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SNOW-CACHING: ON-SITE INTERIM STORAGE OF PLANTING STOCK

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INTRODUCTION

Artificial regeneration using bareroot stock is most successful when planting is done immediately after the dormant seedlings are lifted from nursery beds. Because this is not always possible, dormancy can be maintained by keeping the seedlings cold or frozen. Maintaining the high quality of tree seedlings while they are in interim storage or at field sites awaiting outplanting can be expensive. According to Sedor and Navratil (1975), the long-term storage of tree seedlings requires a temperature approaching 0°C and a relative humidity of 100%. This should prevent problems with mould fungi and physiological drying; problems that are not alleviated using cold-storage methods.

To avoid the significant expense of constructing cold or frozen storage facilities at permanent locations, or the problems associated with the use of refrigerated vans, the authors examined the use of frozen soils under dense black spruce (*Picea mariana* [Mill.] B.S.P.) stands to maintain seedling quality. This concept is similar to the successful preservation in "ice houses" of ice cut from lakes during the winter. Using four methods and seven different approaches, snow-caching was first tried in the Kapuskasing District of the Ontario Ministry of Natural Resources (OMNR) in northern Ontario during the winter of 1975–76. This technical note summarizes the feasibility of on-site interim storage of bareroot black spruce tree seedlings, details snow-cache construction (Fig. 1), and notes the costs and savings associated with the technique.

THE PROBLEM

It can be problematic to synchronize the lifting and transportation of bareroot stock to the planting location at the appropriate time and yet maintain seedling dormancy. Many nurseries in Ontario are situated in the southern part of the province or in agricultural areas, where frost leaves the ground earlier than in boreal cutovers. At these locations, frost often penetrates deep into the soil, especially if shear blade site preparation was done immediately following winter

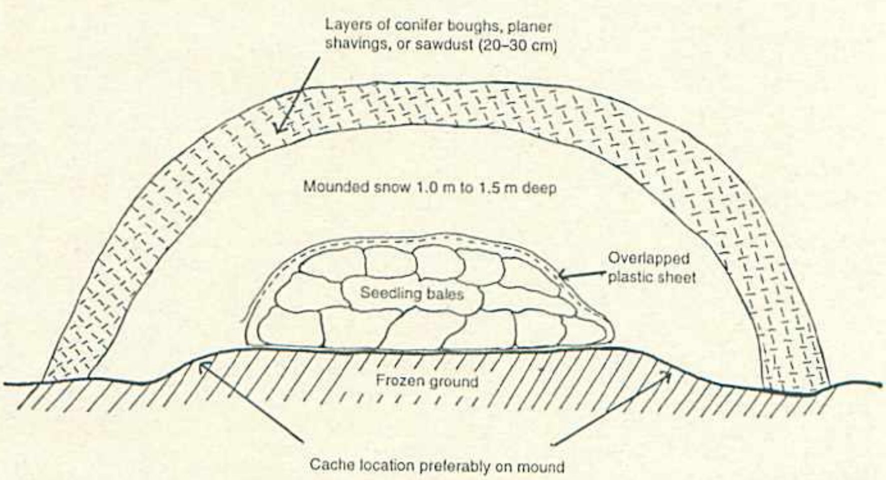

Figure 1. Cross-section through a typical snow-cache showing construction detail and materials used.

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harvesting. As such, planting may not be able to proceed as early as the seedlings can be lifted from the nurseries. To maintain dormancy until planting can proceed, seedlings must be placed into cold or frozen storage. Permanent facilities require a considerable initial investment, and there are annual maintenance and operating expenses. "Reefer" vans (truck trailers with a built-in cooling system) are widely used to transport seedlings from the nurseries to the general planting location, and to provide field storage until planting can proceed. Reefer vans also constitute an investment, and they require maintenance and monitoring while in operation to ensure that temperatures do not rise because of mechanical malfunction.

