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VEGETATION CONTROL AND STOCK TYPE IMPROVE BLACK SPRUCE ESTABLISHMENT

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CATEGORY: Regeneration
KEY WORDS: Black spruce, vegetation control, stock type, planting season

INTRODUCTION

In the absence of vegetation management, it is difficult to establish black spruce (*Picea mariana* [Mill.] B.S.P.) plantations on most cutover sites in Ontario (Hearnden et al. 1992). Nutrient rich upland sites are particularly problematic. It has been estimated that approximately 474 000 ha of productive forest lands (including black spruce, white spruce [*P. glauca* (Moench) Voss], and mixedwood cover types) are lost from commercial production annually in Canada because of inadequate restocking to desirable tree species (Honer et al. 1991).

Studies confirm that forests can often be managed more economically for wood production by using herbicides, because the site's full potential can be utilized (McDonald and Fidler 1993). Recently, however, public pressure has been mounting to reduce herbicide use in forestry. As a result, much research is being directed toward alternative or modified vegetation management practices, such as the application of herbicide in narrow bands (Fig. 1).

This technical note is based on a research project initiated by the Canadian Forest Service–Sault Ste. Marie in 1982 to assess the silvicultural impact of treatments used in the establishment of black spruce plantations on the Clay Belt in northeastern Ontario.

APPROACH

The experimental plantings are located in three northeastern Ontario townships: Kenogaming (not classified for Operational Group [OG] as it was outside the classification zone), Lamplugh (OG 7), and Bragg (OG 7) (Fig. 2). Treatments included postplanting weed control, stock type (paperpot containers and $1^1/_2 + 1^1/_2$ bareroot), and planting season (spring and summer). Planting was done in May and July 1982. Soils ranged from fine textured loams to silty and loamy sands. Mechanical site preparation was conducted using two methods:

• winter shearblading (Lamplugh and Bragg), where the duff, living moss layers, stumps, and small residual trees were removed in 4-m-wide strips without exposing the mineral

Figure 1. A black spruce plantation that was released using a band application of herbicide.

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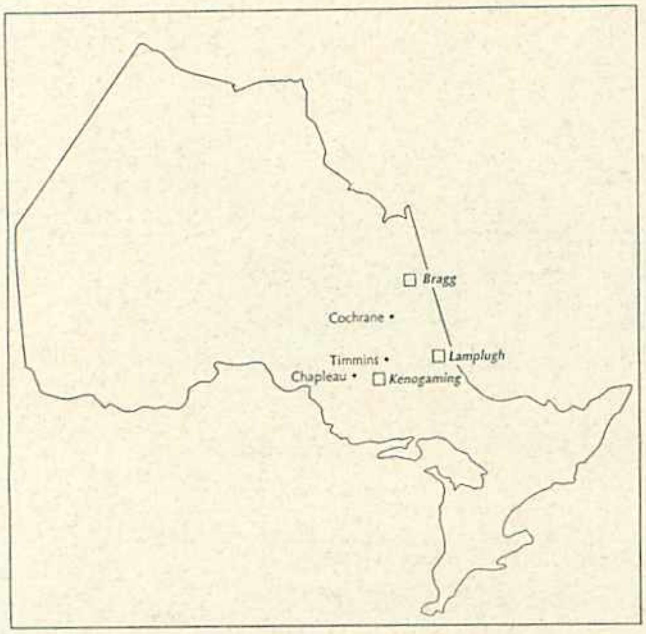

Figure 2. Location of Kenogaming, Lamplugh, and Bragg townships in northeastern Ontario.

soil. Debris was aligned in windrows 3–8 m wide. Seedlings were planted along the outside edges of the shearbladed strips; and

• summer shearblading (Kenogaming), where 5- to 6-m-wide strips were cleared of slash and standing trees. This left 3- to 8-m-wide strips of residual standing deciduous trees, cedars (*Thuja* spp.), and woody shrubs between the bladed strips. Summer site preparation was severe and exposed large areas of mineral soil. Seedlings were planted in spots that retained organic cover along the outside edges and in the center of the strips.

Weed Control

The herbicide glyphosate was used at all treatment sites to control vegetation. Table 1 provides information relevant to herbicide application at each site.

Table 1. Weed control treatments at each of the three experimental locations.

Location, herbicide used, dosage applied, plot area treated, and timing of application in relation to number of growing seasons after planting

Kenogaming	Lamplugh	Bragg
Roundup	Roundup	Roundup
2.14 kg a.e./ha	2.14 kg a.e./ha	2.5 kg a.e./ha
1.75-m swath	1.75-m swath	Broadcast
After 3 seasons	After 3 seasons	After 1 and 2 seasons
(Micron)	(Micron)	(Piston pump and backpack)

Competing Vegetation

The most common tree or shrub species found at the time of planting at the three upland sites (Kenogaming, Lamplugh, and Bragg) were trembling aspen (*Populus tremuloides* Michx.), mountain maple *(Acer spicatum* Lam.), wild red raspberry (*Rubus idaeus* L. var. *strigosus* [Michx.]), and beaked hazel (*Corylus cornuta* Marsh.).

