Nipissing Forest Resource Management – Vermilion Forest Management
Final Report – 2003 Planting Demonstrations

Project #1: Cold Storage vs. Outdoor Overwinter Red Pine

Crop: PR03NNS (1-yr)
Planting Date: May 29, 2003
Assessment: 2003 (yr 1), 2004 (yr 2), 2007 (yr 5)
Location(s): Gurd Tree Improvement Area
McConnell L. Research Area

Background

The benefits of cold storage have been well documented and include both administrative and biological advantages. Cold-stored seedlings are protected from weather (Photo 1) and can be planted before leader extension begins, which should result in less damage during handling from the nursery to the planting site. Ease of handling, exact tree counts, and reduced shipping costs are among the administrative advantages. Generally cold storage results in additional production costs of ~$25-$30 per thousand seedlings (including up front capital costs ~$800,000). Savings in shipping (up to 2X as many seedlings on a truck) and planting costs can help to offset storage costs. Protection of crops from overwinter losses is probably the main reason for considering cold storage. A loss of 200,00 seedlings would equal the cost of cold storage for that year. However, since physiological activity does occur, the length of storage is limited. Physiological differences between cold-stored and outdoor overwintered seedlings may affect the field performance of red pine seedlings. Whether outdoor or cold-stored seedlings perform better probably depends on conditions at time of planting (e.g. late frost would have a negative impact on outdoor overwintered seedlings).

Objective

To compare the quality (as measured by performance in plantations) of cold-stored seedlings to outdoor overwintered seedlings.

Methods

In 2002 a crop of red pine was grown at North Sun Gardens in Ramore, Ontario using the Jiffy reforestation system (36 X 75 mm pellet). In November 2002, part of the crop was packaged for frozen overwinter storage by sealing the entire growing tray in plastic and placing in the freezer. Several trays were placed on the ground in an outside overwinter holding area (Photo 1).

Photo 1. Losses due to edge damage of outdoor overwintered red pine.

In order to determine pre-planting characteristics a sample was collected for foliar analysis prior to storage in the fall of 2002. In spring 2003 samples were collected from both populations for morphological measurements and foliar analyses. Photo 2 shows some needle tip damage that is sometimes typical of outdoor overwintered seedlings.

On May 29 field planting trials were established at two locations within the Nipissing Forest; McConnell Lake Research Area & Gurd Tree Improvement Area. The McConnell site is within the 2003 operational planting area for red pine and white pine; moderate to heavy poplar and maple competition; soil type is coarse sandy loam. The Gurd site is an old farm field with moderate to heavy grass competition, soil type is silty sand (App. 1). In late 2005, the McConnell site received a herbicide treatment by backpack foliar spray.

Photo 2. Needle tip damage on red pine overwintered outdoors.

Assessments were done in 2003, 2004 and 2007 and the data analyzed using SigmaStat software.

Pre-Plant

Pre-plant foliar analysis results are presented in Table 1. Cold-stored seedlings generally maintained their foliar nutrient levels (except for K and Zn) and outdoor seedlings increased in some nutrients (N, K, S, Zn, Fe) and decreased in others (Ca, Mn, Cu). Outdoor seedlings were taller prior to planting due to some leader extension at the nursery (Table 2). Compared to cold-storage, outdoor seedlings were higher in N, K, Zn, and Fe and lower in Ca and Mn.

Table 1. Comparison of pre-storage (fall 2002) to post-storage (spring 2003) foliar analysis for cold-stored and outdoor overwintered red pine.

Element	Pre-Storage	Post –Storage	
		C/S	Outdoor
N %	1.40	1.40	1.60+
P %	0.25	0.24	0.21
K %	0.77	0.29-	0.83+
Ca %	0.33	0.37	0.27-
Mg %	0.18	0.17	0.16
S %	0.05	0.09+	0.10+
Bo (ppm)	10	10	11
Zn (ppm)	40	32-	45+
Mn (ppm)	112	113	90-
Fe (ppm)	87	84	92+
Cu (ppm)	5	2-	2-

(+/- indicate changes from pre-storage foliar nutrient %)

Table 2 summarizes a sample taken before growth had commenced in the spring. In this sample outdoor seedlings were slightly taller but all other features were similar (Photo 3).

