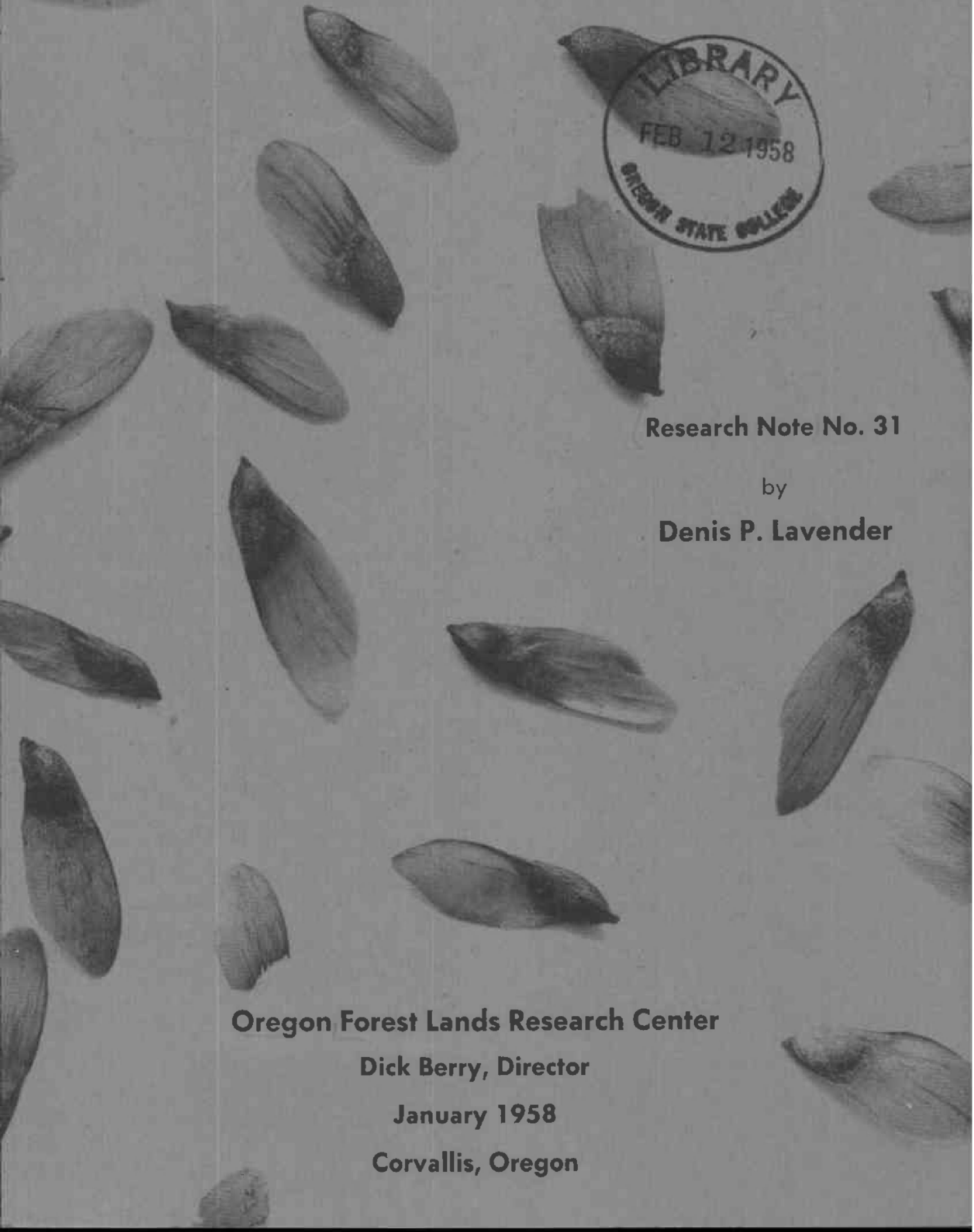
Viability of Douglas Fir Seed

After Storage in the Cones



Research Note No. 31

by

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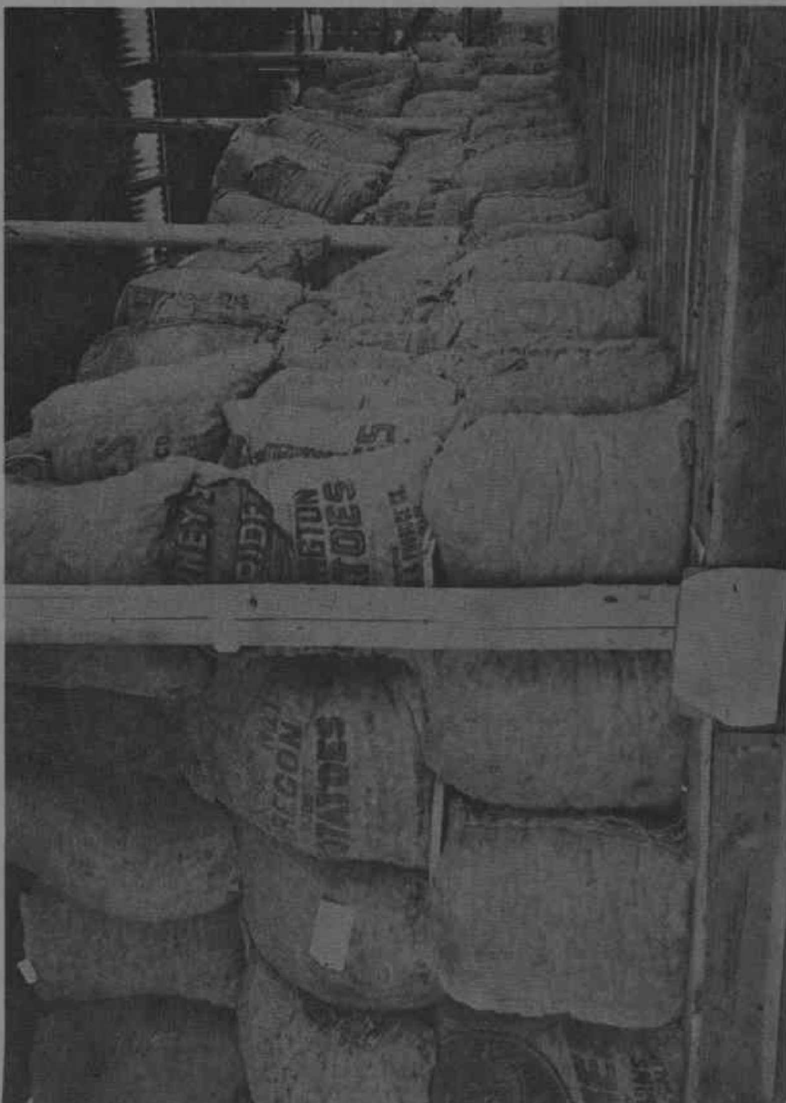

Cones are partially dried in sacks then stored in open sheds

After Storage in the Cones

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Introduction

The current practice in the Douglas fir region of the Pacific Northwest is to collect Douglas fir cones early in the fall and store them in burlap sacks (frontispiece) until drying can be completed and the seeds extracted and cleaned. Although several investigators have studied effects of various storage conditions upon viability of extracted seeds, the literature reveals no information concerning effects on Douglas fir seeds of prolonged storage in the cones. The study reported here was designed to determine effects of such storage over two and four month periods.

Cone Collection and Storage

Between August 22 and September 6, 1956, approximately five pounds of Douglas fir cones were picked from each of 40 trees scattered over the Willamette Valley within a 30-mile radius of Salem (elev. 100-500 ft.). Each of the 40 lots was divided into thirds and each third then placed in cotton bags. These bags were put into four burlap sacks and stored in an unheated warehouse. A hygrothermograph was placed with them to provide a continuous record of temperature and humidity.

Seed Extraction

The first third of each lot of cones was air dried at temperatures between 80 F and 100 F with the seeds hand extracted and cleaned on a South Dakota Blower. After cleaning, the seeds were placed in individual containers and stored in the same warehouse as the cones.[1] Drying and cleaning procedures were repeated in November, 1956 and January, 1957. Experimental material then consisted of three lots of seed; the first stored zero months in the cones; the second, two months; and the last, four months.

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1. Previous work by the author, Lavender, (3) has shown that short term storage under a similar range of temperatures does not affect Douglas fir seed viability.

