STRIP THINNING OF JUVENILE LODGEPOLE PINE

USING THE BRUSH HOG

SX 86406C

CARIBOO FOREST REGION

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INTRODUCTION

Overstocked stands of lodgepole pine natural regeneration that result from logging or wildfire require density control at an early stage in stand development to become merchantable in size by rotation age. These stands can be either juvenile spaced, where crop tree quality and age are expected to allow for post-spacing release from intra-specific competition, or rehabilitated, if the stand's present condition based on its excessive density has regressed to the point where a satisfactory level of release cannot be expected. The Cariboo Forest Region has large areas of such lodgepole pine stands which require either spacing or rehabilitation. At this time, an exact number of hectares is not known, but experience in each of the five Forest Districts indicates that a major effort is required to treat these stands and thereby allow stand development to more adequately reflect site productivity potential.

This Silviculture Trial was designed to test the Justco Brush Hog for strip thinning an overdense lodgepole pine stand, where stem quality, a low level of pest incidence, stand age and stand density were desirable for a density control treatment. This was set up as an operational stand tending project under FRDA funding; however, it was designed to test the Brush Hog for further operational use and has therefore been established as a Silviculture Trial.
OBJECTIVES

1. To operationally test and monitor the Brush Hog for strip thinning of juvenile lodgepole pine stands, using a variety of cut and leave strip regimes.

2. To compare the costs of handspacing alone with Brush Hog strip thinning followed by handspacing of the leave strips.

MACHINE DESCRIPTION

The Brush Hog is relatively small in size when compared with strip thinning machines designed and tested prior to its inception. Overall length is 5.1 m and machine width is 1.4 m. The two front-mounted rotating cutter heads have a total cutting width of 1.7 m, and each is a 61 cm - diameter flywheel with two free-swinging, double-edged steel blades. The prime mover is rubber-tracked. Appendix I gives more specific technical information.

TREATMENT AREA

The cutblock selected for treatment is located in the Horsefly Forest District at 446 km on the Moffat Lake Road. The nearest geographic feature is McIntosh Lake, approximately 2.5 km to the west. The block's tenure is A07050, CP N, Blk.1, and the block was logged in 1974-75 with a feller buncher. No silviculture treatment followed.

Block 1 is a zonal site in the SBSb biogeoclimatic subzone with well-drained, sandy loam soil and an inventory site classification of medium. Aspect is south, slope averages 5%, and slash and brush are low. The stand is 100% lodgepole pine, with 10,958 stems/ha under one metre in height and 9,583 stems/ha in the 0-5.0 cm diameter class. Total density is 20,541 stems/ha, of which 208 stems/ha (approximately 10%) are unacceptable due to form or the presence of western gall rust, needle cast or squirrel damage. The stand has 100% stocking, is generally very healthy, and is in good condition, other than the factor of pre-treatment density.

TIME OF TREATMENT

The strip thinning was undertaken from May 6 to July 6, 1986. The weather was unseasonably cool in May, with several minor overnight snowfalls, followed by two weeks of hot, dry weather at the end of May and beginning of June. Temperatures then dropped and rainfall increased for the remainder of the project.

CUT AND LEAVE STRIP REGIMES

Numerous options for strip widths are possible, which will affect the economic and biological effectiveness of the strip thinning treatment. The most suitable leave strip width is not known for this type of stand in the SBSb subzone, and therefore, a variety of leave strip widths were created with different objectives. Cut strip width is more closely dictated by the cutting width of the machine, but double passes were used in this trial to satisfy a variety of objectives.

Table 1 lists the cut and leave strip regimes undertaken in this trial. A map showing the exact location of these treatment is included in Appendix II.
<table>
<thead>
<tr>
<th>Cut strip Width</th>
<th>Leave strip Width</th>
<th>Comments</th>
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</thead>
</table>
| 1.7m (machine width) | 3m | - helped to familiarize operator with 3m leave strip.  
- live limbs remaining in cut strips were later cut with brushesaws. |
| 1.7m | 2m | - double pass of cut strip to remove live limbs remaining after one pass. |
| 1.7m | 2m | - single pass with monitoring of live limbs. |
| 2.5-3m | 1-1.5m | - adjacent double cut strip  
- narrow leave strip to reduce subsequent handspacing. |
| 1.7m | .5m | - overlapping double pass of cut strip.  
- very narrow leave strip to further minimize handspacing. |
| 1.7m | 1-2m | - overlapping double pass of cut strip.  
- straight strips not required in order to favour leaving taller, thriftier pine. |
| 1.7m | .5-1m | - combination of above two treatments: narrow leave strip not required to be straight in order to leave better stems and avoid creating voids. |
| 1.7m | 3m x 3m | - cross hatching |
| 1.7m | 1.5m x 3m | - cross hatching |
MACHINE EFFECTIVENESS