RESULTS

Weed Control

Black spruce outplants benefited from weed control in the three plantings in which it was used as an experimental treatment. Seedling basal diameter growth responded more quickly to release from competition than did height growth (Table 2). This finding is supported in the literature (Brand 1991). Early black spruce height growth is not a sensitive indicator of competition for site resources nor of seedling vigor (MacDonald and Weetman 1993). This was borne out by this study, where seedling total height was not significantly improved by weed control in a 2–4 year period following treatment, but was significantly better than controls after 8–10 years. This suggests that although height growth does not respond quickly to release from vegetative competition, it does so with increasing time following treatment. It has been recommended by Morris (1988) that height growth measurements not be used as indicators of treatment response in plantations until they are more than 5 years old.

The study shows that growth is a much more sensitive indicator of competition for resources (light, moisture, and nutrients) than is survival. This was further confirmed by the fact that noncrop vegetation on the site did not significantly reduce survival, yet it reduced seedling growth significantly. Similar results have been found by authors working with other conifers (Newton and Preest 1988).

At both the Lamplugh and Bragg sites, seedling mortality was significantly higher with weed control than without, up to 5 years after planting (3 and 4 years after weed control). However, the differences were no longer significant 9 and 10 years after treatment. The initial mortality response may have been due in part to increased frost damage brought about by the removal of the vegetative canopy, solarization of shade-adapted needles, and/or a direct herbicide effect.

Overall, both the container stock and the bareroot transplants responded positively to weed control (Table 2). This treatment benefited the smaller containerized seedlings and the larger bareroot seedlings more or less equally. On only one site (Kenogaming) did weed control benefit the smaller paperpot stock proportionately more than the bareroot seedlings.

Although the experiments were located on four separate sites, the results seem to indicate that the method of herbicide application may have influenced tree form. The trees in the broadcast weed control plots had little or no competition around them, and had larger stem diameters and less height growth compared to similar trees that were treated in swaths. The latter group were surrounded by woody plants and, as a result, had narrower crowns, smaller stem diameters, and greater height growth.

Planting Stock

Initially, the bareroot stock was larger than were the paperpot seedlings. They remained significantly larger on three of the sites 11 years after planting. This was also observed in another study (MacDonald and Weetman 1993), where after 4 years bareroot seedlings maintained greater height and diameter growth than did paperpot stock across a range of sites and competition severity. It has been reported that in Virginia the initial stem diameter of loblolly pine (*P. taeda* L.) seedlings was related to better pulp yields after 20 years (Dierauf et al. 1993). On all sites, after 11 years no significant differences in the rate of mortality occurred due to stock type.

Results are presented in Table 2 for percent mortality, total height, height increment, and basal area diameter for the two stock types and three study locations.

MANAGEMENT IMPLICATIONS

The results of this study, which are corroborated by the findings of related studies, can be helpful in making decisions related to artificially regenerating cutovers in northern Ontario. Seedling mortality was generally the least sensitive measure of competition, therefore it should not be used as an indicator of competition for site resources. After 11 growing seasons, weed control did not have a significant effect upon mortality.

During the initial 5 years following planting, growth in the basal diameter of seedlings was a better response variable than was height growth. However, the value of height growth as an indicator of competitive pressure increases with time following planting.

Glyphosate can control perennial species for many years, because it kills the underground propagules. Thus, even though the herbicide is quickly inactivated by soil microbes and adsorption, it nevertheless modifies plant succession patterns in favor of the artificially regenerated species. Also, a shift in vegetational succession may have been assisted by physical site disturbances caused by harvesting and mechanical site preparation. Litter fall and the growth of nonvascular plants on disturbed soils can substantially reduce the amount of receptive seedbed following site disturbance, and because chemical tending creates little new receptive seedbed, the regeneration of seeded species may be limited following herbicide application.

In all of the plantings the total height and stem diameter of bareroot stock were significantly greater after 11 growing seasons than the initially smaller paperpot stock, and on two of the sites annual height increment remained significantly greater after 11 growing seasons. From this observation it appears that initial differences in seedling size gave the transplants a longer-term advantage, and that the absolute size differences increased with time. However, based on the limited findings to date, it would appear that large seedlings should not be a substitute for vegetation control.

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Table 2. Effect of weed control on mortality, total height, height increment, and basal diameter growth in black spruce 11 years after outplanting and 8–10 years after treatments in paperpot and bareroot stock types.

		Mortality (%)		Total height (cm)		Height increment (cm)		Basal diameter (mm)	
		Paper pots	Bare-root	Paper pots	Bare-root	Paper pots	Bare-root	Paper pots	Bare-root
Kenogaming	Weed control	13.7	14.0	291.7	327.8	43.6	43.5	44.4	47.5
	No weed control	16.7	28.0	198.1	288.0	24.3	34.5	25.7	40.0
Lamplugh	Weed control	22.7	16.7	248.1	275.0	28.7	28.5	48.2	59.8
	No weed control	11.0	3.3	219.8	265.0	23.2	27.3	37.8	47.7
Bragg	Weed control	30.1	19.5	257.7	275.9	33.1	36.0	54.5	57.2
	No weed control	18.0	16.5	246.3	245.5	30.2	30.1	41.1	36.6

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