FOUR STRATIFICATION MEDIA EQUALLY EFFECTIVE IN CONDITIONING SUGAR MAPLE SEED FOR GERMINATION

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Successful and efficient laboratory techniques have been worked out for germinating the seed of many of our important tree species. However, the seed of sugar maple (Acer saccharum) has received little attention.

Sugar maple fruit normally is shed in the fall, and the seed characteristically germinates the following spring. According to Jones,[1] germination is conditioned by a prolonged period of after-ripening, which requires a low temperature (optimum near 5° C.) and plentiful moisture. Recommendations for laboratory germination of sugar maple seed as given in the Woody-Plant Seed Manual[2] specify that after-ripening be accomplished by stratifying the seeds in either moist sand or peat for 60 to 90 days at temperatures between 36° and 41° F. The germination tests are then made by subjecting the seed to alternating day-night temperatures of 86° and 68° F. for an additional 20 to 30 days.

In a study of sugar maple seed at the Northeastern Forest Experiment Station's Burlington, Vt., project in 1962, we compared, under experimental conditions, the effectiveness of sand, perlite, sphagnum moss, and germination paper as stratification and germination media.

Methods and Materials

What is generally referred to as the seed of sugar maple is really a winged fruit known as a samara. In this study the seeds were not removed from the fruits, but rather the whole fruits were stratified.

Sugar maple fruits were collected from three widely separated roadside trees in Chittenden County, Vt., from September 21 to October 5, 1962. The trees were selected because of their relatively high percentages of filled fruits. These percentages, as determined

1 Jones, H. A. Physiological study of maple seeds, Bot. Gaz. 69: 127-152. 1920.

2 United States Forest Service. Woody-Plant Seed Manual. U.S. Dept. Agr. Misc. Pub. 654, 416 pp. 1948.

by cutting tests on ten 100-fruit samples from each tree, aver aged 71, 53, and 73 for trees A, B, and C, respectively. The fruits were kept separate by source for subsequent determination of germination differences among trees.

Condition and coloring of the fruit coats varied from soft and bright green on tree A to relatively hard with colors ranging toward yellow and light brown on trees B and C. Moisture content of the fresh fruits was in excess of 100 percent of dry weight. The fruits were air-dried slowly on wire-screen racks in an unheated building. When stratification was begun on December 3, their moisture content had dropped to about 20 percent.

Wooden greenhouse flats lined with polyethylene plastic sheets were used for the sand, perlite, and sphagnum moss media. The flats were filled to a depth of about 2-1/2 inches,

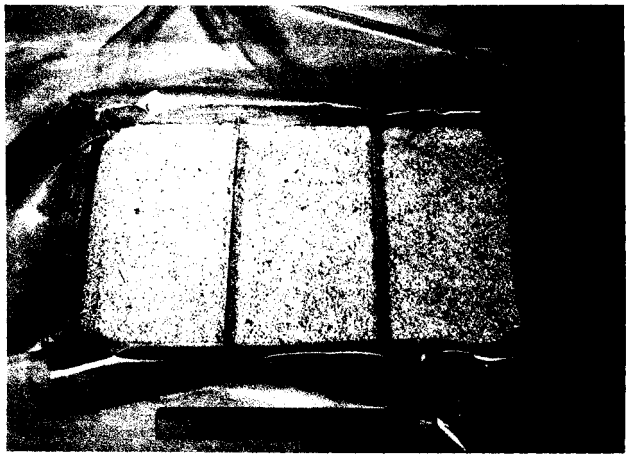

Figure 1.--An assembled flat with fruits in place and covered, ready for the cooler when the plastic sheet has been folded over the top. This one contains perlite; flats with sand and sphagnum moss were prepared in the same way.

and dividers were inserted to provide separate areas for the three seedlots. The polyethylene sheets were cut large enough that the edges could be folded over to cover the moistened media and inhibit drying (fig. 1).

For the fourth medium, germination paper, we used covered plastic boxes measuring 11 x 14 x 4 inches (fig. 2). Paraffin-coated wire-screen platforms 1 inch high were used to support the paper above 1/2 inch of water. By having the ends of the paper dip into the water, capillary action kept the paper moist. Tapwater was used to moisten all media.

The fruits were soaked in water 24 hours before placing them in or on the different media. Those placed on the paper were not covered except by the box lid; those on the other media were covered with about 1/4 inch of the same moist material, and the polyethylene sheets were then folded over the top.

