INHERITANCE OF GERMINATIVE ENERGY AND GERMINATIVE CAPACITY IN DOUGLAS-FIR

by Thomas E. Greathouse'

In the West foresters have had considerable difficulty in reforesting south-facing slopes. We considered this problem when we selected plus-trees for the first Douglas-fir seed orchard in Region 6. We were, however, faced with the need to answer such questions as these: (1) Should we try to produce seed inherently suited for south slopes? (2) If so, should we strive to get seed primarily of high germinative energy,[2] or is high germinative capacity an adequate indication of suitability?

Before we can select for either of these traits we need to know how they are inherited. As part of a progeny test, therefore, we checked germinative energy and germinative capacity for the seeds from several control-pollinated full-sib Douglas-fir progenies.

Procedure

The seeds developed on grafts in a seed orchard. The ortets are growing within 25 miles of each other on the Olympic National Forest in western Washington. The variation due to environmen-

[1] *Forester, Division of Timber Management, Pacific Northwest Region, Forest Service, U. S. Department of Agriculture, Portland, Oregon.*

[2] *As used here, germinative energy is the number of days at which 50 percent of the total germination has been attained.*

[3] *As used here, germinative capacity is me percentage of the seeds sown that have germinated or are sound, but ungerminated at 49 days.*

al differences between the sites in which the ortets are growing should, therefore, be relatively limited.

We planned to make a six-parent diallel cross excluding self pollinations. Some of the crosses, however, were not successful (table 1). To satisfy progeny test requirements we also used the same six clones as pollen parents in making crosses with several other clones. We plan to repeat this whole array of crosses in 1966 to verify the results reported in this paper.

Table I.--Results of planned diallel crosses of six Douglas-fir clones1/

Female parent tree no.	Male parent tree no. 1	2	7	8	22	23
1	-	X	X	X	X	X
2	X	-	X	X	0	0
7	X	0	-	0	0	0
8	X	X	X	-	X	X
22	X	X	0	0	-	0
23	0	0	0	0	0	-

1/ X = successful cross; - = no cross attempted; 0 = unsuccessful cross.

We pollinated the conelets in the spring of 1962. That fall we collected the cones, air-dried them, and extracted the seeds. We placed the seeds in paper envelopes which were then stored at 35° F in a refrigerator from January to April 1, 1963.

The seeds were not stratified (but may have absorbed some moisture in the refrigerator) before we sowed them on April 1. At that time we look 150 filled seeds from each lot[4] and divided them into three weight classes (heavy, medium, and light).[5] We then divided the unequal number of seeds in the three weight classes into essentially equal groups and placed them on moist filter paper in petri dishes so that each petri dish contained 50 seeds (36 to 44 in three crosses), made up of one-third of the seeds from each weight class. On the same day we distributed the three petri dishes for each lot randomly in a growth chamber.

After an initial check on Friday and Saturday, April 5 and 6, we examined the petri dishes each Monday, Wednesday, and Friday for 7 weeks. Wh a seed produced a radicle about 3 millimeters long we tallied it as germinated. At the close of the test period we cut all ungerminated seeds and found no sound ones left.

4 Three crosses had fewer seeds: 100 for 1x2, 136 for 1x23., and 107 for 2x8.

5 Classification was on the following weight basis: heavy > 15.0 mg., medium, 13.0-15.0 mg., and light, < 13.0 mg.

Results

The germination test results brought out effects of both maternal and paternal parents on germination characteristics.

Maternal influence. — Curves of cumulative germination percent indicate what we interpreted to be a strong maternal influence. For example, seeds from clone No. 10 show high germinative energy, regardless of pollen parent (fig. 1). Furthermore they reach 50 percent of total germination about 7 days before seeds from clone No. 1 do. Unfortunately we made no crosses with clone No. 10 as a pollen parent.

Further evidence of the maternal effect was based on seeds produced when we applied pollen from clones Nos. 1 and 2 on conelets of clones Nos. 8, 10, and 22. We punched the data on IBM cards and used a program to give Student's "t" values (fig. 2). All three female parents had germinative energies that differed significantly at the 1-percent level.

Paternal influence. — The curves bring out a tendency for decreasing germinative capacity when clones Nos. 2, 22, 7, and 23 were used as pollen parents on clones Nos. 1, 10, and 8 (figs. land 3). In addition, clones Nos. 10, 22, and 8 all produced seed with a higher germinative capacity when fertilized with pollen from clone No. 2 than when fertilized with pollen from clone No. 1 (fig. 2).

