Status Report to the Living Legacy Trust
Funding Program 4

Effect of Selected Intensities of Silviculture on Growth and Yield of Overstory and Understory White Pine

Part 1. Residual overstory structure, composition and growth

Part 2. Growth of planted white pine

Project Number: 130-209

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Report Date: March 31st 2003

***Project activities**:*

Part 1. Residual overstory structure, composition and growth (Lead: Murray Woods). Fifth year growth response data was collected in 2002. Between August 3rd to November 31st, 2002, each tree with a DBH greater than 10 cm within each 0.5 hectare treatment plot was re-numbered and measured generally following the methods described by Hayden et al. (1995). We numbered and mapped ingrowth (new trees that were smaller than the 10 cm DBH in 1997). We recorded the following information: species (for new trees), status (live, dead, cut, down), diameter, we re-assessed logging damage, deformities, live crown ratio (ratio of live crown to total tree height), and decay class (if dead or down). We entered and cleaned the data in preparation for analysis. From January 7 to March 31, 2002, we analyzed and summarized the data and produced a project summary in the form of a fact sheet for technology transfer purposes.

Part 2. Growth of planted white pine (Lead: Andree Morneault). Each treatment plot was planted with 1-year-old Jiffy container stock in spring 1998 using operational standards (2.7 m x 2.7 m spacing). After planting, 40 seedlings were randomly chosen within each treatment plot (40 seedlings x 5 treatments x 3 replicate blocks = total of 600 seedlings). Each seedling was numbered, tagged and pinned for repeated growth and survival measurements. In 2002, we collected 5th year data. Total height, basal diameter, crown measurements and seedling condition (using both condition codes

and a vigor rating based on methods described by Pitt et al 1992) were recorded and entered into a database in November, 2002. The data was cleaned and prepared for analysis. From January 7 to March 31, 2002, the data were analyzed and summarized and a project summary in the form of a fact sheet was prepared for technology transfer purposes.

1. Project Synopsis:

This project is part of a larger, comprehensive study looking at plant diversity and succession, salamander populations, natural regeneration ecology, competing vegetation, soil and plant nutrients, and environmental monitoring in response to shelterwood harvesting and site preparation in white pine stands. The study, initiated in 1994, is located in the Britt area of Parry Sound and has been supported by the OMNR, the Canadian Forest Service, various universities, and Westwind Forest Stewardship Inc. (the local SFL) since it's inception. In 2002, Tembec, through the FRP, was invited to support the data collection and analysis of the growth and yield aspect of the study.

This project provides a unique opportunity to compare the effect of different site preparation treatments on the survival, growth and recruitment of white pine regeneration. It also provides data on the rate of residual stem and stand growth and the impacts of logging damage (abrasions and root damage) on long-term growth and quality development of white pine following the seeding cut of the shelterwood system. The operational nature of this study allows the direct transfer of the knowledge gained to silvicultural ground rules, yield response and post harvest succession rules.

Specific objectives of this proposal include:

- To quantify the effect of logging damage on the quality and growth and yield of residual white pine in stands managed under the shelterwood system.
- To measure survival and growth of planted white pine following operational shelterwood harvesting and site preparation and to determine optimal treatment combinations for productive (i.e. competitive) sites.
- To develop basal area and volume growth rates following uniform shelterwood activities in a white pine dominated stands.

This study will provide much needed data to support the development of early managed stand growth and yield curves for white pine managed under the shelterwood system in Ontario. Specifically, it will provide data on the overstory and understory white pine response to the seeding cut of the shelterwood system and four site preparation treatments: no site preparation, mechanical site preparation (straight

blade on small bulldozer), chemical site preparation (air blast sprayer using Vision herbicide), combined mechanical/chemical site preparation.

Site Description

The study is located 65 km north of Parry Sound, near Britt in central Ontario (50°80', 54°85'). In 1995, the study plots were located in 90- to 100-year-old stands dominated by white pine with minor components of red pine (*Pinus resinosa* Ait.), trembling aspen (*Populus tremuloides* Michx.), and white spruce (*Picea glauca* (Moench) Voss). These Site Class 2 (Forest Resources Inventory) white pine sites were classified as Ecosite 11 (white pine-red pine, fresh to moist) based on the Central Ontario Forest Ecosystem Classification System (Chambers et al. 1997). Soils vary over short distances but are most commonly medium sandy loams, less than 30 cm deep, dry to moderately fresh, and very rapid to well drained. Understory vegetation was dominated by balsam fir (*Abies balsamea* (L.) Mill.), red maple (*Acer rubrum* L.), trembling aspen, low sweet blueberry (*Vaccinium angustifolium* Ait.), beaked hazel (*Corylus cornuta* Marsh.), bracken fern (*Pteridium aquilinum* (L.) Kuhn), and wild raisin (*Viburnum cassinoides* L.), with very little advance reproduction of white pine.

Study Design

The study was established using a randomised complete block design, with 5 treatments replicated in 3 blocks. The treatments are:

NC: no cut, no site preparation

C: cut (1997) and no site preparation

M: cut (1996) and mechanical site preparation (1997)

H: cut (1996) and chemical site preparation (1997)

MH: cut (1995) and both mechanical (1996) and chemical site preparation (1997)

Blocking was based on site characteristics. Blocks are separated by several km and differ in total pre-harvest basal area of pine and moisture regime. Treatment plots measure 100 m x 50 m and are surrounded by a 30-m buffer.

