Duration of cold storage alters time required for seedling bud-break

In sugar maple, balsam fir, and yellow birch

by
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This article reports that length of cold storage has a definite effect on rate of bud-break initiation in three commercially important tree species. A positive correlation appears to exist between lenghty storage and speedy growth resumption after dormancy.

Once plants become "physiologically dormant" (Romberger 1963,) they generally require a cold period before resuming visible growth. Under forest conditions in the Northeast, this requirement is satisfied by natural chilling during the winter months. Frequently, however, we wish to force early seedling growth by bringing plants into the greenhouse. Under these circumstances, we need to know the minimum length of time they must be exposed to low temperatures in order to break physiological dormancy. Apparently this varies tremendously with species (Wareing 1969).

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Methods

Seventy-two 1-year-old half-sib sugar maple *(Acer saccharum* Marsh.) and yellow birch *(Betula alleghaniensis* Britt.) seedlings and thirty 5-year-old half-sib balsam fir *(Abies Balsamea L.)* seedlings were potted in November 1971. The potting medium was a 1:1:1 mixture of peat, perlite, and loamy sand. Approximately 24 gm. of dolomitic limestone and 12 gm. of superphosphate were added to each 1 gallon planting pot.

After being potted, the seedlings were stored for varying lengths of time at approximately 33°F. in a walk-in cooler. Twelve sugar maple seedlings, 12 yellow birch seedlings, and five balsam fir seedlings were randomly assigned to each of the following cold storage periods: (1) 0 month; (2) 1 month; (3) 2 months; (4) 3 months; (5) 4 months; and (6) 5 months.

After the designated storage period, seedlings were transferred to a heated greenhouse. Depending upon treatment, the approximate date of transfer was either November 15, December 15, January 15, February 15, March 15, or April 15. Within the greenhouse, 150watt General Electric wide flood bulbs placed 4 feet above the greenhouse bench provided a 15-hour day length. Diurnal air temperatures generally varied between about 60° and 75°F. Seedlings were watered as necessary and an NPK nutrient solution was incorporated into the watering system once a week.

We recorded the number of seedlings which had broken bud at 2-week intervals during the period mid-November 1971 to late June 1972.

Results and Discussion

For all three species tested, there tended to be a positive correlation between the length of cold storage and the speed with which growth was resumed after seedlings were transferred to the heated greenhouse (table 1).

Cold storage was most important for sugar maple and yellow birch. For example, when sugar maple seedlings were stored in the cooler for 4 months, most broke bud within 2 weeks. But with no cold storage, none broke bud in less than 20 weeks and only two of 12 broke bud during the 30-week observation period. Similar results have been reported for this species by Kriebel and Wang (1962).

Cold storage was least important for bud break on balsam fir. These seedlings required at least 8 weeks to break bud if they received no cold storage. After 2 months in storage this minimum period had been reduced to 4 weeks, but additional storage periods of

TABLE 1.—*The effect of six cold storage periods and subsequent weeks in the greenhouse on percentage of seedlings which broke dormancy*[1]

Weeks in greenhouse	Months in cold storage: 0	1	2	3	4	5
	Percentage of seedlings which broke bud					
			Sugar Maple[2]			
2	0	0	0	0	75.0	91.7
4	0	0	0	33.3	91.7	100.0
6	0	0	33.3	100.0	91.7	100.0
8	0	33.3	91.7	100.0	91.7	100.0
10	0	66.7	100.0	100.0	91.7	100.0
12	0	91.7	100.0	100.0	91.7	–
14	0	91.7	100.0	100.0	91.7	–
16	0	100.0	100.0	100.0	–	–
18	0	100.0	100.0	100.0	–	–
20	8.3	100.0	100.0	–	–	–
22	8.3	100.0	100.0	–	–	–
24	8.3	100.0	–	–	–	–
26	16.7	100.0	–	–	–	–
			Yellow Birch[3]			
2	0	0	0	0	75.0	50.0
4	0	0	25.0	91.7	91.7	91.7
6	0	0	91.7	100.0	91.7	91.7
8	0	33.3	91.7	100.0	91.7	91.7
10	0	58.3	91.7	100.0	91.7	91.7
12	0	75.0	91.7	100.0	91.7	91.7
14	16.7	75.0	91.7	100.0	91.7	–
16	25.0	75.0	91.7	100.0	91.7	–
18	75.0	75.0	91.7	100.0	–	–
20	75.0	75.0	91.7	–	–	–
22	75.0	75.0	91.7	–	–	–
24	83.3	75.0	–	–	–	–
			Balsam Fir[4]			
2	0	0	0	0	0	0
4	0	0	100.0	100.0	100.0	60.0
6	0	100.0	100.0	100.0	100.0	60.0
8	80.0	100.0	100.0	100.0	100.0	80.0
10	100.0	100.0	100.0	100.0	100.0	80.0

[1]Because the study was terminated in late June, some seedlings were in the greenhouse for 30 weeks but others for only 10 weeks. Each percentage is based on 12 seedlings for sugar maple and yellow birch, and five seedlings for balsam fir.

[2]Results for sugar maple did not change after 26 weeks.

[3]Results for yellow birch seedlings did not change after 24 weeks.

[4]Results for balsam fir seedlings did not change after 10 weeks.

1, 2, or 3 months did not reduce the time required for bud break.

Under the study conditions, we could not establish a minimum length of cold storage absolutely necessary for bud break. Rather, the longer seedlings were in cold storage, the more rapidly they broke bud. For all practical purposes though, sugar maple and yellow birch seedlings should be stored for 1 or 2 months.

In this study all seedlings were exposed to the normal gradual cooling experienced during early fall in Vermont before treatments were imposed. It is probable that the chilling received during early fall satisfied, to a certain extent, the cold requirements necessary to break physiological dormancy. If treatments had been imposed earlier, duration of cold storage might have been more critical.

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