During the spring numerous silvicultural activities, not just planting, get under way. Hence, workers and equipment are not always readily available. Trucks are needed to transport seedlings and personnel. Also, many planting sites are not readily accessible to general purpose vehicles; therefore, this requires special purpose vehicles to transport the planting stock on appropriate schedules. Further problems can be encountered in keeping stock dormant during interim (field) storage and in ensuring that excessive drying does not occur.

THE PERCEIVED SOLUTION

Many peatland forest sites retain frost for extended periods in the spring. The insulating blanket created by *Sphagnum* mosses is very effective in protecting underlying soil horizons from radiant heat (Fig. 2).

Snow-caching bareroot seedlings came from the idea that late frost in peatland black spruce stands could perhaps be effectively used to keep seedlings dormant for extended periods while awaiting proper planting conditions. To enhance the frost's action, the snow cover could be compacted to allow the frost to penetrate deep into the soil.

With workers and equipment more readily available during the winter, seedlings that have been fall-lifted can be moved from frozen storage at the nurseries to interim storage at the planting sites. No specialized carriers are needed to transport the tree seedlings into remote locations over a variety of terrain types, and winter access is relatively inexpensive. Transportation of frozen tree seedlings, even into remote sites that normally would not have been regenerated, can be readily accomplished using snowmobiles. With the tree seedlings already on location, planting crews can then be moved to the planting sites using air or ground transportation.

A TYPICAL SNOW-CACHE

Snow-caches are simple in design and, ideally, are constructed on frozen ground. This is accomplished by first selecting an appropriate location during the snow-free season. Then, during the winter, snow is packed on the site to permit frost to penetrate deep into the soil. Several days of cold weather should be allowed for this to occur. A sheet of plastic, large enough to envelope all of the trees to be cached at the site, is laid on the ground. Bales of frozen seedlings are arranged on

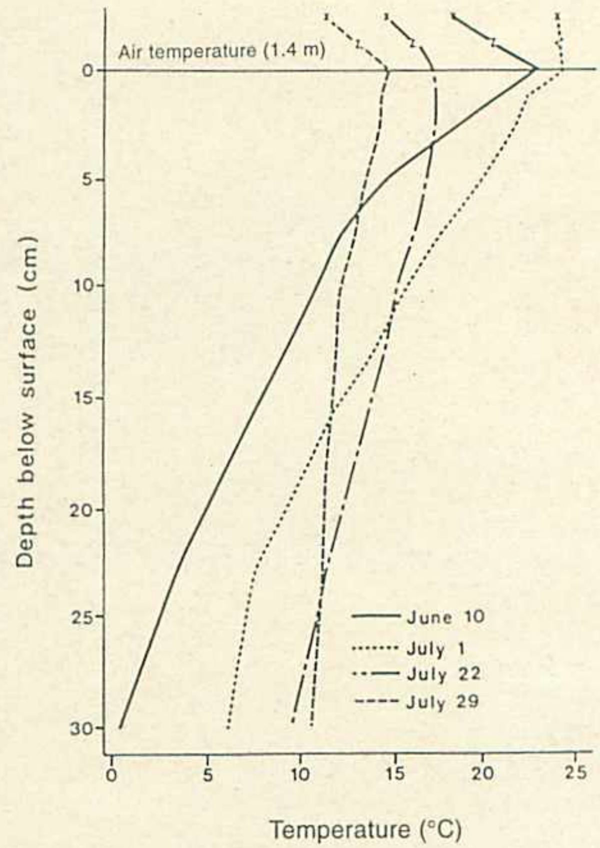

Figure 2. Peat soil temperature profiles from the ground surface to a 30-cm depth in a peatland black spruce stand on 4 days during the growing season (from *Haavisto et al. 1989).*

the plastic. The plastic is then folded over the piled bales to prevent water from seeping into the cocoon that has been formed. A thick layer of snow (1.0–1.5 m) is placed over the seedlings, and a protective covering (20–30 cm) of conifer boughs or, if readily available, planer shavings or sawdust, is added to completely cover the pile (Fig. 1).

