Stratification of Sugar Maple Seeds

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Sugar maple seeds collected from 10 trees in northwestern Vermont were stratified at 1° to 3° C for up to 13 weeks. Results indicate that this method is unsatisfactory for obtaining rapid, maximum germination after stratification.

Experience in the nursery has shown that fall sowing usually results in nearly complete germination of sugar maple seeds (*4*). If fall sowing is not feasible or fails, spring sowing must be used; but there must be some means of breaking dormancy before sowing.

Olson and Gabriel (*9*) recommended pretreatment of 1° to 5° C for 40 to 90 days. Heit (*6*) stratified sugar maple seeds in moist peat moss at 2° to 4° C and at 10° to 15° C and buried seeds in the ground for 5 months. Of those that had been stratified at 2° to 4° C, 95 percent germinated during the 3 months of stratification. Germination occurred after 4 months of stratification at 10° to 15° C, but the percentage was less than that at the lower temperature. The buried seeds also germinated during stratification and could not be sown successfully.

From the results of his experiment, Heit (*6*) recommended that spring-sown seeds be stratified for 50 to 75 days at 2° to 4° C. But we found that when we stratified sugar maple seeds at 1° to 3° C, some seeds germinated after approximately 30 days, while others in the same sample required up to 90 days for germination *(3).*

Because the optimum stratification period for spring sowing was still in doubt, this study was done to determine the length of stratification necessary to obtain 80-percent germination, preferably within 2 weeks after stratification.

Methods

The experiment was conducted over a period of 2 years. During the first year, samaras were collected from 10 sugar maple trees in northwestern Vermont. We knew that seedlots from different sugar maple trees germinate at different rates. However, we wanted to determine an average stratification time so we could make a general recommendation. Therefore, we combined the samaras into one lot.

We air-dried the samaras to 10 to 15-percent moisture content. At 13 weekly intervals, beginning in February, we placed 30 replicates of samaras (100 samaras per replicate) in plastic germination boxes on shelves in a walk-in cooler at 1° to 3° C. We made germination counts and removed the germinated seeds weekly after the first 30 days of stratification. After 13 weeks, all of the boxes that still contained samaras were removed from the cooler and placed on nurserybeds beneath shade-cloth in the Forest Service nursery in Essex Junction, Vt. It was felt that the fluctuating nursery temperature would complement the stratification already received, thus increasing germination. Also placed in the nursery were an additional 30 boxes, each containing 100 samaras. We continued the counting until germination ceased and then opened the remaining samaras and counted the ungerminated seeds. Germination percentages were based on the total number of seeds.

On the basis of the first-year results, we decided to repeat the experiment with some modifications. Because the second-year samara crop was generally poorer than in the previous year, we collected samaras from only 5 of the original 10 trees.

We reduced the number of stratification periods to correspond to those periods that gave the best results in the first test. Beginning in March, and weekly thereafter for the next 5 weeks, 10 replicates of 100 samaras each were removed from storage and stratified at 1° to 3° C. The final set of 10 replicates was stratified in April, making a total of six stratification periods. We removed the stratified samaras from the cooler in May, giving us a range of 3 to 8 weeks for the six stratification periods. However, the samaras were kept at 16° C instead of being placed in the nursery. The germinated seeds were counted and the germination percentages were calculated as in the previous year.

Results

The results of the second-year germination tests for the 3 to 8 weeks of stratification were compared with the same periods in the first-year tests; we used a paired t-test. There were no significant differences in the germination patterns between the 2 years, so we combined the data for those six stratification periods for analysis. Table 1 shows the percentage of germination during stratification and during the first 2 weeks after stratification, the total germination after stratification, and the total. It should be noted that while most of the germination after stratification occurred during the first 2 weeks, it was strung out over several weeks.

Table 1.—*Germination results for the* 2 years *of testing*

	Germination			
Length of stratification	During stratification	During first 2 weeks after stratification	Total after stratification	Total
Weeks	%			
3	0.0	2.9	5.0	5.0
4	.2	14.4	18.6	18.8
5	6.9	28.3	37.2	44.1
6	18.7	26.8	35.0	53.7
7	34.8	26.8	32.0	66.8
8	52.8	20.8	24.4	77.2

Seeds stratified for 3 to 8 weeks failed to germinate satisfactorily after being removed from stratification and placed in a warm temperature. Total germination increased as the length of stratification increased (table 1). However, most of this increase in total germination was because of the increase in the germination that occurred during the stratification period. Germination after stratification increased until the fifth week. It declined slightly during the sixth and seventh weeks and then dropped sharply. The percentage of germination after stratification was greatest for the 5 week stratification period (37 per cent), but the total germination for the same period was only 44 per cent. Total germination was greatest for 8 weeks of stratification (77 percent), but germination after stratification was only 24 percent. None of these results were satisfactory; that is, germination did not reach 80 percent during the first 2 weeks after stratification.

Discussion

The subject of dormancy has been discussed by many (*1, 2, 5, 8, 10*). However, only Amen (*1*) defined dormancy. Dormancy, according to Amen, is an endogenously controlled and/or environmentally imposed temporary suspension of growth and reduced metabolic activity independent of the immediate environment. But even Amen admitted that his definition is inadequate to distinguish various forms of growth cessation.

The factors controlling dormancy are varied, but fall into a few major groups: (1) rudimentary embryos, (2) physiologically immature embryos, (3) mechanical resistance of the structures enclosing the embryos, (*4*) impermeable seed coats, (*5*) presence of germination inhibitors, (*6*) absence of germination promoters, or (*7*) a combination of the foregoing. According to Jones (*7*), sugar maple has a dormant, morphologically mature embryo. This would rule out the first two factors, and the structures enclosing the embryo offer little resistance to germination. Part of the reason for dormancy of sugar maple seeds, as indicated in an experiment by Webb and Dumbroff (11) is a restriction of water uptake by the testa. They theorized that this restriction complements a metabolic block in the embryo. But the cause of this metabolic block is unknown. It is broken by a period of low temperature and a moist medium.

Although stratification of sugar maple seeds at 1° to 3° C broke dormancy, none of the stratification periods yielded the desired result; that is, at least 80 percent germina-

tion within the first 2 weeks after stratification. The maximum percentage of germination after stratification was 37, and the total was only 44 percent, far from what is obtainable from fall sowing. It is therefore obvious that some approach other than simple stratification at a low temperature is necessary to overcome the dormancy of sugar maple seeds for satisfactory spring sowing.

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