Frontline

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BIOLOGICAL FACTORS USED TO SELECT MECHANICAL SITE PREPARATION EQUIPMENT

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CATEGORY: Site preparation
KEY WORDS: Black spruce, site preparation equipment, microsite, microclimate, FEC, V-types

INTRODUCTION

Postharvest site preparation is a key step in the overall silvicultural planning cycle that consists of harvesting, site preparation, reforestation, and stand tending. A guide to assist in choosing mechanical site preparation equipment for northwestern Ontario conditions is now being published by the Canadian Forest Service.[1] The purpose of this guide is to assist forest managers with the selection and proper use of mechanical site preparation equipment so as to produce an acceptable environment for seed germination and for seedling establishment, growth, and survival.

The guide is divided into three sections. Section A summarizes the microclimatic variables important to the biological requirements for seed germination and seedling growth (Fig. 1). It also outlines the positive and negative effects of mechanical site preparation on each variable. In Section B, results of mechanical site preparation are divided into categories and defined. Schematic, cross-sectional profiles of typical categories of mechanical site preparation are used to depict recommended and nonrecommended planting and seeding positions. The categories are matched with tree species' requirements for the four principal conifer crop trees in northwestern Ontario: black spruce (*Picea mariana* [Mill.] B.S.P.), white spruce (*P. glauca* [Moench] Voss), jack pine (*Pinus banksiana* Lamb.), and red pine (*P. resinosa* Ait.). A pre- and posttreatment photo-series of typical site preparation case studies from across northwestern Ontario is presented in Section C. It is organized according to the northwestern Ontario Forest Ecosystem Classification vegetation types (FEC V-types)(Sims et al. 1989) and treatment units (Racey et al. 1989). Using black spruce examples of seeding and planting that relate to mechanical site preparation, this technical note provides highlights from each of the sections.

BIOLOGICAL REQUIREMENTS OF SITE PREPARATION

The goal of site preparation is to create an environment or microsite that favors crop tree performance. This includes successful seed germination as well as seedling survival,

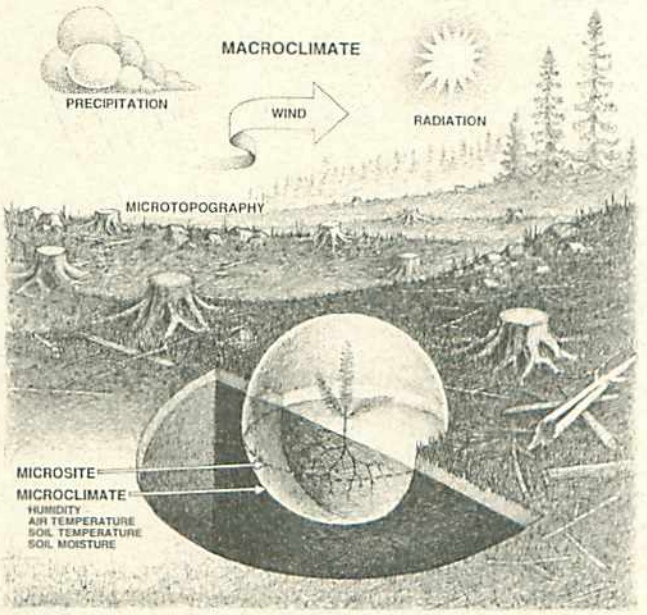

Figure 1. The seedling environment in a typical cutover.

[1]Sutherland, B.J.; Foreman, F.F. (In prep.) Guide to the use of mechanical site preparation equipment. Nat. Resour. Can., Canadian Forest Service–Ontario, Sault Ste. Marie, ON.

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establishment, and rapid early growth. Macro- and microclimatic and microtopographic factors are responsible for this environment. Microclimate fluctuations depend on weather conditions, terrain, vegetation cover, and soil properties (Caborn 1973). Microclimate and soil nutrients are the factors most likely to be influenced by site preparation.

