Moisture Retaining Materials, Storage Duration for Unrefrigerated Bales of Nursery Stock Studied for Effects on Survival and Growth

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In 1955, an experiment conducted by the Midhurst Research Center compared sphagnum moss, locally collected moss (a mixture from a local marsh), poplar excelsior, and poplar excelsior treated with a wetting agent, as the moisture retaining materials in bales of nursery stock. The bales *used* were the standard for Ontario at that time, trees being placed "roots inwards" in alternate layers with the moisture retaining material, and rolled in a covering of wax paper and burlap. Wooden battens were used for rigidity, and a wire or steel strapping tied near each end. The ends of the bales were open, exposing varying amounts of the tops of the packaged trees, depending upon size of the stock. The same packaging method, using sphagnum moss, is still in general use but supplemented by other methods, chiefly the kraft-polyethylene bag.

After packaging (April 28 and 29, 1955), the trees were stored in an unheated shed at Larose Forest, about 65 km southeast of Ottawa, in an attempt to simulate storage during normal practice, as in freight car, shed, or covered transport. Nine plantings were done on a nearby research area on the forest, starting May 2, and continuing twice a week until ending May 30, a storage period of about 4 1/2 weeks. At planting time there were eight replications of the four storage treatments in blocks of 50 trees each, taken from four bales of each treatment. A total of 14,400 trees were planted.

The experiment and materials have been described more fully in a previous report (6), which was based on the firstyear survival, taken on November 8 and 9, 1955. The conclusions drawn at that time were: there were no significant differences in survival caused by the moisture retaining materials, and, survival deceased with length of storage in a curvilinear (quadratic, concave) pattern.

Since the first survival count and report, three examinations of the plots have been made, a 5th-year examination in May 1960, a 10th-year in November 1964, and a 15th-year in April 1970. Each measurement consisted of the height in centimeters of every living tree to permit study of survival and height trends.

Moisture Retaining Materials

In the first-year survival studies, no significant differences due to materials were shown. However, in the 5th and again in the 15th-year, survival differences significant at the 5.0 percent level were obtained, (table 1). The

TABLE 1.—Moisture retaining material: Average percentage of survival, and height in centimeters at 5, 10 and 15 years after planting

	L Local moss	S Sphagnum moss	WU Excelsior untreated	WT Excelsior treated	Significance
Fifth-year					
Survival percent	65.8	70.5	71.7	70.9	*
Height cm	69.3	69.7	68.6	69.6	NS
Tenth-year					
Survival percent	65.4	69.6	70.4	70.5	NS
Height cm	187.6	189.2	189.8	190.6	NS
Fifteenth-year					
Survival percent	64.6	68.6	70.0	69.1	*
Height cm	327.3	335.4	333.6	333.4	NS

* Significant at the 5.0 percent level
NS Not significant

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figures for survival are comparatively low as a result of averaging the nine times of planting. As shown in the next section of this report, there was a considerable decline in survival after the fourth planting. Further examination by range test showed that the difference was due chiefly to one treatment, L, or locally collected moss, which gave lower survival than the other three treatments. No significant differences among these three treatments were shown. None of the analyses of height data were significant, although it can be observed that by the 10th and 15th-year, the average height of trees for the L treatment was slightly lower (table l).

The results indicate that the locally collected moss did not hold moisture as well as the other materials, or that it contained some inhibiting factor of survival such as mold or fungi (3,5). Wood excelsior still appears as good as the more usual sphagnum moss, and there is no apparent benefit in the use of a wetting agent.

Length of Storage

The effect of holding or storage upon survival and height is illustrated in Figures 1 and 2 respectively. The pattern of survival follows that reported for the first year (6) very closely, highly significant for 5, 10, and 15 years after planting. After storage for 11weeks, the survival rate declined increasingly with time. The trend is regular and consistent with the exception of the sixth planting where survival was worse than expected. There is also an indication, although not in the first-year data, that survival at the third planting was below the general curve which could be used to represent survival expectation.

