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CORRIDOR RAKING: AN ALTERNATIVE METHOD OF SITE PREPARATION

INTRODUCTION

In Nova Scotia brush-raking followed by burning is one of the most common methods of preparing sites for planting. However, due to rising costs and the potential negative impact on productivity of removing slash from forest sites, alternative methods are being developed. This report summarizes the results of a trial to determine the productivity and effectiveness of one of these methods: corridor raking.

METHODS

This study involved a corridor raking treatment conducted at 6 sites, during the months of August and November 1990. Prior to treatment, the slash and ground conditions were assessed at each site. During the trial a time study was carried out, and following raking, a survey was conducted to determine the percentage of plantable area, width of slash piles and area site prepared.

SITE PREPARATION PROCEDURES

Corridor-raking uses a skidder brush-rake combination to create site prepared corridors. The corridors are formed by the forward motion of the machine and rake moving through the slash. Therefore the corridors are generally as wide as the rake. As slash accumulates in front of the rake, the operator pushes-off to one side to clear it. This action creates a non-site prepared strip made up of alternating areas of small slash piles and unraked slash (Figure 1). In corridor raking, the operator spends the majority of working time in forward motion. This is in sharp contrast to conventional brush raking where a considerable portion of working time is spent backing up (Dunnigan and Cormier, 1988).

In this study, the equipment used at 5 of the 6 sites was a 380 Timberjack® equipped with 3.0 m wide 5-tooth Raumfix® brush rake (the fourth tooth was missing). A Ranger® 67-F

® Timberjack - Timberjack Inc.
® Raumfix - Hans Wahlers
® Ranger - Valmet Logging Inc.

Canada

Nova Scotia

equipped with a 3.0 m wide Raumfix (5-tooth) was used at Lower Harmony. The same operator was used at four of the sites (Killag, Maple Grove, Georgefield, and Cooks Brook) whereas different operators were used at Lower Harmony and Little River. Each of the operators were experienced in conventional brush-raking, but had never attempted corridor raking before. Following instructions, the operators were given approximately 2 hours to familiarize themselves with the treatment. Attention was directed towards minimizing the width of the slash piles and proper push-off procedures. To limit the width of the non-site prepared strips, operators pushed away from the previously raked corridors. To avoid forming a mound of slash at the ends of the rows, the operators were instructed to clear their rakes before reaching the end of each corridor.