Figure 3 shows a typical snow-cache covered by a layer of conifer boughs and situated in a well-shaded peatland black spruce stand. Snow-caches constructed on a totally exposed, readily accessible site, utilizing a cover of planer shavings, are shown in Figure 4. Figure 5, which depicts a 1-week (late May) thermograph chart, shows that the core of the snow-cache remains very stable just below freezing.

Several key points should be emphasized. The bottom of the snow-cache should be somewhat higher than the surrounding area to ensure that water from the spring snowmelt will not soak the lower seedling bales. Failing this a platform of poles should be constructed, onto which the first layer of seedling bales can be placed. The plastic film is essential because it not only helps to maintain the cold, but ensures that the meltwaters from higher in the mound do not percolate into the lower layers but effectively exit the cache.

The number of seedlings placed into a snow-cache is dependent on the area to be planted. Small snow-caches representing 1 or 2 days of planting, even though somewhat

Figure 3. A snow-cache covered with conifer boughs.

Figure 4. Two snow-caches constructed on a landing that is totally exposed to the sun.

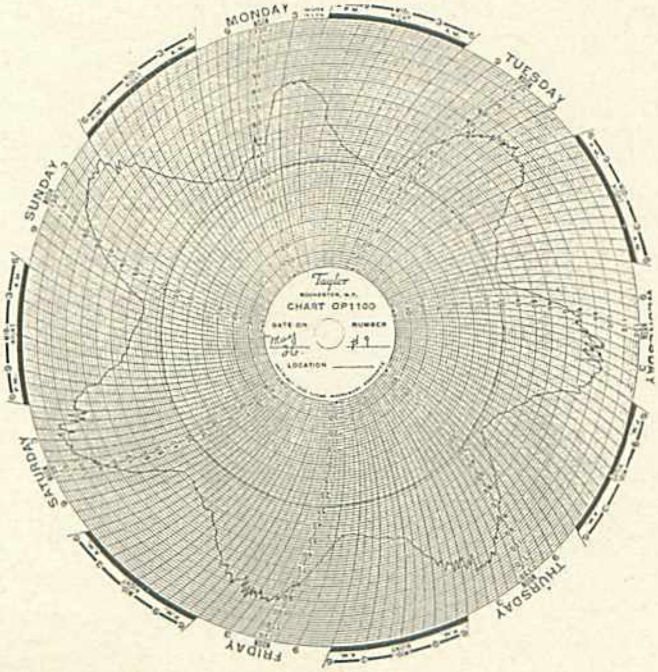

Figure 5. A thermograph chart showing air temperature trends (outer line) and the temperature at two depths (two superimposed inner lines) in the snow-cache shown in Figure 4.

more expensive to construct, may be advisable. If inclement weather or other reasons beyond the control of the planting crews prevents progress, then unused seedlings remain dormant.

Snow-caches should be opened 1 or 2 days prior to planting to allow the seedlings to acclimatize and have the roots soaked. The shaded side of the cache should be opened first to minimize melting of snow. A large snow-cache can be opened and seedling bales removed as needed. Because thawing will begin immediately in the vicinity of the opening, protection in the form of a tarpaulin or plastic sheet is advisable to hold the cold inside. No special care is needed for small snow-caches — they are usually opened completely and the seedlings acclimatized in the conventional manner.

IMPLEMENTATION, COSTS, AND SAVINGS

The first operational trials, with 102 000 bareroot tree seedlings, were established in the Kapuskasing District during the winter of 1975–76. Several types of snow-caches were tried; however, the simplest and most effective was the one described in this technical note. By the late 1970s, about 20 million tree seedlings per year were being snow-cached in the northeastern part of the province. Currently, with more cold or frozen storage facilities available at OMNR district headquarters and at silvicultural camps, only about 3–5 million seedlings are snow-cached annually in the province.