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Table 2. Pre-plant (i.e. post-storage) morphological characteristics of cold-stored vs. outdoor overwintered red pine.

Feature	C/S	Outdoor
Ht (mm)	73	80*
Dia (mm)	2.6	2.5
Needle Length (mm)	161	172
H/D ratio	29	32*
Volume (cc)	0.13	0.14

* statistically significant difference (p<0.10)

Photo 3. Cold-Stored and outdoor-overwintered red pine after the nursery phase.

Plantation.

During a July 2003 visual plot inspection it was noticed that the 'outdoor' overwintered stock had more height growth than the 'cold-stored' seedlings (Photos 3). Outdoor overwintered seedlings are expected to be taller initially since they have started to grow before leaving the nursery. This could have had a negative effect in the event of a late frost at the planting site.

Photo 4. Early growth of outdoor (right) vs. cold stored (left) red pine.

At the end of the 2nd year (2004) at both sites, the outdoor overwintered seedlings were larger than seedlings that were frozen-stored (Figs 1 & 2). Survival for the two groups was over 90 % at both sites. The red pine at the operational site (McConnell) were taller than at the field site (Gurd), but had less stem volume after 2 years, probably a result of heavy competition at McConnell. The open field site had only grass competition. (App. 1)

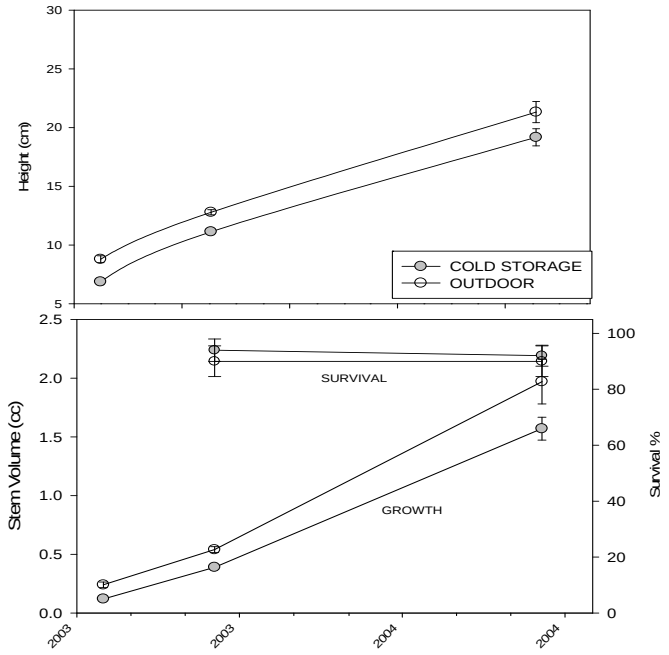

Figure 1. 2nd year (2004) growth and survival for cold-stored & outdoor overwintered red pine at the Gurd Tree Improvement Area.

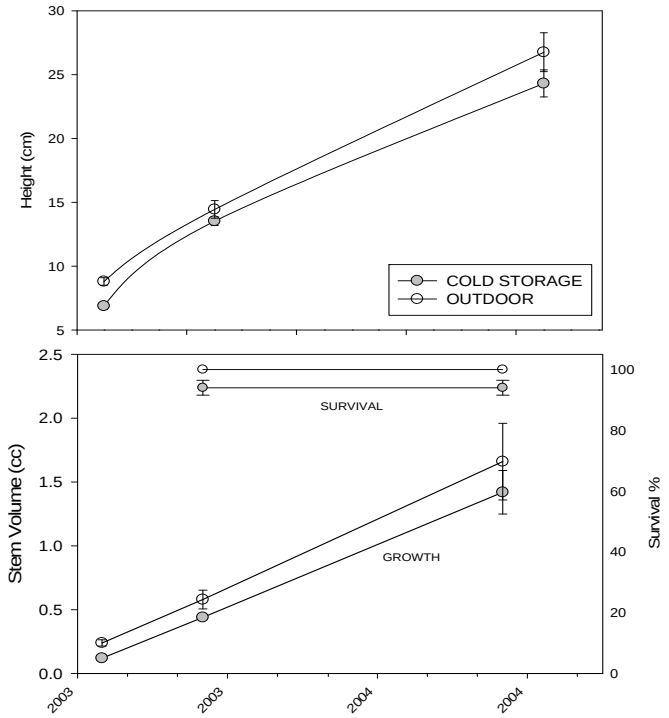

Figure 2. 2nd year (2004) growth and survival for cold-stored & outdoor overwintered red pine at the McConnell Lake Research Area.

