APPRAISING EFFECTS OF PHYSICAL DAMAGE TO DOUGLAS-FIR SEED

by

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Many dents, cracks, and related forms of damage can be detected when one examines dewinged Douglas-fir seed under low-power magnification. Such damage varies by seed lot and raises several questions regarding relative value of different lots. Over the past year, a modest amount of work has been done cooperatively to explore effects of such processing damage to Douglas-fir seed. 1/

Three important questions arise concerning presence of damaged seed within a lot:

1. Does any damaged seed produce normal germinants in standard germination tests?

2. If so, will such damaged seed contribute equally well to production of seedlings in soil?

3. Does quality of damaged seed deteriorate more rapidly with age than that of undamaged seed?

We now have information which provides preliminary answers to questions 1 and 2.

Germination of Damaged Seed in Standard Laboratory Tests

Three lots of Douglas-fir, each having over 20 percent of the seeds damaged, were selected for testing. Seed of all three lots, two from the Siskiyou National Forest in southwestern Oregon and the third from the Wallowa-Whitman National Forest in northeastern Oregon, had been collected by commercial contractor in 1964, extracted, cleaned, and shipped in early 1965 to the Forest Service's Wind River Nursery. Upon delivery in February, the seed was placed immediately into cold storage at 0° F. Composite samples were drawn from each lot in May 1965 and sent to the Oregon State University Seed Laboratory for separation of damaged from undamaged seed and testing of each portion for germination by standard techniques.

To separate damaged from undamaged, seeds were examined individually

1/ Procedures for this study were planned and appropriate phases of the work were done either jointly or individually by Edward Hardin, Oregon State University Seed Laboratory; Harold Dahl, Region 6 National Forest Administration: and the author,

under 7-power magnification. Each seed whose hull was cracked, dented, punctured, or partly crushed was classed as damaged. Four 50-seed replicates of undamaged and four of damaged seed from each lot were germinated on perlite without prechili or with 21 days' prechill at 3-5° C., as prescribed in the standard test. 1/ Germination tests were run for 21 days (28 days for seed without prechill) with seed exposed each day to weak light for 8 hours at 30 C. and to darkness for 16 hours at 20 C .

Some damaged seeds produced normal germinants (table 1). If we assume that germination potential of those seeds damaged in a lot initially equalled that of undamaged seed, then damage reduced highest germination from 80 to 10, 79 to 7, and 87 to 26 percent in the three individual lots.

Table 1.--Total germination of undamaged and damaged Douglas-fir seed in standard tests 2/

National Forest Seed source	Elevation	Undamaged		Damaged	
		No chill	Prechill	No chill	Prechill
	Feet	Percent			
Siskiyou	1,500	71	80	7	10
Siskiyou	2,000	70	79	3	7
Wallowa-Whitman	5,500	87	80	26	11
Average		76	79	12	9

Production of Seedlings from Undamaged and Damaged Seed

In August 1956, 100 undamaged and 100 damaged seeds from each of the three lots were sown in two 18- by 20-inch wooden flats filled to a 5-inch depth with Stabler shotty loam soil from the Wind River Nursery. Each sublot of 100 seeds was apportioned among 3 rows randomly designated from 18 available in the two flats. The seed received no treatment prior to being sown about three-eights inch deep. The flats were placed in a growth chamber set for 80 F. and 1,600 foot-candles of light for 15 hours per day and 50 F. for 9 hours

1/ Association of Official Seed Analysts. Rules for testing seeds. Ass. Offic. Seed Anal. Proc. 54(2), 112 pp. 1965.

2/ Germination percents include, in two instances, small numbers of firm ungerminated seed remaining at the end of the test.

of darkness. Seedlings grew under this regime until February 1966 when day length was shortened and temperature reduced to induce setting of buds. Germination was tallied regularly at first, and survival was checked periodically. Seedlings were counted for the final time in July 1966, washed out of the soil, measured for height above cotyledons, and ovendried at 90 C. to obtain average top, root, and total weight.

Germination of damaged seed averaged nearly the same in soil as on perlite, but this average smooths out major differences shown by individual lots (table 2). Damaged seed from two of the three lots produced 1.6 times as many seedlings in soil as on perlite. Germination of damaged seed from the third lot was less than half as much in soil as on perlite. No trend was evident for damaged seed to germinate more rapidly than undamaged seed, based on days elapsed to reach 50 percent of total germination.

