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Effect of Field Stratification on Douglas Fir Seed Germination

by
Denis P. Lavelle

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Dick Berry, Director

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Forest Lands Research Center

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- Develop the full potential of Oregon's timber resource by :
 - increasing productiveness of forest lands with improved forest practices.
 - improving timber quality through intensified management and superior tree selection.
 - reducing losses from fire, insects, and diseases—thus saving timber for products and jobs.
- Keep development of the forest resource in harmony with development of other Oregon resources.

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- Seed production, collection, extraction, cleaning, storage, and germination.
- Seedling production, establishment, and survival for new forests.
- Growth and development of trees, quality of growth, and methods of thinning and harvesting to grow improved trees.
- Study of forest fire behavior and fire weather to prevent fires.
- Insect pests and their control, to save trees.
- Disease control and prevention in Oregon forests.
- Mammal damage and the controls to help regrowth.
- Soils and their relationship to growth.
- Development of improved forests through selection and breeding.

Effect of Field Stratification on Douglas Fir Seed Germination

by Denis P. Lavender

Introduction

Success of coniferous seedings on Pacific Northwest forest land depends upon weather favorable to germination and growth of the seedlings, effective rodent control, favorable seedbeds, and high quality, viable seeds. Foresters have long been concerned with the dual problems of storing and pre-treating seeds to achieve the maximum possible germination when they are sown in the nurseries or in the field. Because most reforestation work in the Northwest has involved Douglas fir (*Pseudotsuga taxifolia* Poir.) seed and seedlings, the study reported here investigated the efficiency of present handling methods in securing maximum germination of such seed.

This study was designed to answer the question: Are natural weathering conditions more favorable to the germination of Douglas fir than currently employed stratification¹ methods? It appeared that relative efficiencies of seed stratification and natural weathering should be indicated by comparing the following for each method: 1) physical condition of seeds; 2) germination percent. It was also believed that such data could indicate what changes, if any, could be made to improve current seed storage and stratification practices.

Experimental Procedures

All seed for this experiment was gathered by the investigator in the fall of 1953. Collections were made near Marion Forks at an elevation of approximately 3,600 feet in the North Santiam River drainage. The cones were dried at temperatures of 85 to 105 F². Seed was extracted in a small rotary drum and cleaned on a small Clipper fanning mill. The seed was cleaned further with a South Dakota Blower until a cutting test, based on 800 seeds, showed 98.8 percent sound seed³. A laboratory germination test was run on a random sample of this seed to provide a standard to be compared with similar tests run after the seed underwent various storage procedures. Results of this test showed seed viability of 95 percent.

1. Storage in a moist medium at 34 - 39 F for a period of six weeks.
2. The author wishes to express his appreciation to the Woodseed Company of Salem, Oregon for their cooperation in making their facilities available for this work.
3. Cutting test: one hundred seeds, selected at random, were bisected along the long axis and condition of embryo and endosperm noted. The percent seed classified as "sound" may be considered an estimation of the maximum possible germination percent.

Since the study was designed to compare viability of seed overwintered under natural field conditions with that of seed stored artificially and then stratified, experimental procedures are divided into "natural stratification" and "laboratory stratification." Because the germination period of any given lot of Douglas fir seed cannot be predicted exactly, the field phase of the experiment was planned to include the entire range of known germination dates. Laboratory testing was planned so that samples of seed stored artificially were placed in germinators on approximately the same dates as germination was checked in the field.

Natural Stratification

The experimental area was located in the Tillamook Burn approximately 2,200 feet above mean sea level, with the specific site on a ridge dividing the drainages of the South Fork of the Wilson River and Jordan Creek. There were four major exposures within an area 500 feet square (plate 1).

A randomized block design was used in the field phase of the study, with one block for each principal exposure. A block consisted of ten seed spots, two spots for each of the five planned examination dates

Individual seed spots consisted of approximately 350 seeds (eight seeds per square inch of soil surface) inside an enclosure providing protection against seed-eating mammals (plate 2 and figure 1). The "cans" were approximately 7-1/2 inches in diameter with a protective hardware-cloth cover. Each can was placed in a hole approximately 2-1/2 inches deep, from which the soil had been carefully removed. The soil was then replaced in the closest possible approximation to its original condition. The Douglas fir seeds, selected from the mass of experimental seed by random with pneumatic seed counters, were scattered over the surface of the soil inside each can.