Discussion

High germinative capacity is always a desirable attribute of seed. The fact, however, that Douglas-fir female parents may exert a strong influence on germinative energy of the seed, as indicated by

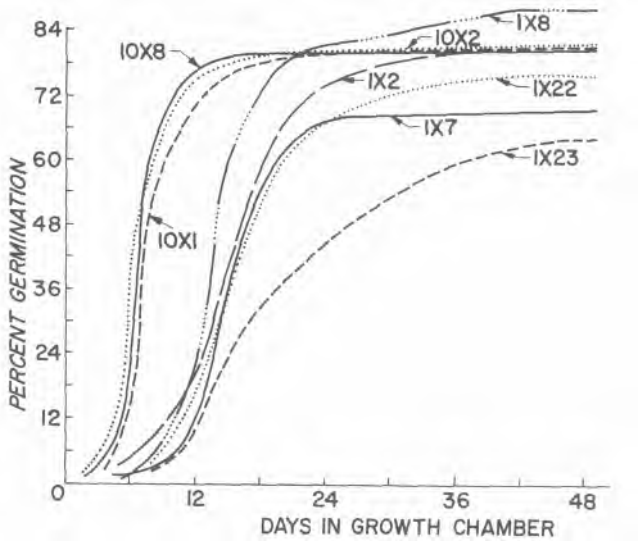

FIGURE 1. — Maternal influence of clones 1 and 10 on germinative energy.

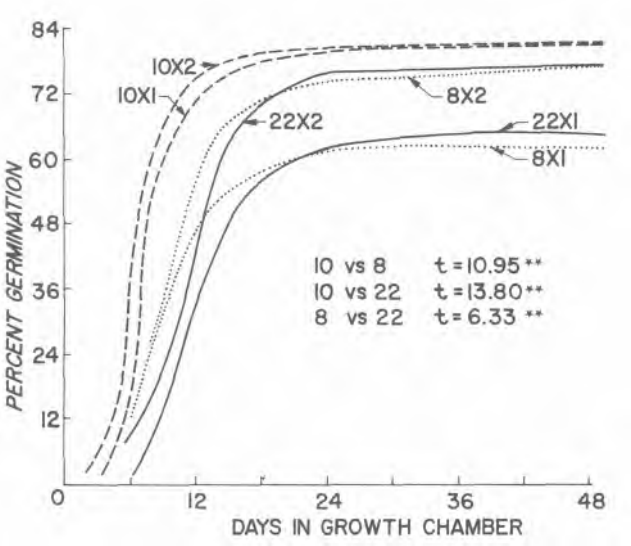

FIGURE 2. — Maternal influence of clones 8, 10, and 22 on germinative energy. ** indicates significant at the 1-percent level.

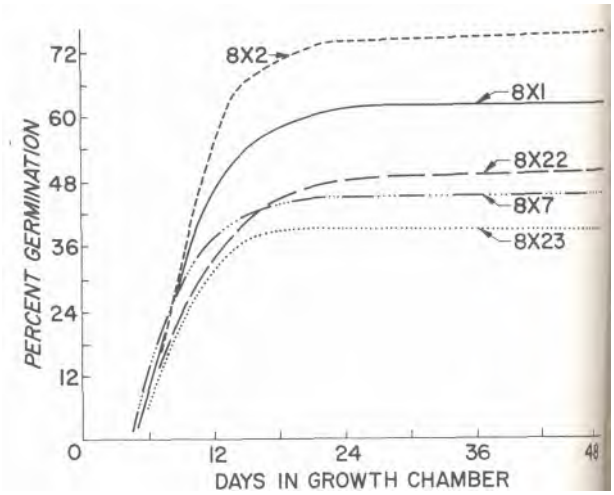

FIGURE 3. — Paternal influence on total germination.

these tests, may have little significance so far as natural regeneration is concerned. In a wild stand, where we cannot moderate the weather, we never know whether nature will favor an early or a later germinating lot in a given year. Furthermore, if nature had been partial to either when selecting survivors over the past few thousand years, we would expect less variation among trees growing in a relatively limited area.

For artificial regeneration, however, high germinative energy may be a decided advantage. In the nursery, prompt and even germination can get most of the seedlings off to an even start and produce uniform stock that simplifies the nurseryman's problems. In direct seeding also, high germinative energy could permit quick response of the seeds to favorable growing conditions. This could be particularly helpful on south slopes where favorable conditions may be of very limited duration. Furthermore, quick germination could reduce the time during which seeds are subject to bird and rodent damage.