Seed Testing

After the seeds were cleaned, a cutting test[1] was made on each of the 120 lots (40 trees, three storage periods). On the basis of these tests, sufficient seeds to provide 100 sound seeds for each lot were randomly selected and stratified[2] for three weeks. Original plans called for standard oven germination tests; however, since laboratory facilities were overtaxed at this time, greenhouse tests were substituted. Greenhouse temperature was controlled thermostatically to provide a close approximation of the more rigorously controlled conditions possible in laboratory tests. Twenty-seven seedflats, 12" x 19 1/2" x 4" (inside dimensions), were used in the germination tests. The substrate was a fresh forest soil, thoroughly mixed and sifted. A template producing depressions one-half inch deep and an inch apart, assured seed rows of equal depth and spacing. Seeds were sown at equal intervals in these depressions and then covered with one-half inch of fine sand. Each seed lot was divided into groups of 25 seeds each and each sublot was then randomly assigned a seed flat and row. Thus, each storage period was represented by 160 randomly located rows of seeds, and each tree, by 12 rows of seeds.

The seeds were sown between February 26 and March 4, 1957. Germination checks were made semiweekly between March 11 and April 15. All seeds had an 8-week germination period; three weeks in stratification and five weeks in seedflats.

Vigor of Stored Seeds

Table I summarizes germination data according to the lengths of time seeds were stored in the cones. These data clearly show that duration of storage in cones had no effect on seed germination. Similarly, data presented in Table I indicate that varying periods of storage in cones had no effect on seed vigor as demonstrated by the average germination period. (The average germination period equals the total number of days between time of planting and date of germination for each seed in a given lot, divided by the number of germinating seeds.)

Cone Size and Germination Characteristics

Eliason and Heit (1) found a definite and positive correlation between the size of the cones of Scotch pine (Pinus sylvestris) and numbers and sizes of both seeds and seedlings. Accordingly, cones and seeds of each lot were weighed and measured to determine if similar relationships existed for Douglas fir. Plates 1 and 2 show the range in size of the cones and seeds.

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1. One hundred seeds, selected at random, were bisected along the long axis and the condition of embryo and endosperm noted. The percent seed classified as "sound" may be considered an estimation of the maximum possible germination percent.
2. Moist storage at 34 F to 39 F.

Although there was a wide variance in cone size between different lots, the size of the cones in any one lot was relatively uniform. In no lot was the difference between the largest and the smallest cones greater than the differences between any three adjacent cones (Plate 1). This does not mean that a specific tree does not produce a variety of cone sizes, as most cones were collected from the lower crowns, and there may be definite size differences between cones grown at the top and those at the bottom of a given tree. A better basis for comparing the effects, if any, of cone size on seed germination and seedling vigor is provided by samples of cones of uniform size than by samples of cones with widely varying sizes but the same means.

Seed Size and Germination

Most seed lots were more than 98 percent sound. If an appreciable number of blank seeds were found in a lot, these were weighed, and the number of sound seeds per gram was then computed. Weight of blank seeds not removed by the South Dakota Blower averaged only 45 to 50 percent of the weight of filled seeds.

Seeds shown in Plate 2 were randomly selected from two seed lots and illustrate the relatively uniform size of seeds from any given lot. Weights of the seed lots were determined by weighing samples of several grams and tallying the number of seeds in each sample. In addition, randomly selected seeds from lots composed of large seeds, and others from lots of medium and small seeds were weighed individually. Figure I presents a summary of this data and demonstrates the relatively uniform seed size from a given lot (several lots are represented in each size class).

TABLE I

Relationship Between Seed Vigor and Duration of Storage in Cones

	0 months	2 months	4 months
Average germination percent	76.8	75.2	76.0
Average germination period	27.8	27.2	25.8

