially wet areas, moisture would accumulate in small depressions and the seed there would rot before germinating. Seeds sometimes became too deeply covered in the depressions as a result of rain and snow-melt. Seed did best when located in well-drained places near the bases of the small mounds or slopes formed in cultivation and usually present throughout the area as in figure 13. Except in very wet areas, seeding on top of mounds should be avoided since the seedlings are liable to die of drought.

Another common mistake involved sowing seed too deeply. Such seed either rotted before germination or produced a seedling of poor vigor that readily succumbed to drought. In figure 14 the soil is up to the primary needles and the seedling on the right is dead from drought.

## Development of herbaceous cover

Herbaceous vegetation that developed on the scarified area played an important role in seedling development. Three species of annuals; small-flowered collinsia, *Collinsia parviflora;* miner's lettuce, *Montia perfoliata;* and spreading nemophila, *Nemophila pedunculata;* appeared to provide germinating seedlings with protection from heat. These species matured in early summer and probably did not use moisture during the later dry summer period. They are prostrate or widely branching forms that develop dense mats, either singly or in combination with each other. Figure 15 illustrates the cover provided by miner's lettuce during the spring, while figure 16 shows that of spreading nemophila during late summer.

Cheat grass, *Bromus secalinus,* was abundant in one area where the subsoil was completely exposed. Examination indicates that this species is apparently beneficial to seedling survival.

Knotweed, *Polygonum* sp., grew abundantly in the wetter areas throughout the summer. Seedlings were not abundant in this portion of the experimental area, and it was not possible to determine whether knotweed itself interfered with seedling development. The wetter condition of this area may have caused seed to rot prior to germination.

**Figure 15.** *Montia perfoliata* providing cover for one-year-old ponderosa pine seedlings.

## Rodent population

In general, such seed-eating rodents as the common western chipmunk, the white-footed deer mouse, and the golden mantled ground squirrel are prevalent through areas having an accumulation of slash. The white-footed deer mouse probably works all winter in these situations. Maximum possible disposal of slash seems advisable as an aid in control of these rodents.

The Belding ground squirrel, Dalles pocket gopher, and Peale's meadow mouse prefer grassy areas. The destruction of sod temporarily translocates these animals from cultivated parts of the seeding area. Figure 17 shows an example of the larger slash, where activity of the Belding ground squirrel is most common.

Successful seed spots were rarely found near the slash. This could be due to greater exposure of the seed to small seed-eating rodents and to the trampling of germinating seedlings in the runways of larger rodents. The most common cause of seedling loss to rodents was the covering of one- and two-year-old seedlings with the material excavated from Belding ground squirrel burrows. This damage was not as great on the sample plots as elsewhere on the general experimental area.

**Figure 16.** Dense, low, spreading cover of *Nemophila pedunculata* concealing two ponderosa pine seedlings.

**Figure 17.** Runways of *Citellus beldingi* under heavy slash. Such accumulations also afford protection for the *Peromyscus* which are of special importance during the winter.

## CONCLUSION

Experience gained from this project in the Ochoco National Forest indicated that rodents were a very minor factor in whether or not seedlings became established, provided tetramine treated seed was used. Within this specific area at least, placement of the seed and the other plants developing around the seedlings were of far more importance.

It now seems reasonable to state that direct seeding, combined with a mineral soil seed bed and adequate rodent control can be profitably used in forest regeneration of this, and similar areas.

The Crystal Creek seeding will be checked in future years to more adequately determine the influence of second-year grass invaders on seedling survival.

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