Key Factors Affecting Survival and Growth of Regeneration

Improving a forest environment for regeneration by mechanical site preparation is accomplished by relieving the constraints to seed or seedling establishment and performance. Fleming (1990) identified near-surface and root-zone moisture deficits, and low surface and soil subsurface temperatures, as major constraints on many upland black spruce cutovers. Other stresses registered by seedlings reflect imbalances and/or extremes in light, nutrients, and soil or atmospheric chemistry (Levitt 1980). Microclimatic components that can constrain seed or seedling establishment and/or performance, and that can be influenced by the site preparation technique used, are soil moisture, soil temperature, air temperature, and light. Included also are soil fertility, thickness of the unincorporated organic layer (humus, LFH, duff or peat layers), and the biotic variables of harvest residue and noncrop vegetation.

SITE PREPARATION MICROSITE CATEGORIES FOR BLACK SPRUCE

A series of schematic profile diagrams are used in the site preparation guide to represent the microsite categories most commonly produced by mechanical site preparation equipment (i.e., screefing, inverting, and trenching) in northwestern Ontario. The purpose of these diagrams is to assist the user in prescribing biologically appropriate mechanical site preparation under a variety of site and soil conditions. Screefing for black spruce seeding on upland sites with moist deep sands and coarse or fine loamy soils, for example, is represented in Figure 2. Summary notes indicate recommended and nonrecommended positions on a profile for regeneration by seeding or planting. The notes summarize relevant literature as well as experience-based opinion solicited from industry and government silviculturists from across northwestern Ontario.

Black spruce (seeding) — Deep sands and coarse or fine loams – moist

Sample tools: Barrel drags (heavy or light, with or without anchor chains and/or tractor pads, depending on surface conditions), disc or cone trenchers, spot scalping (e.g., Bräcke), Young's teeth, blades, and plows. Slopes may erode after treatment with inverting or trenching equipment.

Note: For seeding, it is best to provide numerous microniches with small depressions, microhummocks, and hollows. Survival increases where slash and light vegetation cover provide partial shade to reduce evaporation and ameliorate seedbed temperature.

① Seed 5 cm above to 10 cm below the mineral/organic interface. This includes the H, Hi, Ah, F, Ae, and upper B horizons or any mixture thereof, and pioneer mosses (e.g., *Polytrichum, Pohlia, Ceratadon*).

② Seeding on moist sites, F and H horizons <5 cm above the mineral/organic interface, gives the best results.

③ Seeding on drier sites, mineral soil <10 cm below the mineral/organic interface, gives the best results.

④ Don't seed in depressions (areas with microrelief >10 cm below the mineral/organic interface); cold air often ponds here, subjecting seedlings to low soil temperatures, frosting or frost heaving; and flooding.

⑤ Don't seed on loose, coarse mixtures of mineral and organic material, logging debris, or loose uncompacted feathermoss. These are prone to desiccation.

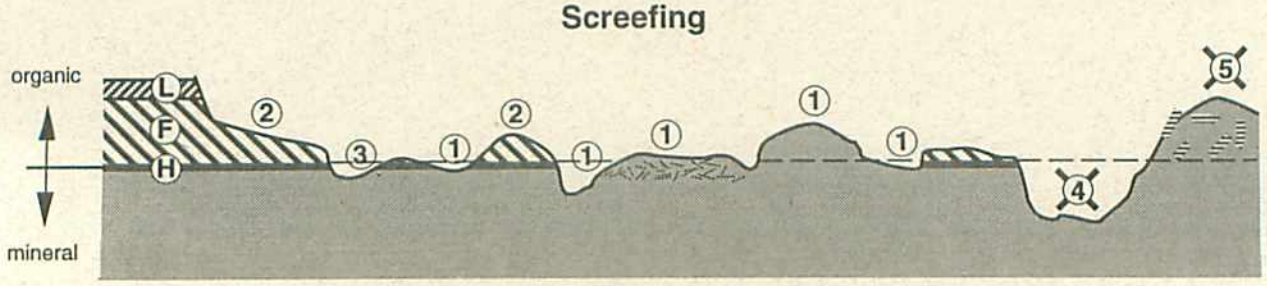


Figure 2. Schematic profile diagram for screefing.