The seed was placed in the field on November 27, 1953. On March 31, 1954, the two cans from each exposure designated for removal in April were brought into the laboratory where all the seeds were separated from the soil. A record was made of the field germinated seeds (plate 3) as they were removed from the cans. Cans for the remaining months were examined in the field with germinated seeds recorded and removed.

A similar procedure was followed on, or about, the first of each of the following months, May, June, July, and October. In addition, field germination counts were made on the "Fall" cans (so designated because it was planned to remove these cans sometime during the fall of 1954) of each block in August and September. Plate 3 shows that only a small percentage of seeds germinated in the field prior to April 1. At that time, therefore, sufficient nongerminated seeds were recovered to permit running germination tests in the laboratory. Results of these tests and field germination counts are summarized in table I.



Plate 1. View of the experimental area showing north exposure in the foreground and west slope in left center background.



Plate 2. Close-up of "cans" in place. Photo taken March 1954 on north exposure.

Laboratory Stratification¹

Seeds to be stored in the laboratory were first selected randomly and counted by means of pneumatic seed counters in a manner identical to that employed in preparing the seed lots placed in the field. Four hundred seeds at 6.4 percent moisture content were placed in each of 15 glass test tubes. The tubes were then sealed with tight rubber stoppers and placed in storage. No drying procedures were used during the study so this moisture level was the equilibrium point for the short period of cold storage prior to initiation of the study. Five tubes were placed in each of three chambers held at the following temperatures: 0 F, 32 F, and warehouse (approximately 40 - 60 F). Six weeks prior to each of the following months, April, May, June, July, and August, one tube of seeds was removed from each storage condition. These seeds were stratified for six weeks and then placed in the germinator oven.

Each of the 15 lots of 400 seeds was divided into four sub-lots of 100 seeds. Each sub-lot was then placed in a 100 mm. glass petri dish. The sub-stratum was paper toweling saturated with a 0.2 percent solution of potassium nitrate. The sub-stratum was changed every week when the seedling count was made. The Minnesota type germinating ovens utilized in the tests were set to maintain cyclic temperatures of: 86 F with light, for eight hours; and 68 F without light, for sixteen hours. Each week, for four weeks, all germinants longer than one-fourth inch were tallied and removed. In addition, at the conclusion of the tests the physical condition of the nongerminated seeds was noted. Results of these tests are recorded in table I.

1. The author wishes to express his appreciation to the Oregon State College Seed Laboratory in Corvallis, Oregon, for their cooperation in making available the facilities necessary to perform the "laboratory" phase of the experiment.

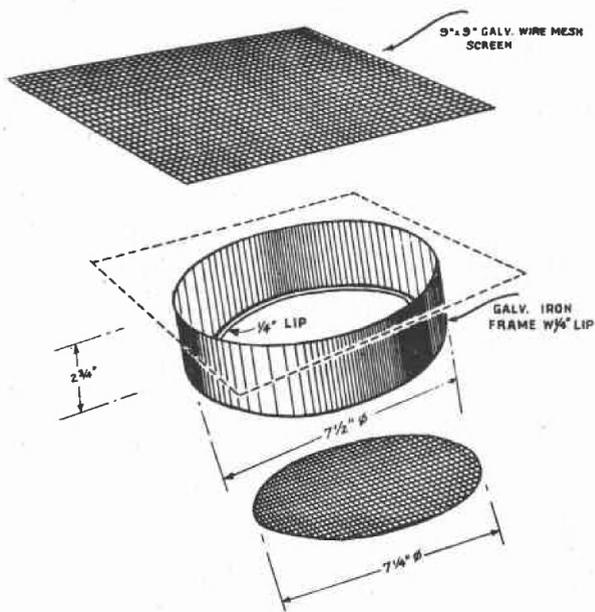


Figure I

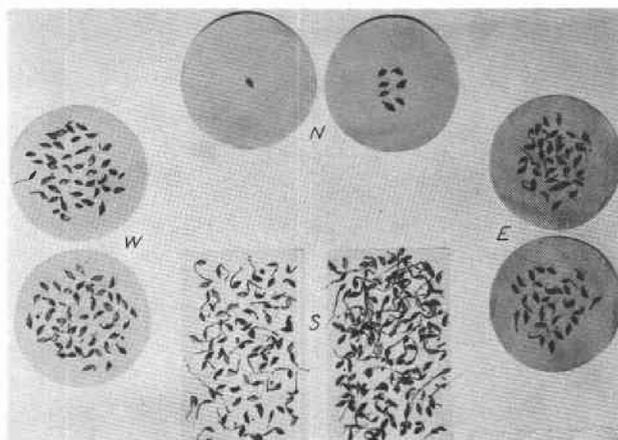


Plate 3. Germinants recovered from cans removed from the field on March 31, 1954. Seeds at the top of the picture were taken from cans placed on a north exposure; those at the bottom, a south exposure; on the right, an easterly exposure; and on the left, a westerly exposure.