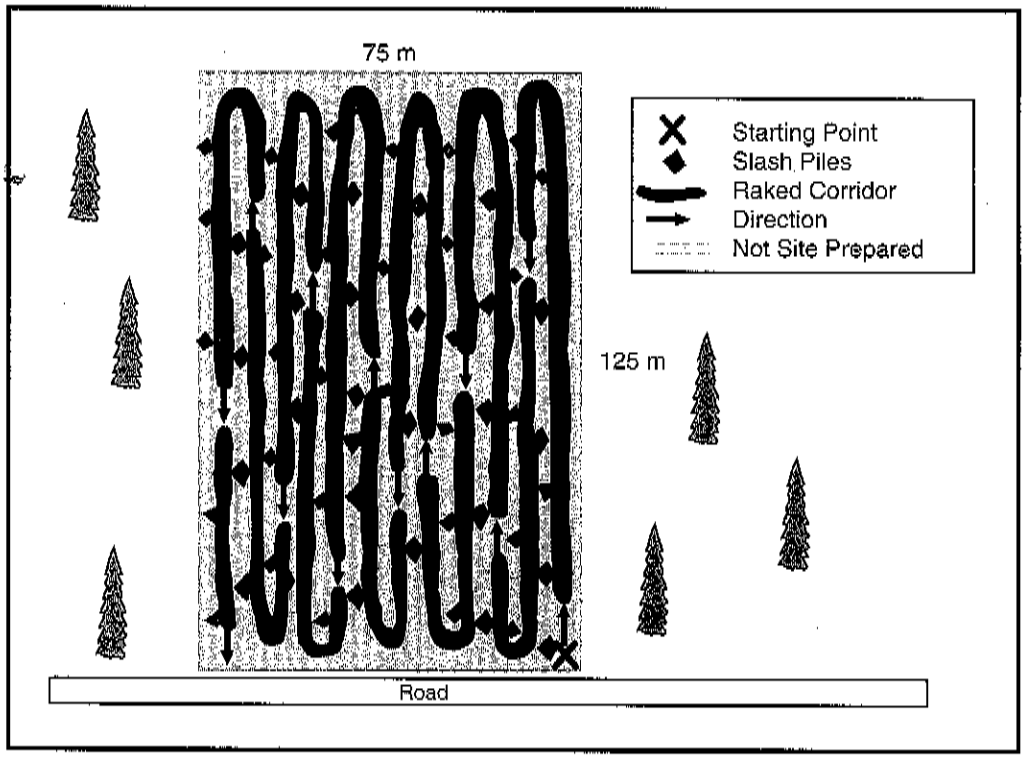

Figure 1. Schematic showing typical corridor raking layout.

DATA COLLECTION

Pre-treatment stand characteristics

To determine the overall slash and site conditions at each location, an assessment was conducted prior to corridor raking. This assessment was carried out by establishing 20 plots, equally spaced, within the area to be treated. Slash depth, diameter, height and load, as well as duff thickness and stump height were measured at each plot.

Time study

The time study consisted of continuous timing of both total and productive operating time, excluding training time. Productive time was defined as the proportion of scheduled time that the skidder and brush rake were engaged in site preparation. Productivity (hectares/hour) was determined by dividing the area of the treatment block by the productive work time.

Plantability assessment

Plantability (opportunities for planting) assessments were conducted on 3 of the sites, prior to and following site preparation. At Killag and Lower Harmony, only post assessments were completed. No assessments were conducted at Little River. The pre-treatment survey was conducted by establishing two 100 metre lines at each site and assessing the plantability of microsites at 1.8 m intervals. Each assessment location was considered

plantable if an acceptable microsite was found within +/- 0.5 m of the preselected spacing of 1.8 m. Planting ease and the reason for a microsite being classified as not plantable were also recorded. The percent not plantable as well as those classified easy, moderate and difficult to plant were calculated as a proportion of the total number of microsites, excluding those sites not plantable for reasons other than slash. This was determined as follows:

$$\% \text{ Easy} = \frac{\text{Easy}}{\text{Plantable} + \text{Slash}} \times 100$$

$$\% \text{ Moderate} = \frac{\text{Moderate}}{\text{Plantable} + \text{Slash}} \times 100$$

$$\% \text{ Difficult} = \frac{\text{Difficult}}{\text{Plantable} + \text{Slash}} \times 100$$

$$\% \text{ Plantable} = \frac{\text{Plantable}}{\text{Plantable} + \text{Slash}} \times 100$$

$$\% \text{ Not Plantable} = \frac{\text{Slash}}{\text{Plantable} + \text{Slash}} \times 100$$

Where,

Easy = The number of microsites rated easy to plant.

Moderate = The number of microsites rated moderately difficult to plant.

Difficult = The number of microsites rated difficult to plant.

Plantable = The total number of microsites rated plantable.
= Easy + Moderate + Difficult.

Slash = The number of microsites not plantable due to slash conditions.

Post-treatment assessments were conducted by walking along the edge of a slash row and assessing the plantability of microsites at 1.8 m intervals. At each interval, a tape measure was extended 3.6 m (2 x 1.8 metres) at right angles to the direction of travel in order to assess planting spots in the middle of the corridor and in the adjacent slash row. Plantability was assessed in the same manner as for the pre-treatment.

A more direct estimate of plantability will be obtained when the trial sites are planted. At this time, planting productivity will be determined by block.

The percentage of each area that was site prepared was determined by measuring the width of each corridor and slash row along an assessment line perpendicular to the corridors.