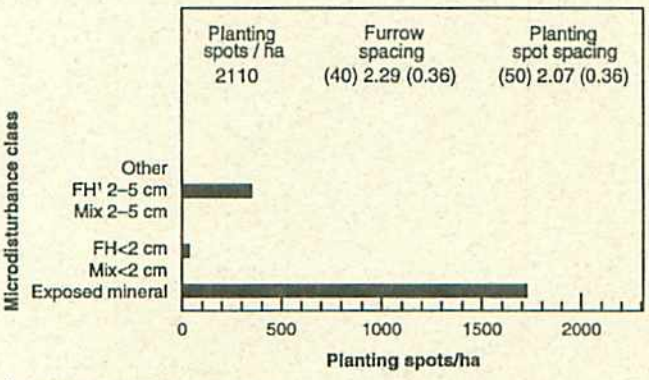
PHOTO-SERIES OF MECHANICAL SITE PREPARATION TREATMENTS

The process of selecting site preparation options is not limited to the biological considerations described in the guide. In fact, nonbiological factors (e.g., economics or limitations to the use of certain site preparation methods) can have a significant impact on the final selection of site preparation treatments. During 1990 and 1991, plots were established across northwestern Ontario to document the quality and quantity of microsites produced. Color photographs, measurements, and subjective descriptions of representative examples of postharvest conditions were taken prior to and after mechanical site preparation treatments.

Of the 48 plots established, 24 of the 38 FEC V-types and 10 of the 11 treatment units were sampled. Of these, 15 plots were located on either black spruce mixedwood or black spruce/jack pine upland V-types and two plots were located on lowland black spruce V-types.

Figure 3a shows a cutover following harvesting; Figure 3b shows a portion of the same area immediately after site preparation. The information presented in the guide includes data gathered on: woody residue left on the site after harvesting; residual trees; stumps; and ground roughness classes by type of obstacle. Technical information relating to the site, for both planting and direct seeding options, is given in Figures 4a and 4b.

Figure 3a. General view of a cutover on a V32 (jack pine–black spruce / ericaceous shrub / feathermoss) site, Treatment Unit E, and 3b, close-up of a scarification furrow created by a Donaren 180 disc trencher.



[1]Fermentation and humus layer.

Figure 4a. Plantability of a V32 cutover site, showing the number of planting spots created by a specific scarification tool on this FEC type.

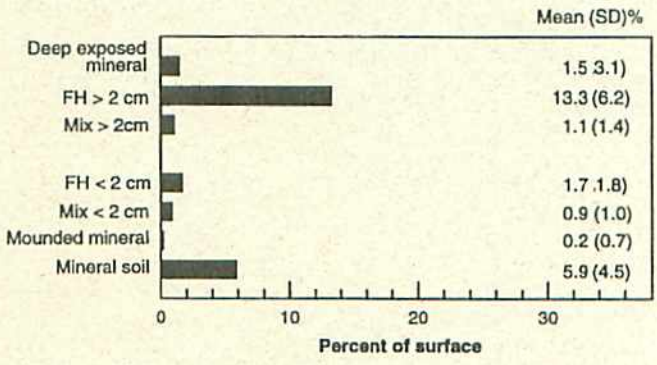


Figure 4b. Potential seedbed area (%) on the same site by microdisturbance class.

MANAGEMENT APPLICATIONS

The site preparation guide provides users with the biological rationale for mechanical site preparation and documents examples of current operational site preparation treatments in northwestern Ontario. The examples shown highlight present trends in site preparation treatments and provide insights to an important and widely used silvicultural activity. Additional sampling under other site conditions and harvesting methods in northeastern and north central Ontario would augment the data and enable further refinement to site preparation methods and choices.

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