Frontline

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PREPLANTING CHEMICAL SITE PREPARATION SUCCESSFUL FOR SPRUCE IN ONTARIO

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CATEGORY: Site preparation
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INTRODUCTION

On fertile mixedwood sites, grasses, forbs, shrubs, and trees rapidly invade forest cutovers and compete vigorously with newly planted coniferous seedlings. To alleviate vegetative competition, improve access to plantations, and create favorable planting microsites, winter shearblading is commonly used for site preparation in northern Ontario. However, shearblading succeeds in reducing competing vegetation only temporarily and additional vegetation control is frequently required to avoid rapid suppression of the planted trees. When planting is delayed by one or more years following mechanical site preparation, the need to control competing vegetation is even greater than on freshly shearbladed cutovers. This technical note summarizes the 5-year results of chemical vegetation control on the performance of planted white spruce (*Picea glauca* [Moench] Voss) and black spruce (*P. mariana* [Mill.] B.S.P.) transplants and black spruce containerized seedlings.

The herbicide used in this study was Vision™ (formerly Roundup™) and the active ingredient is glyphosate. It is registered for release of conifers, site preparation, and injection and frill applications to single woody stems. Glyphosate is rapidly inactivated in the soil and has low toxicity to wildlife and humans.

Glyphosate was chosen because of its wide use in forestry for site preparation (Sutton 1978) and postplanting competition control (Karakatsoulis et al. 1989). Tolerance to glyphosate differs widely among species. It also varies with the physiological state of the target plants (King and Radosevich 1985) and the rate and season of application (Weller and Skroch 1983). The greatest injury to young coniferous trees usually occurs during periods of active growth, whereas the greatest tolerance is found to be in early autumn (King and Radosevich 1985).

METHODS

The study site was located in Lamplugh Township, approximately 60 km east of Matheson, Ontario. It was an upland site with imperfectly drained stone-free clays and clay loams. The original stand consisted of mature white spruce, black spruce, balsam fir (*Abies balsamea* [L.] Mill.), trembling aspen (*Populus tremuloides* Michx.), and white birch (*Betula papyrifera* Marsh.). It was clearcut in the summer of 1981 and shearbladed in January 1985.

Plots were laid out using a standard experimental design, and in June, 1986, 720 seedlings of each of the following stock types and species were planted:

- white spruce transplants (1 1/2 + 1 1/2)
- black spruce transplants (1 1/2 + 1 1/2)
- 1-year-old overwintered containerized black spruce (paperpot seedlings)

Transplant stock was planted with a spade and paperpot seedlings with a Pottiputki® planting tube. Seedlings were planted in rows in the center of 4-m-wide shearbladed strips, at a spacing of 1.5 m between trees. The average heights of the seedlings at time of planting were:

- white spruce transplants: 12.1 cm
- black spruce transplants: 17.5 cm
- black spruce containers: 9.6 cm

The following six treatment regimes, all of which had the shearblading treatment in common, were used on the site:

(1) control (shearblade only);
(2) herbicide treatment of the site in August 1985, the year before planting;
(3) herbicide release in August 1986, the year of planting;
(4) herbicide release in August 1987, the year after planting;
(5) herbicide release in August of each year from 1986 to 1990; and
(6) complete herbicide vegetation control (Treatment 2 plus Treatment 5).

For chemical site preparation, 5.6 L/ha (2.0 kg ai/ha) of Roundup™ in 160 L/ha of water were sprayed over the 4-m-wide shearbladed strips with a motorized backpack mistblower. For postplanting vegetation control, 5.6 L/ha of Roundup™ in 120 L/ha of water were applied using a backpack sprayer. Final assessment of the plots was done after the fifth growing season.

To determine the effect of controlling vegetative competition on soil temperature, temperature was measured in a control plot and in a plot with complete vegetation control. Sensors were placed in the humus layer 5 cm below the surface of the ground and at the humus-clay interface at a depth of 10 to 12 cm.

RESULTS

Results obtained from this study are summarized in Table 1; however, highlights are discussed below.

Vegetation Control

The preplanting chemical site preparation treatment eliminated 95% of the competing vegetation; therefore, treated strips were essentially bare of all vegetation at the time of planting the following spring. However, 5 years later, with no other herbicide treatments having been carried out (Treatment 2), the competition had gradually increased to the point at which chemical release would be required to maintain a "free to grow" status. A herbicide application in August of either the first or second growing seasons failed to release the trees fully. This resulted in severe competition developing soon after seedling establishment. In the release treatment many shrubs were defoliated but not killed. As a result, they resprouted in succeeding years. The poor efficacy of the release treatment, compared to the chemical site preparation treatment, may in part be attributable to the fact that the shrub species were older, more lignified, and larger than at the time of chemical site preparation. Annual applications of glyphosate, with or without initial chemical site preparation, eliminated all competing vegetation and kept the experimental site free of weeds.

