ARE ALTERNATING TEMPERATURES MORE BENEFICIAL THAN CONSTANT TEMPERATURES DURING STRATIFICATION OF YELLOW POPLAR SEED?

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A study by Boyce and Hosner (1963) indicated that moist storage of yellow poplar *(Liriodendron tulipifera L.)* samaras at alternating weekly temperatures of 36° and 54° F. for 26 weeks resulted in 100-percent germination of viable seed within 9 weeks after sowing. Storage at continuous 36° F. and alternating weekly temperatures of 25° and 54° F. resulted in germination of viable seed of 75 and 65 percent, respectively. Storage at alternating weekly temperatures of 36° and 70° F. resulted in 100-percent germination of viable seed. However, germination began under this temperature regime during the 13th week of storage and was complete by the 24th week. Three other storage regimes tested included temperatures below freezing. In each treatment, some seed apparently was killed by freezing.

Boyce and Hosner's (1963) pregermination-treatment studies did not include storage at constant temperatures of 54° or 70° F. But the former temperature was used in the alternating regime to increase germination for nursery or direct sowing. Consequently, we studied the effects on germination of moist storage of yellow poplar seed at *constant* 54° F. If storage at this temperature proved as effective in promoting rapid germination as the alternating regimes described above, pregermination treatment could be simplified. For comparison purposes, moist storage at alternating weekly temperatures of 36° and 54° F., as recommended by Boyce and Hosner (1963), and also continuous 36° F., was included.

Methods

Yellow poplar seed was obtained from the Charlottesville, Va., State Nursery on December 7 and stored dry in a polyethylene bag in a refrigerator. In January, the seed lot was cleared of trash, sticks and other material. The samaras were thoroughly mixed and 30 random samples, each weighing 34 ± 0.1 gms., were extracted. The 30 samples were randomly allocated 'to five groups, four of which contained five samples and one 10 samples.

Samaras in the 10-sample group were dissected to determine the percentage of filled seed and number of seed per sample. A samara was classified as filled if it contained one or two seeds. The average number of samaras per sample was 1019.0 + 11.3,* and the average number of filled seeds per sample was 167.0 ± 14.8.*

The remaining four groups of samaras were evaluated for the effect of temperatures upon germination during moist storage. On January 17 each sample was soaked in water for 24 hours, drained, and packed loosely in a polyethylene bag.

* One standard deviation.

One group of samples was stored at temperatures that alternated weekly between 36° F. and 54° F. The temperature during the initial week was 36° F. Two groups were stored at constant temperatures, one at 36° F., and the other at 54° F. The last group of samples was merely placed in an unheated room, where temperatures varied from a minimum of 55° F. to a maximum of 81° F.; average weekly minimum was 64.6° F.; average weekly maximum was 71.2° F.

Samaras were removed from storage on June 5th after 20 weeks and sown in sand flats in a greenhouse. The samaras were covered with V_2 inch of sand and, watered daily. Germinated seedlings were tallied weekly until the 12-week test concluded.

Results

Seed stored moist at constant 36° F. for 20 weeks produced the most satisfactory germination. This seed germinated between the 2d and 3d weeks after sowing, and by the end of 8 weeks, approximately ? percent of the seed filled with endosperm had germinated. By the end of the 12-week germination test, 92.4 percent of the sound seed in this group had germinated (fig. 1). Differences between the average number of seed germinating per sample and the',, average number filled with endosperm were not statistically significant.

In contrast, germination of seed stored at the other temperature regimes was unsatisfactory. After 12 weeks, only 57.1 percent of the sound seed stored at alternating weekly temperatures of 36° and 54° F., and only 15.5 percent of the sound seed stored at constant 54° F. had germinated.

The former group, stored at alternating temperatures, germinated only during the last week in storage, whets the temperature was constant at 54° F.

Only 0.06 percent of sound seed stored in the unheated room germinated. The findings of this treatment are not included in figure 1.

Discussion

The results of this study vary from those of Boyce and Hosner (1963) in two major ways. Perhaps of greatest importance is that moist storage at constant 36° F. resulted in the most complete germin ation of filled seed (92.4 percent wthin 12 weeks of sowing). The average number of seed that

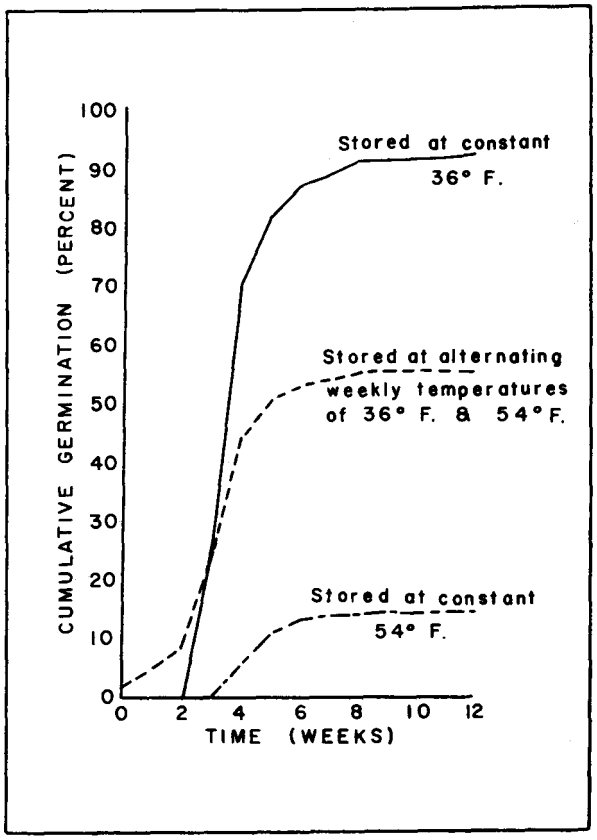

Figure 1.—Cumulative percent germination of filled yellow poplar seeds over a period of time following moist storage at various temperature regimes.

germinated per sample following that treatment was not significantly different from the average number of filled seeds per sample. Storage at alternating weekly temperatures of 36° F. and 54° F. resulted in much lower germination (57.1 percent of the sound seeds within 12 weeks) .

In contrast, the earlier investigation produced almost opposite results. Storage at alternating weekly temperatures of 36° and 54° F. resulted in germination of all filled seed within 10 weeks, while storage at continuous 36° F. resulted in germination of only 73 percent of sound seed.

Another point of contrast between the two studies is that in the current investigation, germination began during the 20th or last week of storage under the alternating 36°-54° F. regime. In the study by Boyce and Hosner, no seeds germinated while in moist storage for 24 weeks under the same temperature regime.

Possible reasons for these differences are many. Two major variables are the lack of strict temperature regulation during the germination test and the differing provenance of the seed. Also, the minor variations that occurred in temperature during storage may have exerted a stronger influence than one would normally suspect. Light may also have been a cause. The physiological basis for these differing results is obscure and additional research is needed.

But nurserymen and others working in pregermination treatments of yellow poplar seed on a large scale should be wary about the use of alternating temperature regimes.

Literature Cited

Boyce, Stephen G., and Hosner, John F.
1963. Alternating storage temperatures increase the germination of yellow poplar seed. J. Forest 61: 731-733.