For all three lots, germination of undamaged seed was less in soil than on perlite, averaging one-fifth less.

More than 10 months after germination, tree percent (the number of seedlings produced compared with seeds sown) varied widely between the three lots for both undamaged and damaged seed (table 3). On the average, 46 trees were produced from 100 undamaged seeds sown in soil compared with 9 from damaged seed. The ratio of tree percent to highest seed germination on perlite, averaging 0,56 for undamaged seed and 0.63 for damaged seed, reveals that performance of damaged seed in soil was comparatively just as good as that of undamaged seed. Such an average masks, however, the fact that, for two lots, more seedlings were produced from damaged seed in soil than germinated on perlite whereas for the third, only one-fourth as many were produced.

Table 2.--Comparative germination of undamaged and damaged Douglas-fir seed on perlite and in soil

National Forest seed source	Undamaged			Damaged		
	Perlite 1/	Soil	Soil/ Perlite	Perlite 1/	Soil	Soil/ Perlite
	------Percent-----		Ratio	------Percent------		Ratio
Siskiyou - 1,500'	80	76	0.95	10	16	1.60
Siskiyou - 2,000'	79	52	.66	7	11	1.57
Wallowa-Whitman	87	70	.80	26	11	.42
Average	82	66	.80	14	13	.88

1/ Highest germination values obtained on perlite.

Table 3.--Seedlings produced from undamaged and damaged Douglas-fir seed sown in soil

National Forest seed source	Undamaged		Damaged	
	Tree Percent	Tree percent/ germination on perlite	Tree percent	Tree percent/ germination on perlite
	Percent	Ratio	Percent	Ratio
Siskiyou - 1,500'	59	0.74	11	1.10
Siskiyou - 2,000'	32	.41	10	1.43
Wallowa-Whitman	47	.54	6	.23
Average	46	.56	9	.63

Data from this study provide no evidence that damage to the seed affects growth of the seedling produced (table 4). For two sources, average height and ovendry weight of seedlings produced from damaged seed exceeded that for seedlings produced from undamaged seed. Seedlings from the two southwestern Oregon sources showed opposite growth trends--for one, seedlings from damaged seed averaged larger; for the other, they were smaller.

Table 4.--Average height and average top, root, and total ovendry weight of seedlings produced from undamaged and damaged Douglas-fir seed

Seedlings	National Forest seed source		
	Siskiyou 1,500'	Siskiyou 2,000'	Wallowa-Whitman
Total number:			
Undamaged	59	32	47
Damaged	11	10	6
Height (cm.):			
Undamaged	9.9	13.7	5.2
Damaged	11.6	12.0	6.4
Ovendry weight (g.):			
Top			
Undamaged	.55	1.01	.19
Damaged	.87	.69	.22
Root			
Undamaged	.39	.68	.22
Damaged	.62	.47	.33
Total			
Undamaged	.94	1.69	.41
Damaged	1.49	1.16	.55

Discussion and Conclusion

Potential of a seed lot containing a mixture of undamaged and damaged seed is less than it should be because a majority of damaged seeds are non-viable. Performance of the lot may be influenced further by failure of those damaged seeds which are still viable. For example, if 30 percent of a lot is damaged seed and three-tenths of this damaged seed germinates in standard tests, then:

$$V_t = V_u\left(\frac{100-30}{100}\right) + 9$$

Where

V_t = total seed viability in percent

V_u = viability of undamaged seed in percent.

For such a lot, damaged, viable seed would be an important component of total viable seed,

Results of this limited study demonstrate two points that affect estimation of seed value:

10 Some portion of damaged seed in a lot may produce normal seedlings and thus contribute to total germination in standard laboratory tests.

2. Damaged, but viable, seed will also produce seedlings when sown in soil. Number produced may not always be in proportion to the damaged seed's contribution to germination in standard laboratory tests.

Presence of many damaged seeds in a lot concerns the user because of the uncertain storability and performance of damaged, viable seed and also because of the unwanted presence and bulk of damaged, nonviable seed. Live and dead damaged seed affect storage space, year of seed use, nursery sowing schedule, and field seeding rate. For one or more of these reasons, presence of damaged seed reduces the lot's intrinsic value to the user.

Much longer and more intensive studies would be required to develop fast, accurate means for closely estimating economic value of damaged seed. Research aimed at minimizing all damage to seed would be more rewarding than following the essentially backward approach of intensively studying unwanted, damaged seed.