Treatments

Before harvest, plots were marked to retain 50% crown closure in dominant and codominant trees, following the OMNR tree marking guidelines (OMNR 1998). Marked trees measuring greater than 10-cm diameter at breast height (DBH) were removed and stand basal areas were reduced from an average of 37.5 m^2/ha to an average of 20 m^2/ha. Experienced operators manually felled and tree-length skidded the marked trees. Designated plots were mechanically site prepared in early fall using a 6-way

blade mounted on a D4 bulldozer. This treatment mixed leaf litter, duff, and mineral soil, uprooted some woody competitors, and displaced woody debris into small piles. Mineral soil exposure and mixed duff and soil covered an average of 25% of treated plots, similar to operationally treated areas. Chemical site preparation was applied in late summer by broadcast spraying Vision® herbicide at 2.1 kg a.e. ha^{-1} using a mist blower mounted on a rubber-tired skidder. On the combined mechanical scarification and chemical treatment plots, the herbicide was applied 1year after the mechanical treatment.

Summary of results

Part 1. Residual overstory structure, composition and growth (Lead: Murray Woods).

In 1997, each tree with a DBH greater than 10 cm within each 0.5 hectare treatment plot was numbered, mapped and measured generally following the methods described by Hayden et al. (1995). We recorded information on many variables including: species, status (live, dead, cut), diameter, logging damage, deformities, live crown ratio (ratio of live crown to total tree height), height (on a sub-sample) and decay class (if dead). In 2002, data was collected to assess 5th year growth response and recruitment.

Data collection

In 1997, we numbered and measured a total of 2801 standing trees: 590 dead and 2212 live. Data collection was done after harvest, but before mechanical and chemical site preparation. In 2002, we re-numbered trees found in 1997, numbered new in-growth, and measured a total of 2961 standing trees: 604 dead and 2357 live trees.

Live trees

In 1997, the most common tree species was white pine (>1000 stems, 76% of total basal area). Balsam fir had the next highest stem density, but in terms of basal area, red pine (9% of total basal area), trembling aspen (5%) and white spruce (4%) were the next most common species. Proportions of each species remained the same in 2002. Other tree species that were present but in smaller numbers were white birch, black cherry, ironwood, sugar maple, red maple, jack pine, largetooth aspen, and larch.

Basal area growth

On average, the treatment plots added 2.13 m^2/ha in basal area over the 5 year period, of which white pine accounted for 1.53 m^2/ha. Plots with the largest basal area increased the most. Individual white pine trees, however, grew more on plots that were cut (average of 10% increase in basal area) compared to the uncut stands (average of 7.5% increase). Analysis of variance did not detect any significant block effects, however, there was a significant treatment effect on the relative growth of white pine basal area: plots that were harvested with no mechanical scarification (C and H) had significantly greater basal area growth of white pine than plots with no

treatment (NC). In the first 5 years after harvesting, logging damage did not appear to have any effect on basal area growth.

Standing dead trees

In both years, dead trees made up about 20% of the standing tree density. In both measurement years (1997 and 2002), dead trees were mainly white pine (50%), white spruce (17%) and white birch (11%).

Standing trees become DWD

From 1997 to 2002, 178 dead trees and 141 live trees fell to the ground (mainly as a result of site preparation and some minor blow-down) and became downed woody debris. We were able to locate many of these trees (126 dead and 68 live) and we will continue to monitor them over time to assess their rate of decay.

Mortality

Overall, 159 trees died from 1997 to 2002, of which almost half were in the no cut, no site preparation (NC) treatment plots.

Recruitment

Several trees were recruited into the overstory from 1997 to 2002. These trees were smaller than 10 cm in DBH in 1997. Of the 469 new trees, over half were balsam fir (290). Recruitment occurred in all treatment plots, but mostly in the NC and H plots.

Part 2. Growth of planted white pine (Lead: Andree Morneault).

Each treatment plot was planted with 1-year-old Jiffy container stock in spring 1998 using operational standards (2.7 m x 2.7 m spacing). After planting, 40 seedlings were randomly chosen within each treatment plot (40 seedlings x 5 treatments x 3 replicate blocks = total of 600 seedlings). Each seedling was numbered, tagged and pinned for repeated growth and survival measurements. Total height, basal diameter and seedling condition were recorded in late autumn of 1998,1999, 2000, and 2001. Condition codes were assigned to each seedling describing damage (browse, broken leaders, necrosis and disease). In 2002, seedlings were be re-measured to assess 5th year response.

Planted tree height and diameter

In 2002, 5 years after treatment, planted trees were significantly larger on plots that had received a harvesting treatment compared to those on the uncut treatment plots ($p<0.05$). Trees were marginally taller and had larger diameters on plots that were site prepared, but the differences were not significant. The largest tree was 134 cm in

height and 22 mm in diameter (MH) and the smallest was 6 cm in height and 0.8 mm in diameter (NC). On average, trees measured between 45 and 60 cm in height and 6 to 9 mm in diameter on harvested plots compared to 20 cm in height and 3 mm in diameter on plots that were not disturbed.

Planted tree survival

Harvesting and site preparation resulted in greater than 80% survival, which was significantly better than survival in the undisturbed treatment plots (51%). Harvesting without site preparation did not significantly improve survival (67% survival).

Fascicle mites

Planted trees in the study area were infected with fascicle mites (*Trisetacus alborum)* in 2001 and 2002. This insect is commonly found in the needle sheath and prevents needle development. From the outside, it can be identified as a yellow discoloration on the shoot. It can be found on branches or the main stem. According to Rose and Lindquist (1984), small shaded trees are susceptible. In our study, we found that there was significantly more trees (>50%) affected by this insect following the harvesting and chemical site preparation treatments (H and MH), compared to the undisturbed treatment plots (13%, $p<0.05$).