Advantage
NOT Restricted to FERIC Members and Partners Vol. 2 No. 17 March 2001

Contents

Commercial thinning: a comparison of mechanized and manual systems in New Brunswick

Abstract

FERIC studied two commercial thinning systems under comparable conditions. The first involved manual felling, processing, and piling, whereas the second was completely mechanized and used a small single-grip harvester. Two shortwood forwarders with different payload capacities were also studied in this operation. The costs at roadside depended strongly on the hourly wages for the workers. A sensitivity analysis demonstrated that the estimated production costs for the two systems were comparable (at $22.83/m³) when the wages reached $19.22 per scheduled hour.

Keywords:

Commercial thinning, Comparative study, Mechanized method, Manual method, Cut-to-length systems, Harvesting, Extraction, Productivity, Costs.

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Introduction

The use of manual felling in a commercial thinning operation lets managers implement small-scale operations by minimizing the need to invest in specialized equipment. This approach thus facilitates getting started with thinning treatments and progressively developing operational experience. In contrast, fully mechanized commercial thinning operations can compensate for a lack of skilled manual fellers and can take place virtually year-round, thereby promoting the implementation of large-scale operations.

Figure 1. The Rocan-T single-grip harvester observed during FERIC's trials.

With the assistance of UPM-Kymmene Miramichi Incorporated (Miramichi, N.B.), FERIC compared a manual system with a fully mechanized system, both producing 2.54-m logs. The productivity of the manual felling and bucking was measured in the same stand as operations with a Rocan-T single-grip harvester. This small machine combines a farm-tractor base with a 6.5-m boom and a Pan 828 single-grip head (Figure 1). The harvester operated on a network with a single ghost trail between extraction trails spaced 24 m apart (the same spacing used for the manual work). Extraction by two forwarders with different payload capacities was also

evaluated for both situations. This report describes the advantages and disadvantages of the two systems.

Study conditions

The stand presented ideal operating conditions. It had been precommercially thinned during its juvenile phase, which explained the absence of unmerchantable softwood stems. Visibility for the operator of the harvester was excellent, and the fellers were not impeded in their movements. The terrain was firm, even, and flat (CPPA class 2.1.1), and the conditions did not differ significantly between the two study blocks. The mean stand characteristics, before and after treatment, appear in Table 1. The stems were small enough for easy handling. Before thinning, 84% of the stems fell into DBH classes ranging from 10 to 14 cm, and the prescription targeted the smallest stems, with the goal of increasing the mean residual DBH. The residual stand, composed of 80% spruce, had a good structure, with regular spacing.

Results

Felling and processing

The shift-level productivity study with five manual fellers spanned 131 hours of work (Table 2). The average felling and processing productivity, based on a tally and scale of the logs produced, was 1.7 m^3 per productive hour (PH) in the manual operation. The high productivity can be explained by the workers' experience with this treatment, the favorable log dimensions, the good terrain conditions (little brushing was required), the reasonable piling distance, and the piling of logs in two rows. At a standard wage of $14/scheduled hour (equivalent to an estimated direct operating cost of $23.50/PH), the direct wood cost was $13.82/$m^3$.

The detailed timing study of the Rocan-T's work measured a productivity of 125 stems/PMH (6.6 m^3/PMH). The operator of the harvester was experienced and benefited from the good visibility (there were few unmerchantable stems). At a direct hourly cost of $96/PMH (including

Table 1. Summary of conditions in the study stand

	Before treatment	After treatment	Diff. (%)
Density (stems/ha)	1850	950	–49
Basal area (m^2/ha)	29	18	–38
Gross merchantable volume (m^3/ha)	150	100	–33
Mean DBH (cm)	14.1	15.5	+10
Average volume (m^3/stem)	0.081	0.105	+30

Table 2. Summary of observations of the felling and processing phase (n.a. = not available)

	Manual system	Mechanized system
Study duration (PH)	131	13.4
Average volume per stem (m^3)	n.a.	0.053
Average volume per log (m^3)	0.029	0.025
Productivity		
stems/PH	n.a.	125
m^3/PH	1.7	6.6

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Publications mail #1677314 ISSN 1493-3381

$14 per scheduled hour for the operator, but excluding supervision costs, profits, transportation of the machines, and other indirect costs), the estimated wood cost was $14.33/m³. Thus, on the basis of these cost assumptions, the cost of manual felling and processing was slightly lower.

Forwarding of the processed wood

FERIC also compared the work of two shortwood forwarders: a Versatile 276 tractor (Figure 2) equipped with a Hardy 1700 boom and a Patu trailer (5-tonne capacity) and a six-wheel-drive Rottne Rapid forwarder (12-tonne capacity). Table 3 presents a summary of the performance of the two forwarders with manual or mechanized piling.