The Brush Hog is an innovative machine that was designed in response to Silvicultural treatment needs. Almost two hundred hours of machine time for this project have yielded a considerable amount of information regarding the capability of the Brush Hog for further operational use. This machine has several distinct advantages and disadvantages which are summarized in Table 2 and discussed below.

Table 2 - Summary of Brush Hog Suitability Following Operational Use in the Cariboo Forest Region

<table>
<thead>
<tr>
<th>I. Advantages</th>
<th>II. Disadvantages</th>
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<td>1. Narrow cut strip width</td>
<td>1. Live limbs left in cut strips</td>
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<td>2. Negligible damage to leave strip edge trees</td>
<td>2. Cannot easily negotiate stumps and slash</td>
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<td>3. Low ground pressure</td>
<td>3. Excessive initial downtime</td>
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<td>4. Mulches cut strip material</td>
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Discussion

I-1 Narrow cut strip width - One of the most obvious benefits of the Brush Hog's design is its narrow cutting width of 1.7m, which may increase slightly by .1-.2m when the machine is tilted over slash or stumps. The narrow cut strip width allows for greater crop tree selectivity when handspacing the leave strips, rather than requiring that only edge trees can be selected in order to satisfy inter-tree spacing. Adjacent double passes have also been included in this trial to compare the effectiveness of single and double pass widths with respect to future handspacing.

I-2 Negligible damage to leave strip edge trees - Strip thinning machines used in the Cariboo Forest Region have typically caused much damage to the edge trees of the leave strips; however, only a few infrequent examples of edge tree damage were noted over the entire treated block. The Brush Hog's forward shroud creates clean lines of the cut strip edges in a dense stand and eliminates handcutting of damaged edge trees.

I-3 Low ground pressure - The Brush Hog's rubber-tracked prime mover gives it high floatation and greater application over spongy ground. This feature was not tested in the block, as the ground was fairly dry. Only some standing water resulting from spring thawing was present and it was wisely circumvented when it interrupted a cut strip.

I-4 Mulches cut strip material - The mulching by the cutter heads leaves an even covering of needles and chips in the cut strips, with no slash or fire hazard. The mulching process as the machine progresses creates a potential hazard to any nearby spectators, since the chips fly out from the cutter head with considerable velocity for up to 30m.
II-1 Live limbs left in cut strips - A general requirement of strip thinning machinery is that it cut low enough to the ground that all branches are removed. Despite the high pretreatment density in this stand of over 20,000 stems/ha, many trees had live branches almost to the ground. It would be unreasonable to expect a machine to cut right to the ground without becoming seriously damaged whenever it hit a rock or stump. Consequently, many live limbs remain in the cut strips, although whether or not they will survive is the more important factor. The largest stems left in the cut strip from a single pass treatment resulted from the small space between the two cutter heads. These stems often lost the leader and many branches, but are likely to survive despite the high amount of damage they endured.

Interim data from FERIO showed that average stump height was 14 cm where no branches remained, 31 cm where the stump did have branches remaining, and that each stump had an average of 2.8 branches. The single pass treatment had twenty live limbs marked and assessed for level of damage, and number of remaining branches. A prediction was also recorded on whether or not that stem will survive based on the number of live limbs, the proportion of healthy needles on each branch, and the degree of shattering in each stem caused by the cutter heads.

II-2 Stumps and slash - The Brush Hog's small size presents a problem when it must negotiate stumps and slash. Although the treated block had low stumps left from feller buncher logging, it was decided after the initial start-up that each stump or any slash in a cut strip would have to be further reduced with a chain saw prior to the passing through of the Brush Hog. This necessity increased the treatment cost per hectare and may not be feasible for extensive operational use.

II-3 Excessive initial downtime - The Brush Hog has had limited operational use and is still at the prototype stage; therefore, interruptions in use due to breakdowns and the need for modification are to be expected. Problems encountered during this project centred mainly on the cutter heads, tracks, and tires. Some improvements in design have been made and are expected to alleviate future breakdown problems significantly.

