

# Nipissing Forest Resource Management – Vermilion Forest Management Final Report – 2003 Planting Trials

**Project #2: Red Pine Fertilizer Rates**  
**Crop:** PR03NWE (2-yr)  
**Planting Date:** May 16, 2003  
**Assessment:** 2003 (yr 1), 2004 (yr 2), 2007 (yr 5)  
**Location(s):** Gurd Tree Improvement Area  
**McConnell L. Research Area**

Background

Foliar nutrient concentration has been shown to be a good indicator of plantation performance for jack pine (Smith & Willis, 2003) and Douglas-fir, sitka spruce and red pine (Landis, 1984) and black spruce (Prezio & Watt, 1998). In 2002 a crop of red pine was divided into two populations at Webb's Greenhouses in Bonfield, Ontario, resulting in different fertilizer regimes being applied. This represented an opportunity to follow the two populations in the plantation to quantify the differences and relate field performance to nursery culture.

Objective

To compare the quality (as measured by performance in plantations) of red pine seedlings grown under different fertilizer regimes.

Methods

In 2001 and 2002 a crop of red pine was grown at Webb's Greenhouses in Bonfield, Ontario using the Jiffy reforestation system (36 X 75 mm pellet). Visual differences (i.e. colour) were noticed for populations of that crop that were grown in different greenhouses.

In order to determine pre-planting characteristics, samples were collected from both populations for morphological measurements and foliar analyses in the spring of 2003. Photo 1 shows damage that occurred sometime between August 2002 and shipping time in May 2003. Damaged seedlings were sorted from the main crop (Photo 2). It was evident that the lower fertilizer regime suffered more extensive damage than the population that received more fertilizer (70 vs. 112 mg N/pellet during 2002 nursery phase).



Photo 1. Overwinter damage on red pine (discoloured seedlings in foreground sorted from main crop and not shipped).

On May 16, 2003 field planting demonstrations were established at two locations within the Nipissing Forest; McConnell Lake Research Area & Gurd Tree Improvement Area. The McConnell site is within a 2003 operational planting block (Garrows/LaSalle 31) 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.

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

Pre-Plant.

Pre-plant measurements indicated that the 'high' fertilized seedlings were larger at the end of the greenhouse phase (Table 1). Also, the needle length for the high fertilizer seedlings was greater (Photo 1) indicating healthier seedlings.

Table 1. Initial morphological characteristics of red pine grown under different fertilizer regimes (low vs. high).

Feature	low	high
Ht (mm)	103	111*
Dia (mm)	3.3	3.5
H/D ratio	31.5	32.5
Vol (cc)	0.3	0.4*

\* statistically significant difference

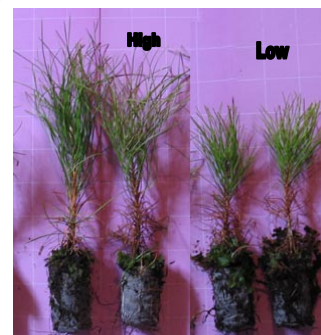


Photo 1. Red pine grown under high (112 mg N/pellet) vs low (70 mg N/pellet) fertilizer regimes (photo taken after the nursery phase)

Although nitrogen (N) levels were the same, pre-plant foliar analysis confirms that the 'high' fertilizer seedlings were healthier than the 'low' fertilizer seedlings (Table 2). 'High' seedlings had more foliar potassium (K), boron (B), and aluminum (Al). All other elements were similar in both groups.

Table 2. Comparison of spring 2003 foliar analysis for red pine grown under different fertilizer regimes.

Element	Spring 2003	
	low (70 mg N/pellet)	high (112 mg N/pellet)
N %	1.30	1.30
P %	0.21	0.23
K %	<b>0.49</b>	<b>0.60</b>
Ca %	0.17	0.19
Mg %	0.13	0.15
S %	0.05	0.05
Bo (ppm)	<b>11</b>	<b>15</b>
Zn (ppm)	51	55
Mn (ppm)	122	119
Fe (ppm)	54	58
Cu (ppm)	3	4
Al (ppm)	<b>11</b>	<b>24</b>

(Shading → higher nutrient concentration for 'high' fertilizer seedlings)

Plantation.

At the end of the second year (2004) at both sites, the 'high' fertilizer seedlings were larger than the 'low' seedlings (Figs 1 & 2). Although survival was not significantly different between the two populations at either site; the 'high' seedlings survived slightly better at the McConnell site and the 'low' seedlings better at the Gurd site.

