WATER DIPPING AND MOSS PACKAGING FOR FROZEN OVERWINTER STORAGE OF JACK PINE

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Water dipping and/or use of sphagnum moss was found unnecessary for frozen overwinter storage of jack pine in Kraft-polyethylene bags.

In 1973, an experiment was started at Swastika Nursery (550 km north of Toronto) to study the effects of water dipping and/or use of moss in packaging of 2+0 jack pine *(Pinus banksiana* Lamb.) for frozen overwinter storage.

Materials and Methods

In the fall of 1973, plots were laid out randomly in the regular 2+0 jack pine nursery beds to provide trees for weekly test liftings for frozen overwinter storage and for fresh-lifted control in the 1974 outplantings. On each lifting date (October 10, 17, 24, and 31-later liftings were not obtainable due to frozen beds), the seedlings were loosened by Egedal lifter, pulled by hand, tied in bundles of 25, and packed in Kraft-polyethylene bags in the field according to the following four treatments:

1. *Dry.* Bundles were packed in Kraft-polyethylene bags without further treatment.
2. *Water dip.* Bundles were dipped (roots only) for about 10 seconds in water before packaging.
3. *Moss*. Bundles were packed in Kraft-polyethylene bags without dipping and with a handful of wet sphagnum moss at both top and bottom.
4. *Water dip and moss.* Bundles were dipped in water and then packed with wet moss at both top and bottom.

The bags (15 for each treatment with 500 trees per bag) were closed with wire twists and placed in frozen storage (-2° C) at the nursery within 2 hours after lifting. On each lifting date, a random sample of eight bundles (200 trees) was obtained for characterization of the stock.

For each of the three plantings in 1974 (May 13, June 10, and July 8), fresh control stock was lifted the previous day and the required number of bags removed from frozen storage at the same time. Samples of the freshly lifted trees were also taken to the laboratory for measurement. A summary of the stock characterization is given in table 1.

The three plantings (of 1,000 trees each) were carried out using a modified wedge system of handplanting on separate but adjacent blocks according to a randomized split-plot design—main plots for date of lifting and subplots for packaging treatment. The planting area was formerly cutover, with considerable logging waste and heavy competition of blueberry *(Vaccinium)* and sweetfern *(Comptonia)* on a deep sandy site.

The results of the experiment have been examined up to the fall of 1978, the 5th year after outplanting, using angular transformation of survival percentages, plot averages for tree heights, and the Duncan multiple range test for treatment breakdown.

Results and Discussion

The data pertain to several differences—those due to planting dates, those due to lifting dates, and those due to packaging treatment.

Season of Planting. A summary of the results in terms of the three planting dates is given in table 2. It is apparent that the stored stock was inferior to the fresh stock at all three plantings. This may have been partly due to the unbalanced stock since the high top to root ratio (4.3 to 4.7) is above the working range for this species of 2.0 to 4.0 given by Armson and Carman (1). Large well-balanced stock has been found best for storage (6,7). The lower height growth of the stored stock is probably due, in part, to delayed bud break in stored stock and consequent shortened growing period (5). On the other hand, taking into account the differences in height at the time of planting, the stored stock for the second and third plantings has been growing at a better average rate over the 5-year period than the fresh stock

Table 1.—*Stock characteristics, 2+0 and rising 3+0 jack pine, Swastika Nursery, fall 1973 and spring 1974*

	Top length	Stem diameter	Ovendry weight	Top to root ratio
	cm	*cm*	*g*	*in ODW*
Fall 1973				
Average of four lifts	16.1	0.39	4.27	4.71
Spring 1974				
May 13	17.2	0.42	4.37	4.26
June 10	33.1	0.45	5.49	6.12
July 8	43.6	0.45	6.57	7.00

Table 2.—*Fifth-year results of an early (May 13-15), a middle (June 10), and a late (July 8) season planting of frozen overwinter stored and freshly lifted jack pine*

	Survival	Height	Aggregate Height[1]
	%	*cm*	*M/ha*
Early plant (May 13-15) Stored	50.8	96.5 [2]	1,471
Fresh	51.0	106.8 [2]	1,634
Middle plant (June 10)			
Stored	53.0	82.0	1,304
Fresh	56.0	89.0	1,495
Late plant (July 8)			
Stored	32.0	65.4	628
Fresh	64.0	73.2	1,405

[1] Aggregate height = planting density of 3,000/ha x survival percentage/100 x average height.

[2] The brackets ([]) = significant pair difference at the 5.0 percent level.

(second planting 13 cm vs. 11 cm/year respectively; third planting 10 cm vs. 6 cm/year). Planting in the normal season (May in this area) is to be preferred, whereas extended season planting can be expected to give reduced performance (3).

Time of Fall Lifting. The results from the different times of lifting have been summarized in table 3; statistical analyses do not apply as these are averages of three separate planting areas. No trend due to date of fall lifting is apparent, but other studies have suggested that later lifting of jack pine is required. The degree-hardening days (D-H-D) were estimated at about 155 (base 10° C) or 280 (base 50° F), whereas 210 (base 10° C) or 375 (base 50° F) has been recommended for this species (4).

Packaging Treatments for Storage. In the separate analyses of variance by plantings, there were no significant differences due to packaging treatment; therefore the results may be summarized as in table 4. There is only a slight confirmation that water dip is damaging as found in another experiment (*2*). The addition of moss to the package was of no value.

Conclusions

Overwinter storage of jack pine was only partially successful; stored trees were not as good as fresh trees in prime planting time and much worse in late planting. Lifting of the trees at a later date for storage than used in this experiment (October 31, 1973) is more promising for successful storage. Late season planting (with

Table 3.—*Effect of date of fall lifting (2+0 jack pine) on survival, height, and aggregate height at 5 years after outplanting (average of three plantings)*

	Survival	Height	Aggregate height[1]
Lifting	*%*	*cm*	*M/ha*
October 10, 1973	44.7	78.5	1,053
October 17, 1973	45.3	81.8	1,112
October 24, 1973	46.0	81.4	1,123
October 30, 1973	45.0	83.5	1,127
May 13, 1974	57.0	89.7	1,534

[1] Aggregate height = planting density of 3,000/ha x survival percentage/100 x average height.

Table 4.—*Effects of overwinter storage packaging treatments (dry, water dip, moss, water dip + moss) of 2+0 jack pine on survival, height, and aggregate height at 5 years after outplanting (average of three plantings)*

	Survival	Height	Aggregate height[1]
Treatment	*%*	*cm*	*M/ha*
Dry	48.5	82.6	1,202
Water dip	47.7	81.6	1,168
Moss	48.8	83.5	1,222
Water dip + moss	45.3	85.8	1,166

[1]Aggregate height = planting density of 3,000/ha x survival percentage/100 x average height.

either fresh or stored trees) resulted in reduced growth and poorer plantations. Lifting and dry-packaging (no water dipping and no moss) was as successful as other treatments (water dip, moss, or both) for frozen overinter storage in Kraft-olyethylene bags.

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