SITE DESCRIPTION

Table 1 shows site and slash conditions for the 6 study sites. Two of the locations, Killag Mines and Cooks Brook, had been harvested within 3 months of the trial, therefore the slash was fresh and green. At the remaining sites, harvesting took place 2 years before the trial. On these sites, the slash was dry and brittle. At Killag Mines, the mixedwood stand was shortwood harvested with chain-saws, whereas at Cooks Brook the softwood stand was shortwood harvested with a single-grip harvester. The harvester processed the trees at the stump, thereby creating small piles of slash approximately 1 metre high scattered over the site. The remaining 4 sites (Maple Grove, Georgefield, Lower Harmony and Little River) supported mixedwood stands prior to harvesting with chain saws. At Georgefield, the stand was harvested by processing the softwood full-tree and the hardwood tree length. The slash left on site consisted of hardwood tops and branches, and unmerchantable trees. At Maple Grove the softwood was harvested tree-length and the hardwood shortwood. At Lower Harmony and Little River, the stands were harvested shortwood.

Slash loading over the 6 sites ranged from light to moderate. Slash loading was heaviest for the recent clearcuts, that were shortwood harvested (eg. Cooks Brook). At the other extreme, slash was lightest on the sites left 2 years (e.g. Maple Grove).

Table 1. Average stand conditions prior to treatmeant.

Location	Area (ha)	Slash Depth (cm)	Duff Depth (cm)	Stump Height (cm)	Slash Diameter[1] (cm)	Pre-Harvest Covertype	Slash		Harvest		
							Condition[2]	Load[2]	Date[3]	System[4]	Equipment
Killag Mines[5] (Halifax Co.)	2.1	90	9	25	2-5	Mixedwood 50% SW, 50% HW	Fresh/green	Moderate	Summer '90	SHW	Chainsaw
Maple Grove (Hants Co.)	2.0	25	12	29	3-5	Mixedwood 50% SW, 50% HW	Dry/brittle	Light	Winter '88	TL, SW SHW, HW	Chainsaw
Georgefield (Hants Co.)	2.0	27	8	25	2-4	Mixedwood 30% SW, 70% HW	Dry/brittle	Light-Mod.	Winter '88	FT, SW TL, HW	Chainsaw
Cooks Brook (Halifax Co.)	2.0	32	7	22	2-5	Softwood 80% SW, 20% HW	Fresh/green	Moderate	Summer '90	SHW	Mechanical Harvester
Lower Harmony (Col. Co.)	4.2	41	11	20	2-4	Mixedwood 40% SW, 60% HW	Dry/brittle	Light-Mod.	Winter '88	SHW	Chainsaw
Little River (Cumb. Co.)	5.3	42	9	28	2-5	Mixedwood 30% SW, 70% HW	Dry/brittle	Light-Mod.	Winter '88	SHW	Chainsaw

1. Average diameter of slash
2. Slash load as a description of slash conditions based on depth, volume and type (light; moderate;mod. heavy)
3. Season and year of harvest (ie. '90 is 1990)
4. Method of harvesting (SHW: shortwood; FT: full tree; TL: tree length; SW: softwood; HW: hardwood)
5. Trial was conducted by Forestry Canada.

RESULTS

PLANTABILITY

The results of the plantability assessment showed that on average, 90% and 75% of the site prepared corridors and slash rows respectively could be planted (Table 2). The slash piles in the non-site prepared strips averaged

Table 2. Plantability (pre & post raking), production and post site conditions by location.

Location	% Plantability[1]				Productivity[4]		Post Rake Conditions	
	Pre	Post					Slash Row Width (m)[5]	Area Site Prepared[5] (%)
	Total	Total	Slash[2]	Corridor[3]	Ha/Hr	Utilization (%)		
Killag Mines[6]	ND[7]	90	87	ND	1.01	ND	3.1	49
Maple Grove	93	84	75	88	1.50	64	2.2	58
Georgefield	99	93	83	96	1.09	98	2.6	46
Cooks Brook	82	82	68	87	1.09	88	2.8	48
Lower Harmony	ND	90	76	97	0.69	ND	2.7	47
Little River	ND	ND	ND	ND	1.01	ND	ND	ND
Average	91	86	75	90	1.07	83	2.7	50

1. Defined as an opportunity for planting (Puttock and Smith, 1987).
2. Percentage of plantable spots within the non-site prepared strip
3. Percentage of plantable spots within the site prepared strip (corridor)
4. Productivity based on productive time only. Utilization is the percentage of sheduled time the machine was engaged in site preparation.
5. Determined by measuring the width of the site prepared strip and slash row.
6. Trial conducted by Forestry Canada.
7. No data

only 2.7 m wide and 1.0 m high and occurred every 15-20 m, therefore they did not provide a serious impediment to planting. Despite this, the slash piles could provide shelter for rabbits and result in seedling browsing. The overall plantability was 86% or 2660 trees/ha at 1.8 x 1.8 m spacing. By allowing assessment locations to vary by 0.9 m (i.e 1/2 of 1.8 m) instead of 0.5 m, plantability at each of the 6 trial sites would have been greater. In Nova Scotia, the distance between planted trees is permitted to vary up to 1/2 the prescribed spacing.