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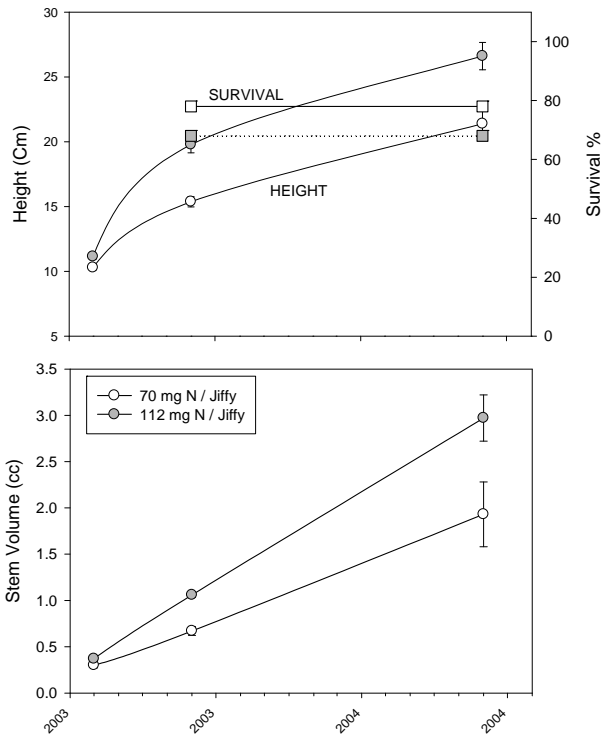


Figure 1. 2<sup>nd</sup> year (2004) growth and survival for red pine grown under different fertilizer regimes (Gurd Tree Improvement Area).

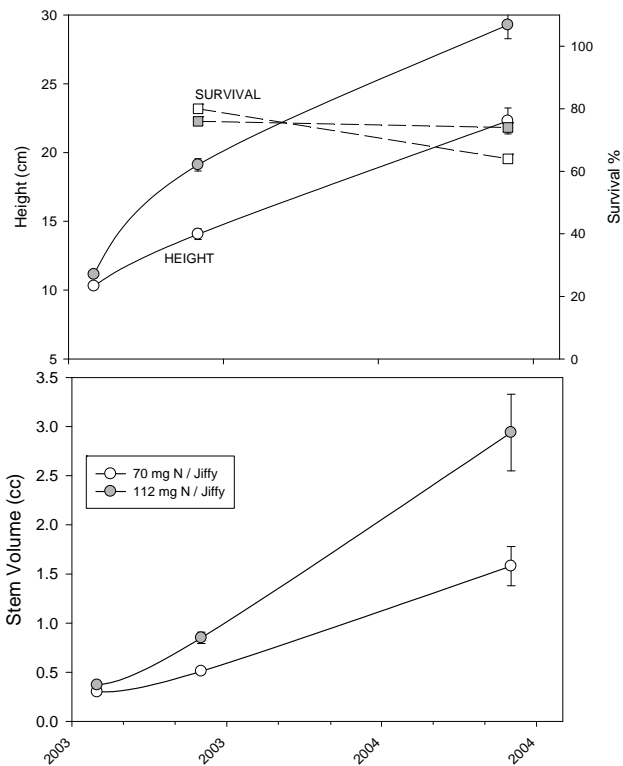


Figure 2. 2<sup>nd</sup> year (2004) growth and survival for red pine grown under different fertilizer regimes (McConnell Lake Research Area).

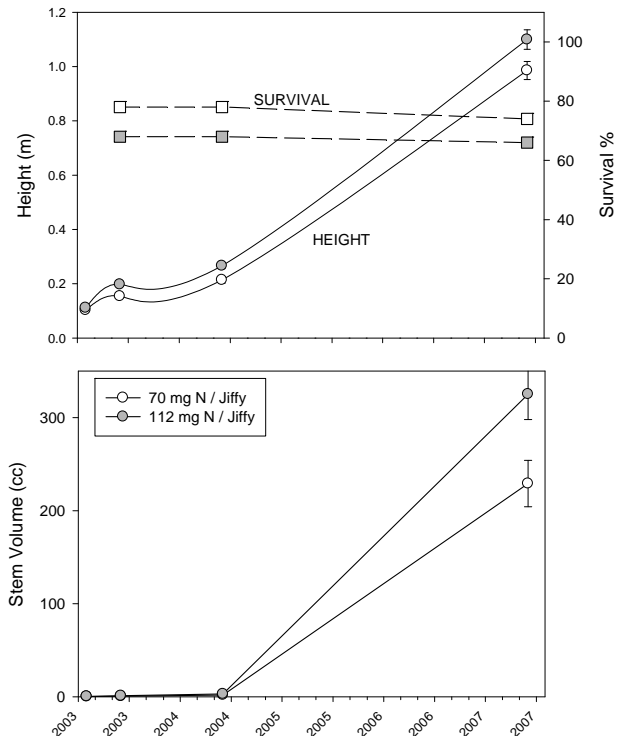


Figure 3. Effects of fertilizer regime at the nursery are still evident in plantations after 5 years (2007) – Gurd Tree Improvement Area.

