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HEXAZINONE AN EFFECTIVE SITE PREPARATION TOOL ON FINE-TEXTURED SOILS

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INTRODUCTION

On fertile sites, one of the principal objectives of site preparation is to reduce vegetative competition. Herbicides, used either alone or in combination with other site preparation tools, have the potential to reduce weed competition effectively and efficiently. This note reports on a study that examined the field performance of black spruce (*Picea mariana* [Mill.] B.S.P.) seedlings planted following site preparation using the herbicide hexazinone.

Hexazinone, the active ingredient in the liquid herbicide Velpar®L, controls a broad spectrum of annual and perennial weeds effectively. It is absorbed primarily through the roots, with some foliar absorption. The herbicide has been used (Fig. 1) to a limited extent by forest managers to prepare sites for conifers in both the Lake States and northern Ontario.

Figure 1. Aerial application of Velpar®L.

METHODS

In 1979, Forestry Canada, Ontario Region (FCOR) and the Ontario Ministry of Natural Resources (OMNR) jointly initiated a study of the effectiveness of hexazinone as a site preparation tool. Velpar®L was broadcast in early spring at several dosages on five productive upland sites (Table 1). Vegetation had not flushed at the time of application except on the site treated on 31 May (Table 2). Black spruce was planted on all five sites. Spring-lifted bareroot transplant (1½ + 1½) stock and Japanese FH408 paperpots were hand planted. The seed source was Site Region 3200 (Skeates 1979).

RESULTS

Vegetation Control

On the fine-textured sites studied, hexazinone at dosages of 2.0, 4.0 and 9.0 kg a.i./ha effectively controlled herbaceous vegetation such as red raspberry (*Rubus idaeus* L. var. *strigosus* [Michx.] Maxim.) and grasses. However, the

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Table 1. Description of the study areas.

Soil texture class	Soil moisture regime[b]	Mean length of growing season (days)[cd]	Mean date[c] last spring frost	Mean date[c] first fall frost	Mean annual precipitation (cm)[c]
Missinaibi-Cabonga Forest Region (B.7)[a]					
1. deep silt loam	fresh to very fresh	162	15 June	2 Sept.	76.2
2. deep silt loam	very moist	162	15 June	2 Sept.	76.2
Northern Clay Forest Region (B.4)[a]					
3. deep silty clay	moderately to very moist	160	8 June	7 Sept.	78.7
4. shallow sandy clay loam to deep clay loam		160	8 June	7 Sept.	78.7
5. deep silty clay	moderately to very moist	160	8 June	7 Sept.	78.7

[a] after Rowe (1972)
[b] after Anon. (1985)
[c] after Chapman and Thomas (1968)
[d] No. of days with mean daily temperatures above 5.6°C

Table 2. Description of the herbicide and planting treatments.

Application rate (kg a.i./ha)	Application date	Planting date	Application equipment
1) 0.0, 4.5, 9.0	19 May 1978	29 May–4 June 1979	skidder with ground sprayer (Boom Jet 5880–OC20 boomless nozzle cluster)
2) 0.0, 1.1, 2.2, 4.5	15 May 1980	4–7 June 1980	helicopter with boom sprayer (24 D–7 nozzles oriented back 45° below horizontal)
3) 0.0, 1.0, 2.0, 4.0	30 April 1981	12–25 May 1981 27–28 May 1982	helicoper with boom sprayer (30 6508 flat fan nozzles oriented back 45° below horizontal)
4) 0.0, 1.0, 2.0, 4.0	1 May 1981	27 May–2 June 1981 4–5 June 1982	helicoper with boom sprayer (30 6508 flat fan nozzles oriented back 45° below horizontal)
5) 0.0, 2.0, 4.0	31 May 1982	31 May–3 June 1982 16–19 May 1983	helicopter with boom sprayer (29 6508 flat fan nozzles oriented straight back)

herbicide was relatively ineffective on more deeply rooted brush species such as mountain maple (*Acer spicatum* Lam.) and beaked hazel (*Corylus cornuta* Marsh.) and tree species such as pin cherry (*Prunus pensylvanica* L.f.) and birch (*Betula* spp.) at the 2.0 and 4.0 kg a.i./ha dosages.