Planting ease was improved at 2 of the 3 sites where a pre and post assessment was carried out. At the sites with the heaviest initial slash load, the number of planting spots rated 'easy to plant' increased (Figure 2). For example, at Cooks Brook, were the initial slash conditions were categorized as moderate, 58% of the micro sites were classified easy to plant after raking, as compared to 40% before raking.

At the other extreme, where the slash load was light (Maple Grove), the planting ease was not improved. In fact, the percentage of "easy" planting spots was lower (44 vs 42%) and the percentage of "difficult" spots higher (11 vs 19%) after corridor raking.

PRODUCTION

The major factors influencing production were slash conditions (age, type and volume) and site conditions (soil moisture). On sites where slash conditions were lightest (Maple Grove), production was highest, averaging 1.5 ha/hr (Table 2). On the freshly cut softwood sites (Killag Mines & Cooks Brook), where the slash was fresh and green and the load was heavier, production was 30% less (1.05 ha/hr). Production was lowest at Lower Harmony as a result of wet ground conditions (0.69 ha/hr) despite the slash loading being light-moderate. Productivity over all sites averaged 1.07 ha/hr.

The high production associated with this treatment is directly attributed to the fact that 1) on average only 50% of each site was treated (Table 2) and 2) the prime mover was moving forward for most of the time.

COST

The cost of corridor raking was determined using the following variables:

Costs (including profit)		($/hr)
Machine	: 380 Timberjack 135 horse-power	60
Brush rake	: 3.0 m Raumfix	10
Operators wages	: labour	15
Total		85
Productivity (ha/hr)	- Low:	0.69
	- High:	1.50
	- Average:	1.07

The Timberjack 380 and the 3.0 metre Raumfix brush rake are two of the most commonly used pieces of site preparation equipment in Nova Scotia. Based on the range of production (ha/hr) achieved during this trial, treatment costs for corridor raking (based on productive time only) could be expected to vary as outlined

