FALL VERSUS SPRING SOWING OF SUGAR MAPLE SEED IN A NURSERY

Fall sowing resulted in greater germination, survival, and height growth at the end of the growing season.

Clayton M. Carl, Jr. and Harry W. Yawney,
Research Foresters, Northeastern Forest Experiment Station, Forest Service, U.S. Department of Agriculture

Fall sowing of sugar maple seeds reduces the nurseryman's workload during the normally busy spring season, and eliminates the time, labor, and material required. for stratifying seeds. One disadvantage of fall sowing is that seed may be lost during the winter to rodents or other causes. In an earlier study on sowing sugar maple seeds in a nursery, Heit (*3*) reported that germination was greater in fall-sown seeds than in those sown at other times of the year. However, he did not stratify the seeds for different periods to determine whether they could be satisfactorily sown in the spring.

METHODS

Collecting and storing — In early October we collected samaras from a sugar maple tree near Burlington, Vt. We did not separate the samaras that contained seeds from those that were empty (*2*). We air-dried the samaras until their moisture content was about 15 percent, and stored them in plastic bags at 2° C.

Treatments — The samaras were treated four ways:

1. Sown in the fall
2. Stratified for 38 days and sown in the spring (Spring 38)
3. Stratified for 49 days and sown in the spring (Spring 49)
4. Stratified for 60 days and sown in the spring (Spring 60).

We sowed all samaras in shallow grooves and covered them with one-fourth of an inch of sawdust. A treatment plot consisted of four rows of 50 samaras each (figure 1). We collected data from the middle two rows on each plot; each treatment was replicated 10 times.

Fall sowing — These samaras were sown in mid-November and were mulched with 4 inches of hardwood leaves to prevent seedbed erosion and to protect the new seedlings from frost heaving. We removed the mulch in late April and placed a plastic shade cloth rated at 50 percent over the plots.

Spring sowing – We soaked the samaras in water for 24 hours and stratified them by placing them on moist germination paper in plastic boxes, and placing the boxes in a walk-in cooler at 2° C. We had planned to sow the samaras on May 20th, which is usually after the last killing frost, but we had to postpone sowing for about a week because the soil was wet. We also placed a 50 percent shade cloth over these plots.

We knew that sugar maple seeds begin to germinate after about 30 days of stratification (*7*), but we did not know the optimum stratification period, so we used three stratification periods. We wanted one of these treatments to bring the seeds to the brink of germination, but not to allow a large number to germinate before the seeds could be sown.

Germination and seedling counts – We took special care to maintain enough moisture on all plots to promote germination and to ensure maximum survival of the emerging seedlings. We determined seed germination by counting seedlings during May and June. In early November we counted the surviving seedlings and measured characteristics such as height and root length.

Germination tests – To evaluate the effect of the four treatments on seed germination, we tested 10 samples of 100 samaras each before the spring sowing. We followed the procedures recommended by Carl and Yawney (*1*). When germination was considered complete, we opened all samaras that failed to show signs of germination. The seeds from the test samples averaged 48 per 100 samaras, and germination was 100 percent. To compare germination results for the actual sowing treatments, we considered 48 or more germinated seeds per 100 samaras as 100 percent germination.

Results

Fall sowing — The average number of seeds that germinated from the fall sowing was 52 per 100 samaras, or 100 percent germination. The average survival of seedlings from these germinated seeds was 51 when the study was

Figure 1.—*A treatment plot consisting of four rows of 50 samaras each. Data on germination and seedling development were collected from the middle two rows.*

completed (table 1).

Spring sowing — The number of seeds that germinated from the spring sowing treatments varied directly with the number of days that the seeds were stratified. In the most successful treatment, Spring 60, 43 seeds germinated in each 100 samaras. Of these, 38 seedlings survived after one growing season (table 1). This treatment produced better results than the Spring 49 treatment, and considerably better results than the Spring 38 treatment.

Seedling development — The average height growth of seedlings after the first growing season reflected the same differences among treatments as those observed for germination. Fall sowing produced the tallest seedlings, followed by Spring 60, Spring 49, and Spring 38, respectively (table 1). Measurements of seedlings from the fall treatment and those from the Spring 60 treatment are shown in table 2.