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After the 5th growing season (2007) survival remained high for both groups at both sites (>90 %), and there were no significant differences in size between cold-stored and outdoor overwintered red pine (Fig. 3; Photo 4). However, in this trial, red pine at the open site was 67% taller and had 10X the stem volume compared to the operational site (Fig. 3). Even though these are different soil types, this difference is probably mainly due to heavy competition from poplar and red maple at the operational site up until late 2005 (see App. 1).

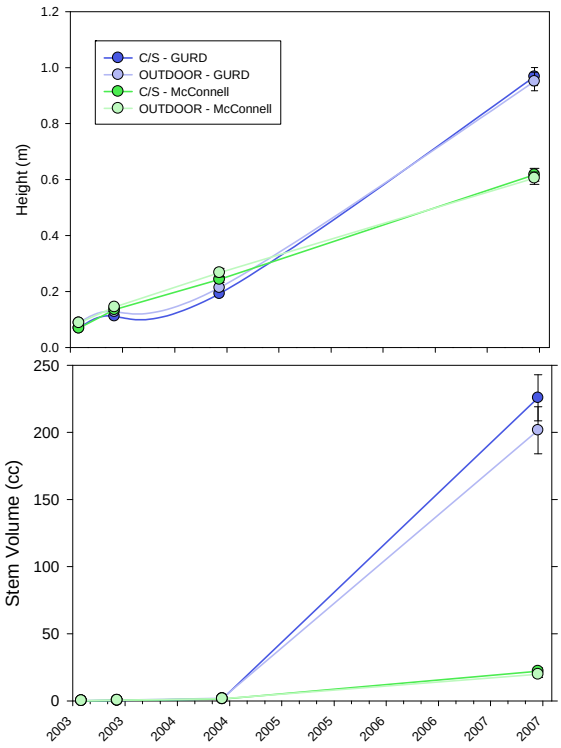

Figure 3. Overwinter storage method for red pine does not affect growth (5th year results – 2007). However, site differences (competition?) are evident.

Summary.

- There is no difference between cold-stored and outdoor overwintered red pine, based on plantation performance after 5 growing seasons.
- In deciding which storage method to use we need to consider the following;
  - Relative cost of each storage method.
  - Logistics of stock handling (i.e. may be important to have frozen, boxed stock delivered dormant later in the season)
- Large growth differences between the two sites may be the result of heavy competition during the first 3 growing seasons at the McConnell site.

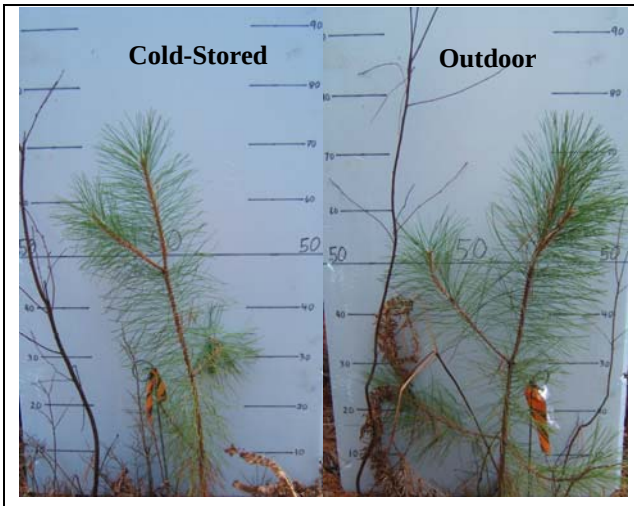

Photo 4. Overwinter storage method does not affect plantation performance of red pine after 5 years (2007) (McConnell).