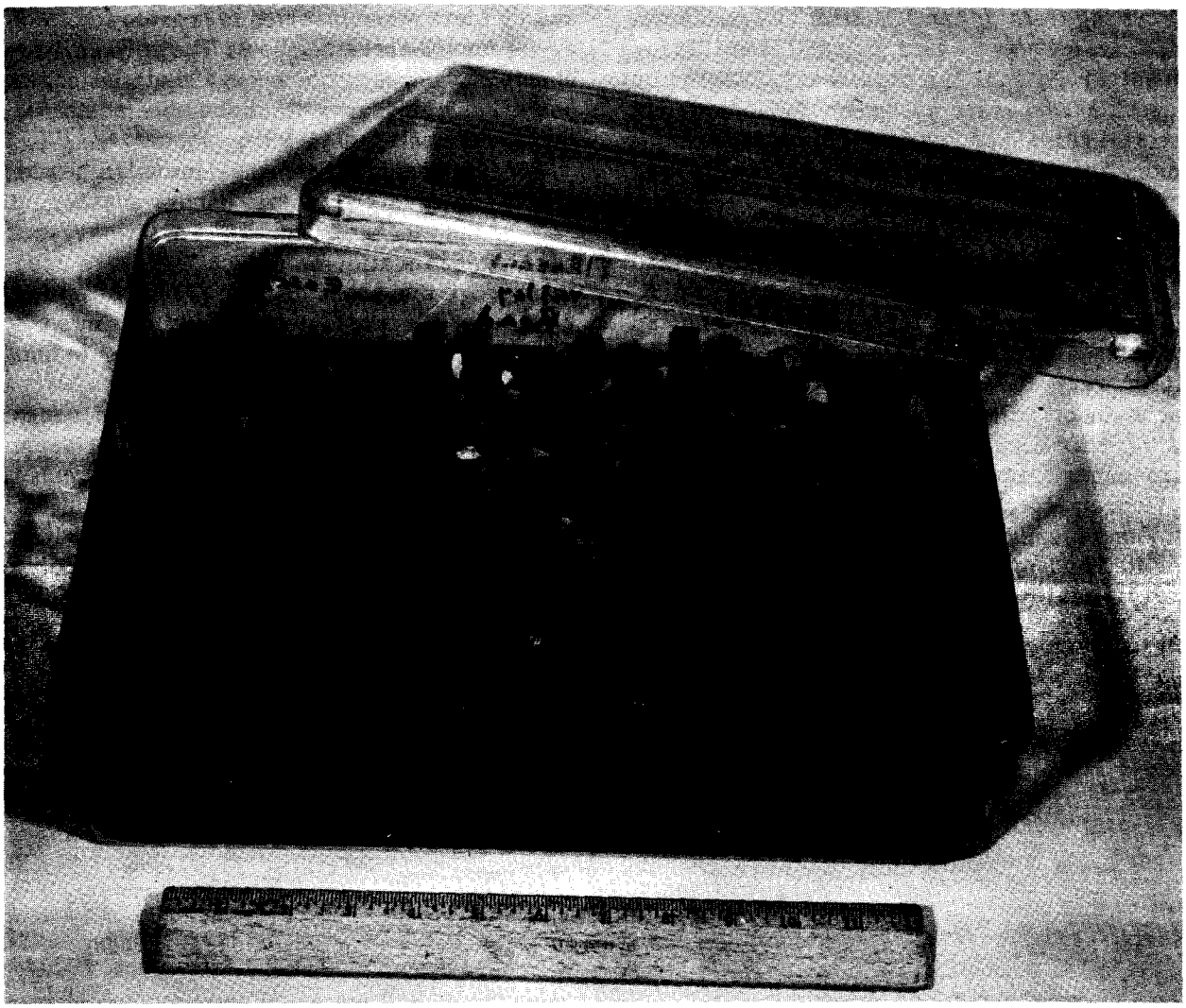

Figure 2.--An assembled box with fruits in place on germination paper, which is supported over ½ inch of water by a wire screen platform. Lid will be closed when the box is placed in the cooler.

When assembled, the flats and boxes were placed in a walk-in cooler and held at 33° to 35° F. for 90 days.

The study design was a 3 x 4 factorial (3 seed lots x 4 media) replicated five times. Positions of seed lots within flats or boxes were assigned at random. An observation sample consisted of 150 unopened fruits.

A seed was considered to have germinated as soon as the radicle became visible. Considerable germination took place at the 33° to 35° F. temperature. When such germination became evident, the germinated seeds were periodically removed and counted. But since the optimum stratification period was uncer

tain, the other seeds were left in the cooler for the full 90 days. After the 90-day period, the boxes and flats were moved to room temperature at about 65° F., and. the remaining fruits were observed for an additional 14 days.

At the end of this period, the fruits in each sample that still were inactive were cut open to determine the number of ungerminated seeds. The number of filled fruits found at this time was added to the germination count to obtain the total number of seeds in the original sample. Germination percentages were based on the total number of seeds as thus determined in each sample--not on the original 150 fruits.

Results

Radicles were first observed on germinated seeds during the sixth week of stratification, and in all media. However, the length of some of the radicles indicated that emergence probably had started several days earlier. This would make the time to initial germination at least 3 weeks less than the minimum stratification period of 60 days that is given in the Woody-Plant Seed Manual.

The final germination percentages (table 1) were consistently high regardless of germination media or tree source.

During the test period, differences were noted among both media and trees in the rate at which germination occurred. In sand, perlite, and sphagnum moss, germination proceeded at equal rates into the 14-day period at room temperature. On paper in the plastic boxes, germination started earlier, proceeded at a more rapid rate, and was completed just before the end of the 90-day cold period (fig. 3).