The differences in height due to planting time were also highly significant at the 5- and 10-year levels. The effect of storage depressed the height growth in accord with the duration. At the 5-year level, the difference in height between the first and the ninth plantings was about 41 percent, at 10 years 22 percent, and by 15 years 9 percent and no longer significant. It is perhaps sur

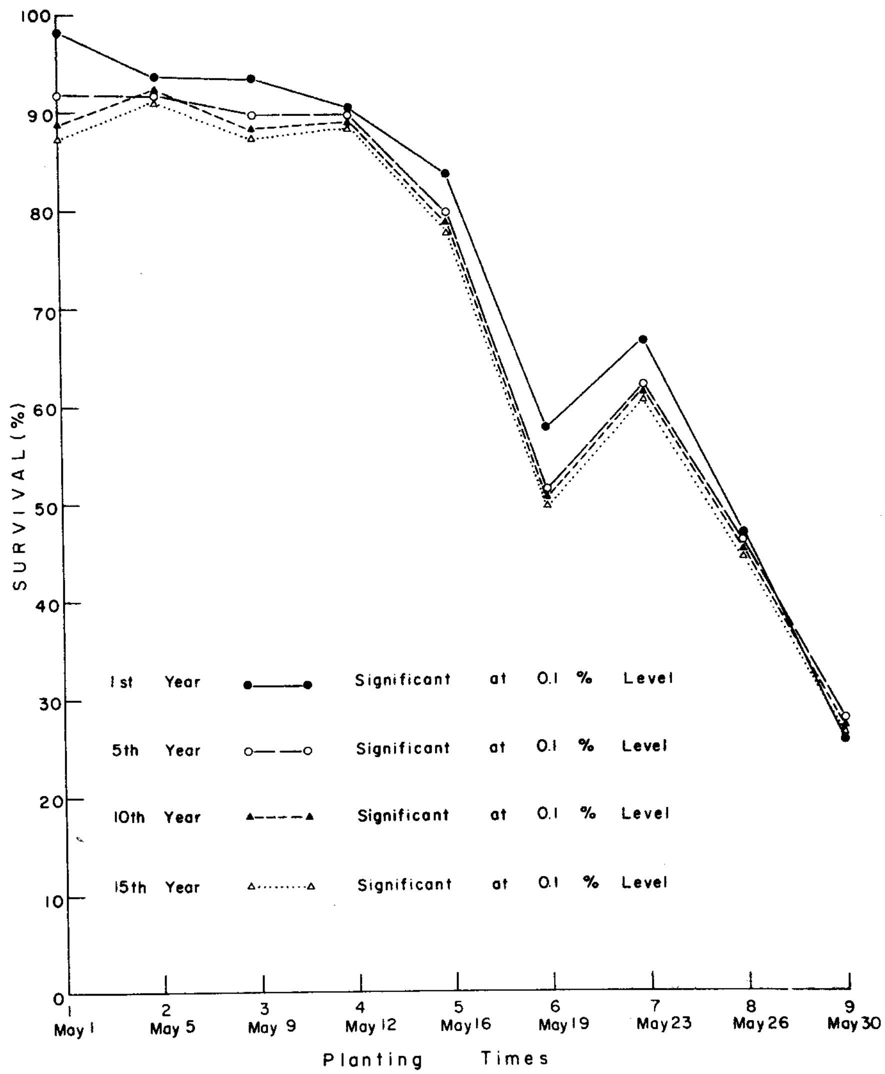

Figure 1.—Percentage of survival, by time of planting. Shows effects of duration of unrefrigerated storage on survival rates at 1, 5, 10, and 15 years after planting.

prising that these height differences were found because it could be expected that with higher mortality of the later plantings the smaller and weaker trees would have been eliminated, leaving larger, faster-growing trees. Obviously, however, the growth rate of the surviving trees was inhibited with duration of storage.

The height growth of trees planted at third and sixth planting times was also reduced, as was survival, below the normal expectation, or below the general trend. At this date we can only speculate on possible causes. The third planting (May 1, 1955) was on a cold, windy day. The wind may have been the damaging factor, or the men may not have planted carefully due to personal discomfort. The sixth planting (May 19) was on a day of low relative humidity and inhibition of survival and growth could be expected (7). This depression of survival, about 15 percent below expected level, and height growth, about 10 percent below, is again a firm indication of the need to curtail planting operations under conditions of low relative humidity.

Finally, the depression of survival and growth with the extension of storage must be considered as a result of two factors: first, damage or inhibition due to storage conditions, the loss of carbohydrate reserves (4), growth of molds and fungi (3,5), and desiccation (8); second; the loss of growth that can he expected from planting late in the season; loss of the best part of the growing season, and a short first year. In this experiment, these factors are confounded. Depression of survival and height growth with duration of unrefrigerated storage into the advanced growing season has been previously noted (2), with fresh stock and tubelings

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can damage the bark and make it possible for borers to get in.

The adult of the rhododendron borer is a moth. The moths appear during the latter part of May and in

Figure 2.—Average tree height, by times of planting. Shows effects of duration of unrefrigerated storage on height of 5, 10, and 15 years after planting.