The range of costs associated with snow-cache construction depends upon the type and location of the cache, and can vary substantially. Costs include equipment for clearing and packing the location to facilitate deep freezing; road access, if required; transportation of workers and tree seedlings; and materials such as plastic film, sawdust, or planer shavings, if used. Differences in total costs will therefore depend on a number of items and not merely on the number of seedlings to be cached at a particular location.

Based on cache construction at seven OMNR districts over the period 1979–1984, the cost per thousand seedlings ranged from $1.86 to $16.08 (1984 $). (Because of variability in the cost of specific activities, direct conversion to 1995 $ would not be meaningful.) Snow cache construction in the Hearst District between 1989 and 1992 ranged from $15.33 to $17.32 per thousand seedlings, including salaries and average daily transportation costs for 270 km (D. Finlayson, pers. comm.). When the snow-caches were constructed at a nursery, no costs for transportation or road building were incurred; hence the very low snow-caching costs.

Snow-caches are seen as an alternative to constructing cold or frozen storage facilities at a permanent location. Maintenance and operating costs would be avoided. Transporting frozen tree seedlings during the winter does not require specialized handling or care, and can be done when workers and equipment are readily available. As well, additional (perhaps specialized) vehicles are not required during the spring rush to get seedlings from the tree nurseries and to ensure on-time delivery to the planting locations. For the more inaccessible planting locations, specialized transport vehicles are not needed to move tree seedlings.

SNOW-CACHING: A SILVICULTURAL TOOL

Snow-caching was originally envisioned as a method for avoiding many of the problems that field level forest management personnel face during the busy spring planting season.

Some snow-caches have kept seedlings in a frozen state until late June, effectively extending the planting season until that time. An additional advantage is that remote sites that normally would not have been planted, and therefore would have added to the provincial backlog area, have been regenerated and returned to productive forest.

REFERENCES AND FURTHER READING

Baker, W.D. 1989. Snow cache seedling storage in northwestern Ontario. Northwestern Ontario Boreal Forest Management Technical Notes. Ont. Min. Nat. Resour., Northwestern Ont. Forest Tech. Development Unit, Thunder Bay, ON. TN-03. 4 p.

Dahlgreen, A.K.; Ryker, R.A.; Johnson, D.L. 1974. Snow cache seedling storage: Successful systems. USDA For. Serv., Intermountain For. and Range Exp't. Sta., Ogden, UT. Gen. Tech. Rep. INT-17. 12 p.

Haavisto, V.F. 1980. Seed requirements for regenerating black spruce in Ontario. Dep. Environ., Can. For. Serv., Sault Ste. Marie, ON. For. Res. Newsl. Fall–Winter.

Haavisto, V.F.; Groot, A.; Jeglum, J.K. 1989. Climate, water, and drainage in peatlands. p. 150–156 *in* D.C. MacIver, R.B. Street and A.N. Auclair, eds. Proc. Forest Climate '86. Climate Applications in Forest Renewal and Forest Production. 17–20 November 1986, Geneva Park (Orillia), Ontario. Environ. Can., Atmospheric Environ. Serv., Downsview, ON. 307 p.

Jorgensen, E.; Stanek, W.K.L. 1962. Overwinter storage of coniferous seedlings as a means of preventing late frost damage. For. Chron. 38(2):192–202.

Ontario Ministry of Natural Resources. 1990. Statistics 1989–90: A statistical supplement to the Annual Report of the Minister of Natural Resources for the year ending March 31, 1990. Toronto, ON. 106 p.

Racey, G.D.; Hutchison, R.E. 1983. A field test of the snow cache with 2 + 2 white spruce from Swastika Nursery. Ont. Min. Nat. Resour., Toronto, ON. Nursery Notes 89. 5 p.

Sedor, R.B.; Navratil, S. 1975. Survey of cold storage and its impact on the quality of stored stock in northwestern Ontario in summer 1974. Ont. Min. Nat. Resour., Northwestern Ont. Forest Tech. Development Unit, Thunder Bay, ON. Inter. Rep. 53. 17 p.

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