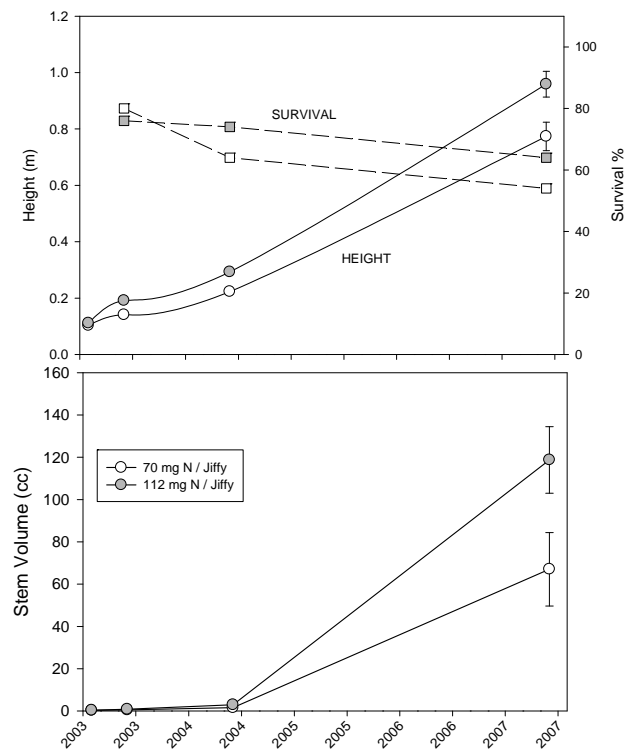


Figure 4. Effects of fertilizer regime at the nursery are still evident in plantations after 5 years (2007) – McConnell Research Area.

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After the 5<sup>th</sup> growing season (2007) both populations of this crop had similarly low survival (25 – 35 % mortality). This is mainly due to a problem that occurred at the nursery in the fall of 2002 (Photo 1). Not all of the damaged seedlings had been removed from the crop prior to shipping because the damage was not yet completely evident. This damage has been reported within the Nipissing Forest Resource Management permanent sample plot program, 2003 (PSP03 5<sup>th</sup> year report).

Figures 3, 4, and Photo 3 show the dramatic effect that nursery stock quality can have on plantation development. Seedlings that received 112 mg of nitrogen during the greenhouse phase have grown significantly faster than seedlings from the lower fertilizer regime (70 mg N / seedling).

As with other 2003 trials at these locations, red pine at the open field plantation at the Gurd Tree Improvement Area are performing better than at the more competitive operational site at the McConnell Research Area. Red pine are ~15 % taller and 3X the stem volume at Gurd compared to McConnell.

## Summary.

- Results indicate that red pine seedlings that receive more fertilizer during the nursery growth phase will perform better after field planting.
- Although foliar nitrogen has been correlated with improved field performance, in this trial, performance is related to total fertilizer applied, as well as foliar potassium, boron, and aluminum. Although one group received more nitrogen in the nursery, this did not result in increased foliar N levels.
- This trial has shown that events during the tree nursery phase of forest regeneration can have a dramatic, long-lasting effect on the quality of forest plantations and the future forest condition.
- Faster growing plantations can impact;
  - Time for a plantation to reach free-to-grow status.
  - Regeneration standards.
  - Reduce the need for herbicide spraying.
- Additional tests have been started to find ways of enhancing the nutrient level of seedlings prior to planting. In 2004, 2005 and 2007 nutrient spiking (addition of high levels of fertilizer just prior to shipping) tests were established for jack pine (2004), white pine (2005), black spruce, red spruce, white pine, and red pine (2007).



**Photo 3.** Effects of fertilizer regime at the nursery are still evident in plantations after 5 years (2007) – McConnell Research Area.

## References:

- Landis, T.D. 1984. Mineral nutrition as an index of seedling quality. IN "Evaluating seedling quality: principles, procedures, and predictive abilities of major tests", Duryea, M.L. ed. Proc. Oct 16-18, 1984. OR St. Univ. pp 29-48.
- Prezio, J and Watt, K. 1998. Survival and field performance of nutrient loaded seedlings. LUSTR Co-op Res. Rep. Feb 1998. 17 p.
- Smith, W.A. and Willis, D. 2003. Nursery fertilizer regimes can affect foliar nutrient, which correlates positively with field performance of containerized jack pine – 12-year results. Alberta Forest Nurs. Assoc. Mod. XI, Dec 2002, Edmonton AB.