Improved Field Performance

On fine-textured soils site preparation with hexazinone significantly improved the field performance of both stock types during the first five growing seasons (Fig. 2). These results apply to seedlings planted within 4 weeks of chemical site preparation and to those planted 1 year after chemical site preparation. Total heights and average stem diameters at ground level were significantly higher in the chemical treatments than in the nonchemical, control treatments (Table 3).

Height Gains Improved With Time

For each stock type and time of planting, the difference in total height between chemical and nonchemical treatments increased between the third and fifth growing seasons.

Crop Tree Mortality

For seedlings planted within 4 weeks of chemical site preparation, average mortality after five growing seasons was higher in plots treated with 4 kg a.i./ha than in plots

Table 3. Summary of 5th-year total heights and stem diameters, expressed as a percentage of the value for the treatment with no chemical site preparation.

Nominal application rate (kg a.i./ha)	Total height[a]		Stem diameter[a]	
	Bareroot	Paperpot	Bareroot	Paperpot
Planted same year as chemical site preparation				
0	100	100	100	100
2	129	137	152	162
4	135	146	176	192
Planted 1 year after chemical site preparation				
0	100	100	100	100
2	138	169	131	165
4	143	188	178	270

[a] For each stock type, values were expressed as a percentage of the control values (=100).

Figure 2. Black spruce transplants, five growing seasons after planting, illustrating differences in shoot form between trees grown among raspberry and other competing species (top) and trees grown in the open (bottom).

treated with lower dosages. In this treatment, mortality was higher than in the nonchemical treatment: 7 and 15% higher for transplants and paperpots, respectively.

Bareroot transplants were more tolerant of the high application rate than were paperpots. One explanation for this differenial tolerance is that paperpot roots were closer to the soil surface than roots of bareroot seedlings. Consequently, hexazinone uptake by paperpot seedlings may have been greater. Other possible explanations include initial differences in stock size and physiological differences (e.g., dormant, cool-stored transplant stock versus flushed paperpot seedlings) at the time of planting.

When planted 1 year after chemical site preparation, both stock types tolerated hexazinone up to the maximum dosages applied. In several instances, survival was improved by the herbicide application.

Frost heaving is a major cause of tree seedling mortality in areas with below-freezing temperatures, adequate soil water and soils that are susceptible to heaving (Heidmann 1976). More frost heaving was observed on the plots with better weed control than on the plots with poorer weed control. Residual vegetation can moderate temperature fluctuations at the soil surface and thereby protect young crop trees from late-spring or early-fall frosts (Graber 1971, Sutton 1984).

CONCLUSIONS AND RECOMMENDATIONS

Herbicides offer a number of potential advantages over other site-preparation methods: they are often less expensive than mechanical site preparation or burning; they result in less soil disturbance and compaction; they do not remove or concentrate a site's nutrient capital; and they can be quickly applied over large areas and used in rough terrain (cf. Newton 1975, MacKasey 1983, Corns 1988). This study suggests that certain forms of mechanical site preparation can be replaced or supplemented with herbicides on upland boreal sites with fine-textured soils.

The forest manager must consider several factors in using herbicides such as hexazinone in site preparation. The amount and type of debris remaining on the site after harvest, the soil texture, and the depth of the organic layer will influence the practicality of using only chemical site preparation. As illustrated by this study, the choice of application rate, planting stock and amount of time between application and planting will affect the field performance and survival of outplanted seedlings.

The results from this study only apply to fine-textured soils. Haxazinone is not registered for use on coarse-textured soils because of concerns about leaching and conifer intolerance. In this study, application at the 2 kg a.i./ha level contributed to better field performance values than in nonchemical treatments. Thuş, application of hexazinone at 2 kg a.i./ ha and planting as soon as practicable afterwards will enable crop trees to take maximum advantage of the weed control.

However, the forest manager must realize that the initial weed control will not be as complete nor the residual weed control as prolonged as with the 4 kg a.i./ha dosage.

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