Cost/Hectare = $\frac{\text{Total Cost}}{\text{Productivity}}$

Low productivity : $\frac{\$85/hr}{0.69\ ha/hr} = \$123.19/ha$

High productivity : $\frac{\$85/hr}{1.50\ ha/hr} = \$56.67/ha$

Average : $\frac{\$85/hr}{1.07\ ha/hr} = \$79.44/ha$

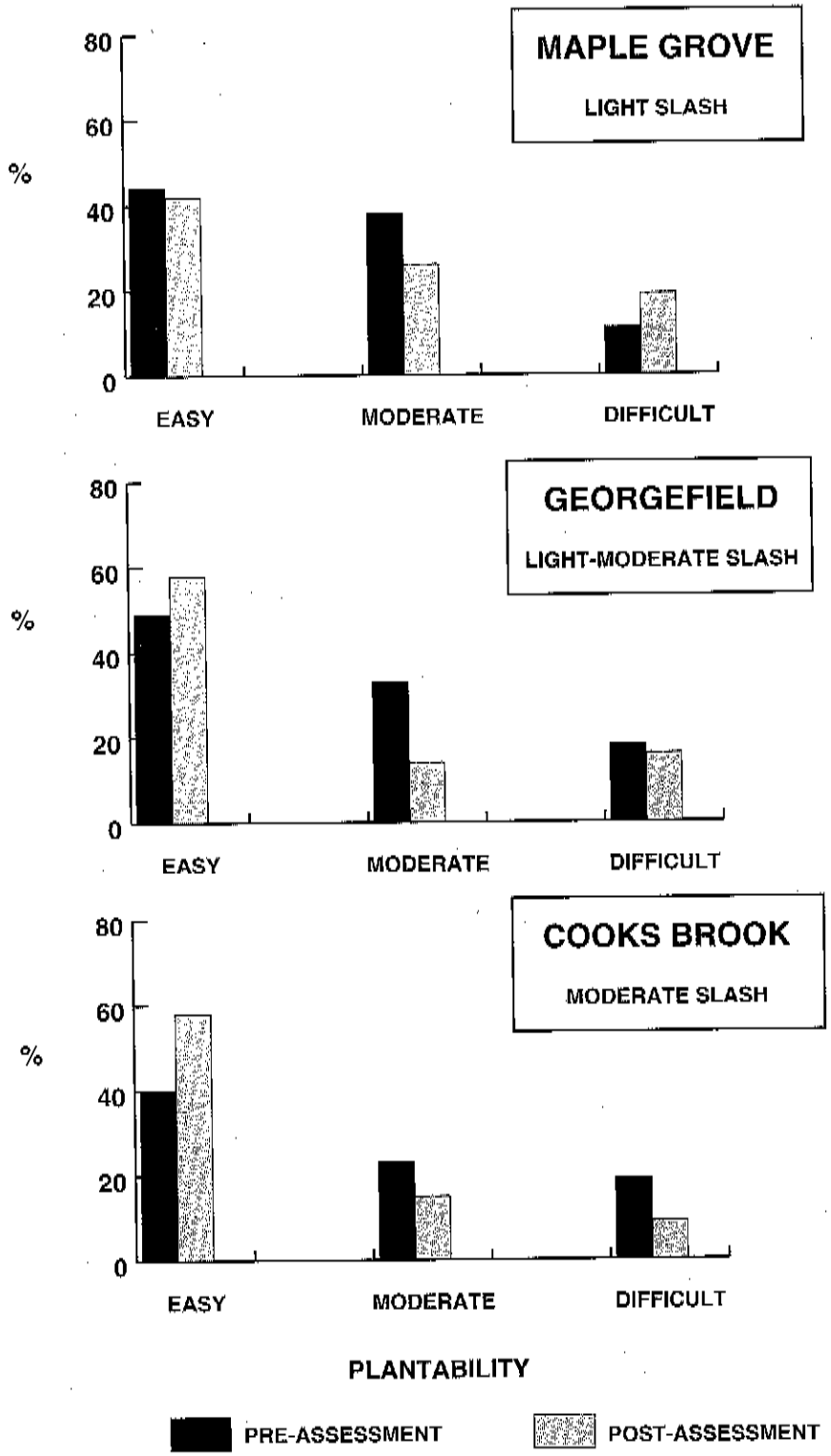

Figure 2. Pre and post planting difficulty. Planting locations categorized as not plantable for reasons other than slash were climinated from the analysis.

CONCLUSIONS

The major findings of this study to determine the productivity and effectiveness of corridor-raking as an alternative method of site preparation are as follows :

1) Average productivity over 6 locations was 1.07 ha/hr (2.63 ac/hr). Productivity ranged from 0.69 to 1.5 ha/hr. The highest productivity occurred on well drained sites with light slash conditions.
2) The width of the slash piles averaged 2.7 m whereas the height of the piles was generally 1.0 m. The percentage of area site prepared averaged 50%, but ranged from 46 to 58%.
3) The relatively high productivity of corridor raking as compared to conventional raking is due to the low percentage of area actually site prepared (50%) and the fact that the prime mover is moving forward most of the time.
4) Assessments conducted following raking showed that, within corridors, plantability averaged 90%, based on a 1.8 x 1.8 m spacing, and within the slash rows 75%. Overall, plantability was 86%.
5) Planting ease was improved at those sites where initial slash load was rated as light-moderate to moderate. It was not improved where the initial slash conditions were light.
6) The cost ($/ha) of corridor raking, based on $85/hour and an average productivity of 1.07 ha/hr was $79.44/ha. Estimated costs varied from 56.67 to $123.19 /ha, based on the range of productivity measured in this trial. All costs are based on productive time only.
7) Corridor raking should be avoided in areas with high rabbit populations.

LITERATURE CITED

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