COSTS

The total area of the treated block is approximately 40 ha and all but a 1-2 ha portion at the southeast end of the block was strip thinned. The cost of the treatment was $25,980.00, for a per hectare cost of $649.50, if the cross hatching treatment can be assumed to compensate for the untreated portion.

The north end of the strip thinned block was juvenile spaced by hand in Fall 1985 by a FWAP crew. Cost for this treatment was approximately $600/ha, but contracting this work to an experienced crew would likely cost only about $300/ha.

Using $650/ha for the strip thinning plus an additional $200/ha (estimated - could be as high as $300/ha) to handspace the leave strips results in a total cost of $850/ha. Quite clearly, costs for strip thinning with the Brush Hog must significantly decline if the Brush Hog is to become a competitive option for density control.
TREATMENT EFFECTIVENESS

The value of strip thinning as a density control treatment, alone or in conjunction with hand spacing, has been a highly discussable topic among foresters. The two main areas of concern are degree of selectivity remaining in leave strips for crop tree selection and cost.

The stand treated in this trial had 100% stocking, although stocking itself was quite clumpy with random voids scattered throughout. Crop tree potential in the leave strips does not appear to have suffered from such an arbitrary treatment as strip thinning. This does not hold for either of the cross hatching regimes (3m x 3m and 3m x 1.5m leave blocks), as too many stems have been removed without regard for crop tree quality, and many voids and unsuitable crop trees now remain.

Cost is a much easier factor to assess, and a comparison of handspacing alone with strip thinning using the Brush Hog followed by handspacing currently shows a single handspacing treatment to be far more cost effective. Continued use of the Brush Hog will undoubtedly lower the cost per hectare to operate it, but until the sum of that cost and the subsequent handspacing cost are equal to or lower than the cost of handspacing alone, the Brush Hog cannot extensively be used operationally for density control treatments. It will be necessary to accurately determine the effect of leave strip width on costs per hectare for strip thinning and for the handspacing treatment to follow, in order to establish the cut and leave strip regime that is the most cost-effective and best-suited to a site.

RECOMMENDATIONS

1. The Brush Hog should be tested for other silvicultural treatments in the Interior, such as brushing and weeding in plantations and site rehabilitation. These projects should also be established as Silviculture Trials.

2. The feasibility of strip thinning for density control should be investigated by the Silviculture Branch to establish whether or not mechanized strip thinning is a biologically desirable and cost-effective treatment, and to recommend that future machine testing be continued or abandoned.
WE SPECIALIZE IN JUVENILE SPACING, SITE PREPARATION, BRUSH CUTTING, AND VEGETATION CONTROL, COMPATIBLE WITH OUR ENVIRONMENT FOR THE FOREST OF THE FUTURE.
Justco Brush Hog Specifications:

**Prototype**
Designed for juvenile spacing, pre-commercial thinning, and slash treatment.

**Prime Mover:** Tracked machine with rubber treads.

**Power:** Chrysler T-120, 300 ci industrial gas motor
rated 122 HP @ 2800 rpm.

**Transmission:** Manual, 8 speed.

**Length:** 16 ft. 8 in. overall. (5.1 m)

**Width:** 4 ft. 6 in. (1.4 m)

**Weight:** 6798 lbs.

**PSI:** 3.48

**Cutter:** Width - 5 ft. 6 in. (1.7 m)

Direct drive hydraulic pump feeding two vertical mounted 18 HP hydraulic motors powering two 24 in.
flywheels each carrying two free swinging double edged, spring steel blades at 1500 rpm.

Cutters mounted in cover shroud for maximum protection of seedling and leave trees.

Each cutter independently controlled to rotate clockwise or counter clockwise.

**Ground Speed:** 5 mph in average operating conditions.

Maximum grade: 30 to 35%.

**Working Material:** 1 1/4 in. to 6 in. diameter.
The Justco Brush Hog moves in on a thirty foot cottonwood tree with a 6" diameter butt.

Brush Hog reduces tree and brush to small debris.

The Justco Brush Hog carries two hydraulic-powered cutting wheels which can economically precommercial thin or clear-cut trees up to six inches in diameter. This machine is the most effective method of handling willow, alder, and other types of undergrowth.

The Justco Brush Hog offers significant environmental advantages, by eliminating the unsightly appearance and potential fire hazard resulting from leaving stacked slash on the ground.

JUSTCO TIMBER SERVICE

Justin (Dusty) O'reg
CONSULTANT

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3 m. leave strips with 1.7 m. wide cut strips