Survival

For both species and stock types, 5-year survival was greatest in plots that received only a single course of chemical site preparation (Treatment 2), followed closely by plots that received annual applications of glyphosate weed control (Treatments 5 and 6). Compared to the control plots, black spruce paperpot stock benefited more than the initially larger transplant stock (for both species) from chemical site preparation plus continuous weed control.

Crop Tree Health

Crop tree condition was positively related to the intensity of vegetation control. There was no visual evidence of herbicide injury, as demonstrated by the high percentage of *healthy* trees in the areas that received annual release treatments.

Height Increment

Annual release treatments (Treatments 5 and 6)(Figs. 1 and 2) were responsible for the greatest height increment in all three stock type–species combinations, followed by treatments that involved only preplanting chemical site preparation (Treatment 2). Black spruce paperpots did not respond as well as the transplant stock to chemical site preparation alone (Treatment 2), but height growth in the preplanting herbicided plots was greater than for the control (Treatment 1) or following one postplanting single-release treatment the year after planting (Treatment 4) (Fig. 3).

Stem Diameter of Crop Trees

Ground-level stem diameter was greatest in plots released annually (Treatments 5 and 6). Chemical site preparation alone (Treatment 2) was more effective than either a single-release treatment the year of planting or the year after planting, (Treatments 3 and 4).

Soil Temperature

From the beginning of June to the first half of August, soil temperatures were higher in plots with no competing vegetation than in control plots. The difference in temperature reached a maximum of 5°C at 5-cm depth and 4°C at 12-cm depth. The warmer soils probably indirectly contribute to the superior growth of crop trees in the competition-free plot.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

This study revealed that competing vegetation has a negative impact on the growth and survival of seedlings, beginning as early as the first growing season after planting.

Chemical site preparation with no subsequent treatment improved survival, height growth, and ground-level stem diameter increment of both species and stock types when compared with controls or single post-planting herbicide treatment. The improvement was most dramatic when compared with vegetation control in the year after planting or with no weed control.

Table 1. Five-year survival, crop tree health, height increment, and ground-level stem diameter of white spruce and black spruce transplants and black spruce container seedlings, by treatment.

	Status after 5 years			
Treatment[a]	Survival (%)	Healthy trees (%)	Height growth (cm)	Ground-level stem diameter (mm)
	White spruce transplants			
1. Control (no herbicide)	77	59	51	10
2. Chemical site preparation before planting	98	91	76	14
3. Herbicide in August of planting year	74	90	61	12
4. Herbicide in August of year after planting	54	56	47	9
5. Annual herbicide release	92	92	87	22
6. Chemical site preparation before planting plus annual release	84	97	88	22
	Black spruce transplants			
1. Control (no herbicide)	83	44	50	8
2. Chemical site preparation before planting	94	90	88	16
3. Herbicide in August of planting year	89	84	69	12
4. Herbicide in August of year after planting	60	50	51	9
5. Annual herbicide release	88	98	94	22
6. Chemical site preparation before planting plus annual release	88	97	96	22
	Black spruce paperpots			
1. Control (no herbicide)	63	29	46	6
2. Chemical site preparation before planting	93	80	69	12
3. Herbicide in August of planting year	73	80	66	11
4. Herbicide in August of year after planting	67	57	54	9
5. Annual herbicide release	85	100	94	21
6. Chemical site preparation before planting plus annual release	87	99	91	22

[a] All treatments included shearblading.

Figure 1. White spruce transplants 5 years after planting (chemical site preparation plus annual release).

Figure 2. Black spruce transplants 5 years after planting (chemical site preparation plus annual release).

Figure 3. Black spruce transplants 5 years after planting (shearbladed and released once in August of the year in which the seedlings were planted).

Annual applications of glyphosate maintained weed-free conditions which not only removed aboveground and root competition, but increased soil temperature in the rooting zone. This probably contributed to the superior growth performance of the crop trees.

The results of this study show that on sites with heavy vegetative competition, preplanting chemical site preparation can be a more effective silvicultural treatment than single herbicide treatments done in the years immediately after planting.

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