Discussion

Table I indicates that the longer the cans remained in the field, the fewer total seeds and seedlings were recovered from each can. This was probably due to two factors: 1) the field counts were made at intervals too great to permit tallying all the seedlings that germinated, died, and withered between examinations; and 2) herbaceous cover became progressively heavier as the growing season progressed and this made the location of seeds more difficult. A check of nongerminated seeds recovered from the cans in the laboratory revealed no evidence of fungus attack. None of the insects recovered from the soil in the cans were those known to attack seeds.

Contrary to a commonly accepted belief, there was little evidence that action of weathering agents worked the seeds down into the soil. Most seeds were found lying on the soil surface.

Conclusions

Results of field and laboratory germination counts are summarized in the tables included in the appendix. The figures clearly indicate the following (for this particular lot of seed and the 1953-54 season):

- 1) Natural overwintering of seeds was no more efficient in securing maximum germination of the seed tested in this study than was the usual procedure of cold dry storage followed by a 6-week moist chill (stratification).
- 2) There was no reduction in the seeds' germinative vigor during the 6-month storage period under any of the storage temperatures. The moisture level of the seed was 6.4 per cent. This was the equilibrium point reached under the existing storage conditions since no attempt was made to dry the seed prior to, or during the study.

TABLE I

Viability of Douglas Fir Seeds Overwintering in the Field Compared to that of Seed Artificially Stored

Month	Field				Laboratory							
	seeds found (Number)	seeds found (%)	Field Germination seeds found (%)	seeds placed (%)	Lab. Germ. seeds found (%)	seeds placed (%)	Total Germ. seeds found (%)	seeds placed (%)	O F germ. (%)	32 F germ. (%)	Ware- house germ. (%)	Mean germ. (%)
April. .	2648	97.07	13.06	12.68	84.75	82.28	97.85	95.00	97.00	94.50	97.50	96.33
May. . .	2717	96.07	81.36	78.16	13.70	13.17	95.07	91.33	97.25	94.75	92.75	94.92
June . .	2583	94.68	88.65	83.95	4.80	4.55	93.40	88.45	92.00	95.25	94.50	93.92
July . .	2281	83.62	91.80	76.76	1.42	1.19	92.76	77.56	93.75	95.25	95.75	94.92
Fall . .	2032	74.49	90.96	67.78	0.94	0.70	91.89	68.47	96.25	94.25	95.75	95.42

1. Entries in the "laboratory germination" columns for all months from May through fall were determined from the following factors:

Number of sound, light-colored seeds noted during cutting tests of non-germinated seeds recovered from all cans for months after April

x

Sound, non-field germinated seed recovered from "April" cans which subsequently germinated in laboratory.

Total sound, non-field germinated seed recovered from "April" cans.

(This procedure was necessitated by the small numbers of nongerminated seeds recovered from each can which made laboratory germination tests impractical.)

TABLE II

Field Germination by Exposures

Date Examined	Germination			
	North %*	South %*	East %*	West %*
April				
Seeds found	0.00	16.05	5.97	3.27
Seeds placed	0.00	13.90	5.23	3.05
May				
Seeds found	43.31	71.04	72.34	83.88
Seeds placed	37.80	59.90	62.17	76.87
June				
Seeds found	84.69	78.93	82.76	89.68
Seeds placed	70.82	64.37	68.77	80.70
July				
Seeds found	92.80	88.75	87.33	96.25
Seeds placed	71.77	65.32	69.21	82.77
Fall				
Seeds found	94.92	93.18	78.61	98.86
Seeds placed	74.05	64.08	58.21	76.25

*Each germination percent is the average of germination percents for all cans in the field during the preceding period. Thus, each figure for April is the mean of 10 cans; for May, 8; for June, 6; etc. This procedure provided a broader base for computing total average germination for each month and accounts for the total germination of seeds found on the East exposure being lower in the fall cans than in the mean of field germination recorded in July.

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