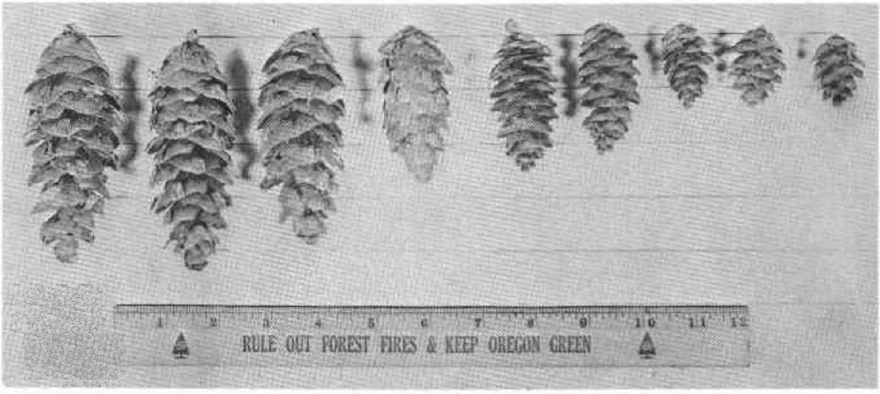


Plate #1. A sample of the cones collected for this study. The cones in any one lot were nearly always within the range of size represented by any three adjacent cones.

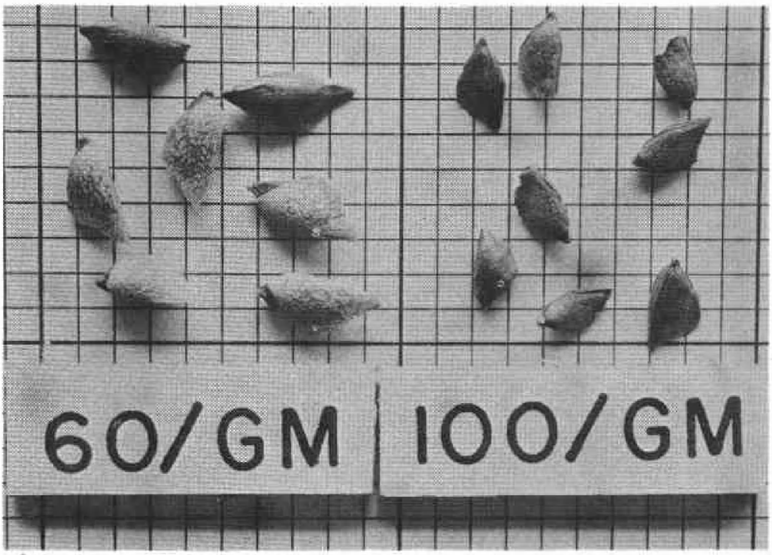


Plate #2. These seeds are typical of the larger and smaller seed lots tested in this study. Note the uniform size of the seeds from each group. Cross sectioned paper is scaled at 10 lines to the inch.

TABLE II

Relationship of Cone and Seed Weight to Weight and Vigor of Resultant Seedlings

Lot number	Cone weight*	Seed weight**	Germination	Germination period	Seedling weight
			percent	days	gms.
33	37	60	70	32.3	.11
21	37	63	77	27.5	.12
4	60	67	79	24.4	.10
9	63	68	87	24.6	.13
10	61	69	82	25.3	.13
24	39	69	89	29.1	.10
3	59	70	83	26.8	.14
15	42	70	76	27.1	.10
35	45	70	82	26.6	.10
36	48	70	90	27.5	.12
26	37	72	66	29.5	.12
22	58	73	64	29.4	.09
37	38	73	91	21.1	.13
39	47	73	81	25.7	.17
40	84	73	85	25.4	.12
6	69	74	67	31.9	.11
20	59	75	85	26.4	.13
28	78	77	84	23.5	.12
5	70	81	82	25.3	.10
17	53	82	84	28.3	.08
18	83	82	63	28.7	.11
31	80	82	87	24.1	.10
19	71	83	67	28.0	.11
38	43	83	91	24.5	.10
1	71	85	86	21.8	.10
29	53	85	78	23.9	.11
12	60	86	85	23.5	.11
30	57	86	57	28.5	.10
27	69	87	63	31.0	.08
8	64	88	82	27.9	.11
13	54	88	70	30.2	.10
34	88	89	61	28.5	.09
11	67	91	64	32.4	.10
32	78	91	70	29.4	.10
16	72	92	88	23.4	.12
25	51	98	62	30.1	.08
14	70	98	77	31.1	.09
2	54	98	85	26.3	.10
23	68	99	85	26.1	.10
7	94	102	49	32.7	.09