The larger forwarder was the more productive, irrespective of the system used, and its productivity with manual piling was higher than with mechanized piling. The analysis indicated that this improved performance resulted from the larger size of the manually produced log piles. As such, the small and large forwarders required 26 and 58% more time, respectively, to load the mechanically piled logs. With direct hourly costs of $57/PMH for the small forwarder and $87/PMH for the large forwarder (both are typical for the study region), the estimated extraction costs were comparable for the two machines ($5/m³) in the manual operation, and were slightly lower with the larger forwarder for the mechanically piled wood ($6.20/m³ vs $6.95/m³).

Sensitivity analysis for production costs as a function of worker wages

The production costs for the manual and fully mechanized shortwood systems depend on the productivity of each phase and on the hourly cost assumptions. The wages paid to the workers represent an essential component of these costs, along with the costs of the mechanics responsible for maintenance of the machines. The wages earned by forestry workers vary from region to region, and a sensitivity analysis can be performed to estimate how roadside production costs are affected by this variation. The production costs in Figure 3 are based

Figure 2. A shortwood forwarder built from a Versatile 276 tractor equipped with a Hardy 1700 boom and a Patu trailer.

Table 3. Summary of observations of the shortwood forwarders over a standardized extraction distance of 150 m

	Versatile-Patu-Hardy		Rottne Rapid	
Piling	Manual	Mechanized	Manual	Mechanized
Study duration (PMH)	3.5	4.1	2.0	2.4
Average volume per cycle (m³)	6.5	5.7	11.3	11.3
Productivity (m³/PMH)	11.3	8.2	17.3	14.0
Details of the work cycle				
Loading (min/cycle)	15.4	19.4	17.4	27.5
Average volume per pile (m³)	2.4	1.3	2.4	1.3
Number of grapple loads per cycle	29.3	38.0	38.7	53.3
Average volume per grapple load (m³)	0.22	0.15	0.29	0.21

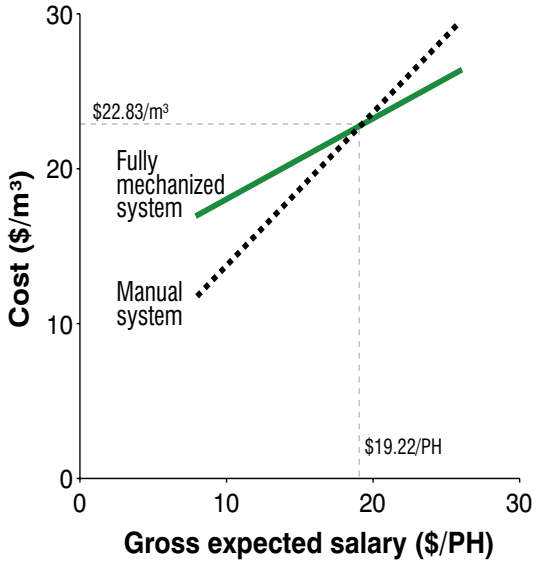

Figure 3. Relationship between production costs and the gross hourly wage for the manual and fully mechanized systems.

on the productivities reported in Tables 2 and 3. The analysis revealed that the production costs of the two systems were equal ($22.83/m³) at a gross wage of $19.22 per scheduled hour. The wages typically paid in eastern Canada fall on both sides of this threshold, which suggests that the manual approach could be more attractive in some regions than in others.

Implementation

Many factors should be considered when selecting a harvesting system for a thinning operation, starting with the scale of the operation. Contractors typically require harvest levels of more than 15 000 m³/year to justify the purchase of a single-grip harvester.

Manual teams

The scarcity of workers skilled in manual felling and processing, the remoteness of the operations, camp costs, and wages themselves all increase labor costs. In implementing a manual operation, you should plan for worker training so as to improve their productivity and meet the prescription's quality criteria.

As in the operation described in this report, you should establish a narrow spacing between extraction trails to reduce the distance workers must travel to manually pile the processed logs. Piling is much less fatiguing if the shortwood forwarder has a sufficiently long boom (for example, with a telescoping extension) that it can retrieve logs piled 5 m from the extraction trail. Favorable terrain and stand conditions can improve the well-being and stability of your workforce and thereby improve productivity. To provide employment during more of the year for teams that have developed skills in thinning work, consider planning a variety of complementary silvicultural work, such as harvesting in riparian zones or on fragile sites, performing precommercial thinning, or training the workers to operate mechanized systems as well.

Mechanized teams

The viability of mechanized operations often depends on whether you can maintain a high utilization rate for the equipment. This rate depends on the maintenance strategies you employ, on the dispersion of the stands to be treated, and on the ability to balance night work (on the extraction trails) with day work (on ghost trails). Appropriate planning can help to ensure favorable operating conditions. The time that operators need to acquire sufficient experience is critical; plan to allow some leeway for up to 12 months until operators overcome the learning curve. Small single-grip harvesters require a smaller investment than larger machines, but the latter typically have longer booms and more robust felling heads. This makes them more versatile than smaller machines. Meek (2000) presents various approaches that can guide you in mechanizing commercial thinning operations.

Acknowledgments

The author thanks the staff of UPM-Kymmene Miramichi Incorporated who participated in the study, and particularly the workers, who showed considerable patience during FERIC's presence, and the supervisors, who provided excellent control of the treatment conditions.

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