Root length, root volume, root-crown diameter, and stem height were greater in seedlings from the fall treatment than in those from the spring-sown treatments. There was no difference in root/shoot ratios. Since the seedlings were harvested after one growing season, we do not know whether the differences among treatments would have been maintained had the seedlings been allowed to continue growing.

Discussion and Summary

This study shows that fall sowing of sugar maple seeds is superior to spring sowing. Germination was greater from fall sowing, and the average survival and height growth of seedlings was greater at

Table 1.—*Average germination of seeds, survival and height growth rates of seedlings for four sowing treatments*

Sowing treatment	Stratification period	Germination (June 8)		Survival (Nov. 2)	First-year height growth
	Days	*Percent*	*Number*	*Number*	*cm*
Fall	—	100	52	51	18.0
Spring	60	89	43	38	14.0
Spring	49	75	36	33	13.0
Spring	38	31	15	14	11.7

Table 2.—*Characteristics of seedlings for fall and spring sowing, after one growing season*

	Seedling characteristics				
Sowing treatment	Stem height	Root length	Root-crown diameter	Root volume	Root/shoot ratio
	cm	*cm*	*mm*	*cm3*	
Fall	18.0[1]	25.9[2]	4.1[2]	2.30[1]	2.14
Spring 60	14.0	21.8	3.6	1.58	2.04

[1]Significant at the 1 percent level.
[2]Significant at the 5 percent level.

the end of the first growing season. Seedlings from fall-sown seeds benefited from a longer growing season. When the winter mulch was removed in late April, considerable germination had already occurred. Because the soil in the nursery was wet, however, spring sowing was not completed until nearly 3 weeks after the seedlings from the fall-sown treatment were uncovered.

When stratified seeds are used, extra care is required when the seeds that germinated during stratification are sown. Exposed radicles, even short ones, are damaged easily. Stratified seeds from the Spring 60 treatment had radicles up to 1 inch long. A prerequisite for successful spring sowing of sugar maple seeds is a method that provides complete afterripening before the germination period.

Some sugar maple seeds apparently require a longer stratification period than others; this phenomenon has been observed many times in germination tests. Though some seeds in a seedlot may germinate at 30 days of stratification, others in the same lot may require up to 90 days. We do not know why this occurs, but one reason may be that the testa restricts water movement and acts as a timer controlling dormancy (*6*). Seed stratification also may be influenced by factors such as seed maturity, photoreaction, temperature, or the presence of inhibitors in the pericarp, in the testa, or within the embryo.

Heit (*4, 5*) recommended fall planting of many fruit and hardwood seeds, and our results with sugar maple seeds support his recommendation. We also produced greater—and earlier—germination and larger and, healthier seedlings by sowing in the fall.

Literature Cited

1. Carl, C. M., Jr., and H. W. Yawney. 1966. Four stratification media equally effective in conditioning sugar maple seed for germination. Tree Planters' Notes 77:24-28.
2. Carl, C. M., Jr., and H. W. Yawney. 1969. The use of pentane to separate filled and empty sugar maple samaras. Tree Planters' Notes 20:24-27.
3. Heit, C. E. 1939. Germination of sugar maple as correlated with seed treatment. Notes For. Invest. 34, 2 p. N.Y. State Conserv. Dep., Albany.

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4. Heit, C. E.
1962. Fall planting of hardwood tree and shrub seed recommended. N.Y. Nursery Notes from Cornell, 3 p. Cornell Univ., Ithaca.
5. Heit, C. E.
1967. Propagation from seed. Part 8: Fall planting of fruit and hardwood seed. Am. Nurseryman 126(4):12-13, 85-90.
6. Webb, D. P., and E. B. Dumbroff.
1967. Factors influencing the stratification process in seeds of *Acer saccharum*. Can. J. Bot. 47:1555-1563.
7. Yawney, H. W., and C. M. Carl, Jr.
1969. Sugar maple seed research. *In* 1948-1968: 20 years of nursery progress. Proc. Northeast. Area 20th Aniv. Nurserymen's Conf. Sept. 11-12, 1968, p. 115-123. U.S. Dept. Agric. Northeast. Area St. and Priv. For.