*No. of cones per pound
**No. of seeds per gram

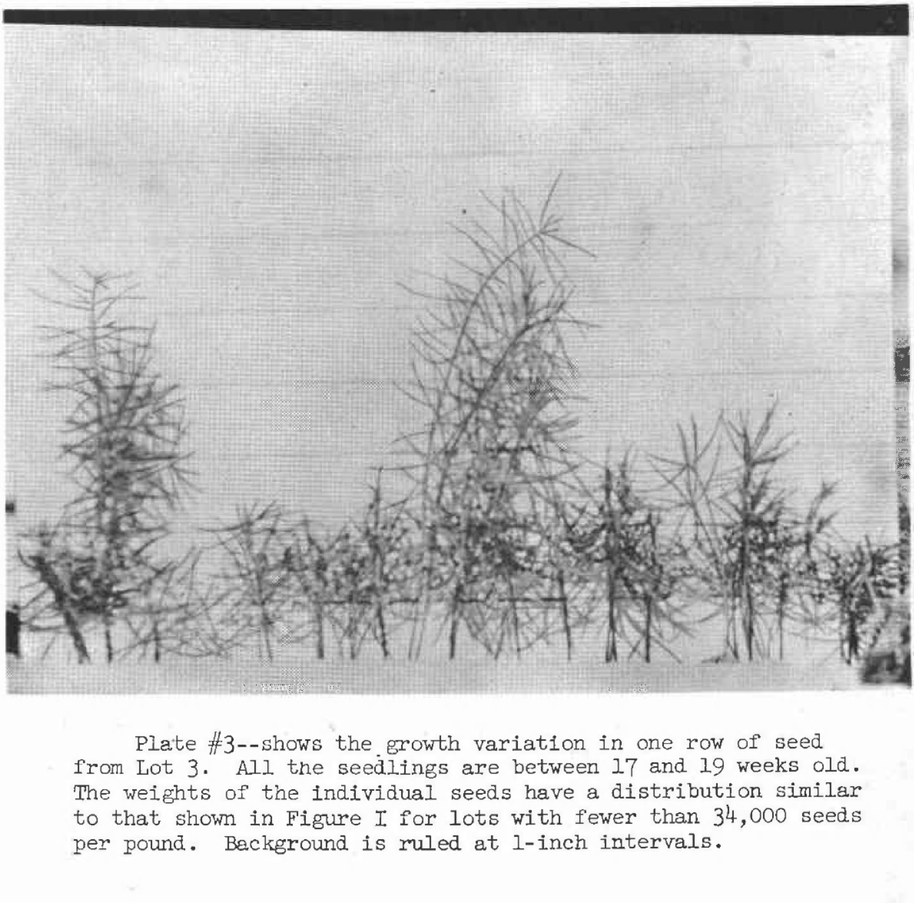
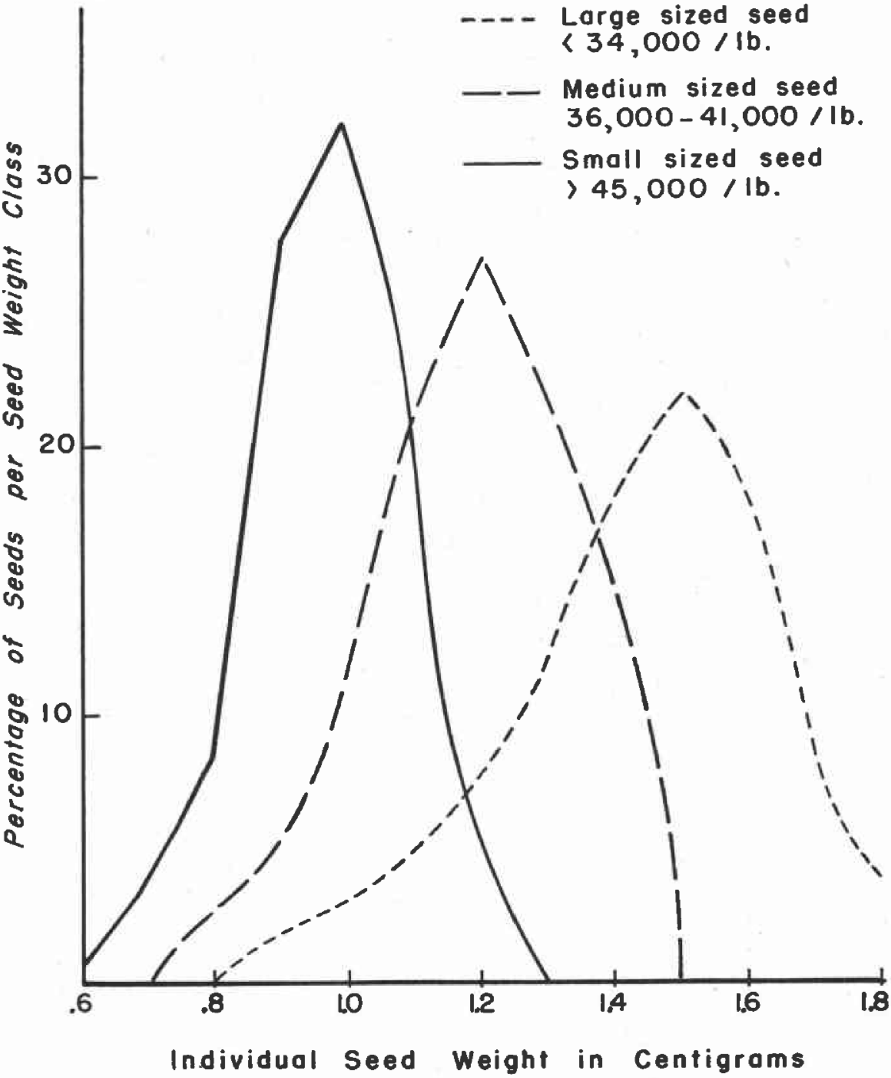