Germination rates for the seedlots from trees A and B were approximately the same throughout the test period. Germination of the seed from tree C was noticeably slower during the first few weeks, but accelerated rapidly during the later week. At the end it slightly exceeded the percentages of germination for seed from trees A and B.

Before the data were subjected to analysis of variance, the percentages were transformed by the expressions V(100-P) + 1/2 P, where

TABLE 1.--Average germination percent of sugar maple seeds after stratification for 90 days at 33° to 35°F. followed by 14 days at 65°F.

Stratification medium	Seed source			Media average
	A	B	C	
Sand.....	96.3	98.3	98.9	97.8
Perlite.....	96.7	95.3	98.2	96.8
Sphagnum moss..	96.3	99.3	99.8	98.5
Germination paper.....	97.3	99.5	99.6	98.8
Tree average	96.7	98.1	99.1	98.0

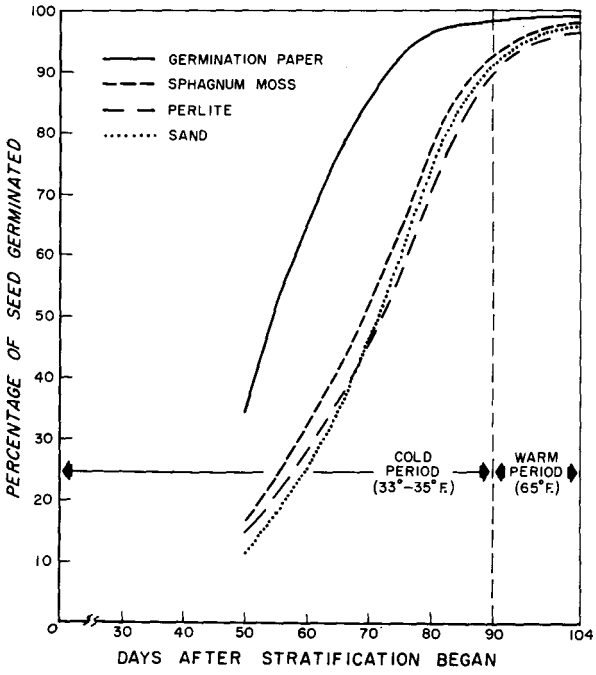

Figure 3.--Rates of sugar maple seed germination in the different media.

P equals percent germination. The analysis indicated that germination differences among media were not significant. Differences among seedlots (trees) were highly significant, although the means were close. That the relatively small differences could show high significance was due to the extremely narrow range of variance in the data. By partitioning the degrees of freedom for trees, it was found that tree A differed significantly from trees B and C, but trees B and C were not significantly different from each other.

Discussion

The fruits from tree A at the time of collection appeared, from condition and color of the pericarps, to be less advanced in maturation than those from trees B and C. And, as previously noted, the germination of the seed from tree A was significantly lower than the germination of the other two seedlots.

Although we cannot rule out a possible relationship here between seed maturity and germination, the mean germination values for all three trees were so high and so nearly

equal (table 1) that, if stage of maturity was in fact responsible for the differences, the effect was of little real importance. For all practical purposes, the seed of all three trees was mature when collected.

The results of this study verified Chandler's [3] observation that sound sugar maple seeds have a high germination capacity. The Woody-Plant Seed Manual indicates a germination range of 16 to 68 percent. These values may have been based on fruit counts without determining the true germination potential by actual seed counts--that is, filled fruits. While selecting the seed trees for this study, percentages of filled fruit were found to range by trees from 20 to 74 percent.

The four media used in the study were equally effective in providing a suitable substratum and adequate moisture for after-ripening. Some fungi appeared on most of the samples, but apparently had no adverse effects.

The use of germination paper in a plastic box offers some advantages, particularly in convenience: the fruits are readily visible for checking the initiation and progress of germination, whereas in the other media the fruits must be carefully uncovered for inspection.

Smaller plastic boxes--measuring 5 x 7 x 1-1/4 inches, and large enough for 100 to 150 sugar maple fruits--have been used in other sugar maple seed studies at Burlington with entirely satisfactory results. This box method has also proved successful for stratifying and germinating seeds of paper birch, Norway maple, and sycamore maple. Toole et al. [4] have reported using plastic boxes in germinating peanut seeds. It is believed that the plastic box procedure should work equally well for most seeds that require a cold, moist, stratification treatment.

3 Chandler, Robert F., Jr. The influence of nitrogenous fertilizer applications upon seed production of certain deciduous forest trees. Jour. Forestry 36: 761766. 1938.

4 Toole, Vivan K., Bailey, W. K., and Toole, W, K. Factors influencing dormancy of peanut seeds. Plant Physiology 39 (5): 822-832. 1964.

Summary

The main findings in the study were:

1. All four media gave consistently good results. The germination paper-plastic box assembly was most convenient because the seed was readily visible for inspection.
2. Germination began after 35 to 40 days of stratification and was essentially complete at 90 days.
3. The seeds (filled fruits) have a high potential for germination.
4. The seed from the three source trees used in the study differed only slightly in germination capacity. Nevertheless, because very little variation occurred within seedlots, the differences were statistically significant.