Plate #3--shows the growth variation in one row of seed from Lot 3. All the seedlings are between 17 and 19 weeks old. The weights of the individual seeds have a distribution similar to that shown in Figure I for lots with fewer than 34,000 seeds per pound. Background is ruled at 1-inch intervals.

Figure I. Individual Seed Size Distribution Within Large, Medium, and Small Seed Class

(Each seed is a composite of seeds from six individual trees)



Conclusions

Data presented in this report indicate the following conclusions:

1) Duration of storage in the cones (up to four months at temperatures near 50 F) has no effect upon the germinative capacity of Douglas fir seeds.

2) The size and vigor of seedlings cannot be predicted from the size of cones or seeds.

An analysis of the data also indicates that for the population of Douglas fir cones and seeds tested in this study there is little or no correlation between the following factors:

1) Germination percent and cone size.
2) Germination percent and the number of sound seeds per cone.
3) Cone size and the number of sound seeds per cone.
4) Cone size and the total number of sound seeds for a given weight of cones.
5) Cone size and the total weight of sound seeds for a given weight of cones.
6) Seed size and average germination period.
7) Cone size and average germination period.
8) Cone size and seed size.
9) Cone size and seedling size.

In general, seed quality and the vigor and size of resultant seedlings cannot be predicted by seed and cone measurements. This agrees with work reported by Iljin (2) and Simak (5) for Scotch pine seeds. The heavier seeds generally produced heavier seedlings, but previous work by the author, Lavender, (4) has shown this relationship true for only the first growing season.

BIBLIOGRAPHY

1. ELIASON, E. J. and C. E. HEIT. The size of Scotch pine cones as related to seed size and yield. Journal of Forestry 38:65-66. 1940.

2. ILJIN, A. I. Vlijanie veličiny semjan sosny na ch kačestvo. Lesn. Hoz. 5 (7), 1952 (54-5) Russ.

3. LAVENDER, DENIS P. Douglas fir seed germination after exposure to varying temperatures and humidities. Salem, 1954. 3 p. (Oregon State Board of Forestry. Research Note No. 18).

4. ________________ Effect of seed size upon the size and vigor of resultant Douglas fir seedlings. Oregon Forest Lands Research Note No. 32.

5. SIMAK, M. Samengrösse und samengewicht als qualitätsmerkmale einer samenprobe (Pinus sylvestris L.) Medd. Skogsforskn Inst. Stockh. 1955.