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COMMERCIAL THINNING ON DIFFICULT TERRAIN WITH THE VALMET 901C SINGLE-GRIP HARVESTER

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INTRODUCTION

In mid-December of 1998, FERIC monitored commercial thinning operations on Scierie Saguenay Ltée.'s limits approximately 70 km northeast of Chicoutimi (Que.) in the Monts Valins region. The area is noted for its variable topography (e.g., steep slopes) and in winter, heavy snowfall. The winter operation FERIC studied comprised a full-sized cut-to-length system based on a 12-tonne single-grip harvester (the Valmet 901C) and a 12.4-tonne forwarder (the Valmet 646).

SYSTEM DESCRIPTION

The Valmet 901C single-grip harvester (Figure 1) is well suited to stable operation on steep slopes and difficult terrain because its cab and compact tele-boom crane are mounted on a slew-ring platform that can tilt 22° forward, 20° backward, and 17° to either side to keep the cab level. The platform is well positioned behind the front axle to improve the weight distribution and lower the machine's center of gravity. The 110-kW engine powers a two-range hydrostatic transmission equipped with a microcomputer-based monitoring system. This system ensures that the engine power delivered to the drive train is optimally controlled under varying terrain conditions, thereby consuming less fuel and minimizing the potential for wheel slippage.

The harvester is 2.8 m wide, has a turning radius of 5.9 m, and has a ground clearance of approximately 56 cm. The 901C is equipped with Valmet's model 945 harvester head, which weighs 720 kg. The head's maximum felling diameter is 55 cm and its maximum feeding speed is 4 m/sec. The model 998 tele-boom crane (with telescoping sections) has a 9.5-m reach and 98 kN-m of lifting torque. When the crane is partially or fully extended and the parking brake is engaged, the rear axle's oscillation locks to provide additional stability. The total slewing angle (rotation) of the integral cab and boom on the slew-ring platform is 315°. Because the tele-boom is mounted at the right side of the cab, the operator has an unobstructed frontal view all the time.

The 87-kW Valmet 646 forwarder (with an 11.0-tonne payload) was equipped with a 7-m Cranab 650 boom. The forwarder (Figure 2) was 2.6 m wide. With a powershift transmission and torque converter, the machine can attain speeds up to 32 km/h.

Figure 1. The Valmet 901C harvester.

Figure 2. The Valmet 646 forwarder.

STUDY CONDITIONS

The 45- to 50-year-old stand was made up of 96% black spruce and 4% balsam fir. The soils were sandy loams on variable slopes (up to 30%), and the CPPA terrain classification was 2.3.3. Unlike the normal practice on Crown land in Quebec, where the primary objective is "thinning for quality", the prescription called for the removal of small, suppressed, poor-quality, or double stems (leaving a single stem) in the codominant class. Trees targeted for removal were selected on the basis of residual spacing (to leave residuals 2.4 to 3.0 m apart) rather than basal area, and this resulted in removal of approximately 50% of the merchantable volume. Extraction trails were opened at night and leave strips were thinned during the day. The targeted distance between the 4.2-m-wide trails was 20 m, and this allowed the harvester's long boom to effectively reach the center of the strip. Trails occupied 21% of the total area. The pre- and post-treatment stand conditions appear in Table 1.

Table 1. Pre- and post-treatment stand conditions

	Before	After	Difference (%)
Density (merch. stems/ha)	2920	1225	–58
Basal area (m^2/ha)	41.9	19.6	–53
Merch. volume (m^3/ha)	187	94	–50
Average diameter (cm)	13.5	14.3	+6
Average volume (m^3/stem)	0.064	0.077	+20

PRODUCTIVITY

FERIC monitored the operation during the day shift while the leave strips were treated. The harvester produced both 2.4- and 3.6-m lengths at a rate of 4.6 m^3/PMH. The productivity and breakdown of the work cycle time elements appear in Table 2. Based on an average forwarding distance of 150 m, the forwarder produced 8.4 m^3/PMH with an average cycle time of 44 minutes. Insufficient wood ahead of the forwarder resulted in a reduced average payload of 6.2 m^3. Based on a direct hourly operating cost of $75.97/PMH, the estimated forwarding cost was $9.02/$m^3$.

DISCUSSION

Considering the operating conditions, the harvester performed well; neither the snow depth (around 1 m) nor the 30% slopes in some areas of the stand adversely affected machine travel. Long-reach booms on harvesters of this size must provide the operator with precise control of the harvester head, particularly when fully extended. This minimizes the potential for individual stem damage during selection. Damage to the residual stand during this study was less than 5%.

Table 2. Productivity and distribution of work cycle time elements for the harvester

	Valmet 901C harvester	
Study duration (PMH)	17.6	
Average merchantable volume (m^3/stem harvested)	0.058	
Productivity		
stems/PMH	80	
m^3/PMH	4.6	
Estimated direct operating cost ($/PMH)[a]	123.90	
Harvesting cost ($/$m^3$)	26.93	
Work cycle elements	min/tree	%
Moving	0.08	11
Cutting unmerchantables or brushing	0.07	9
Positioning head	0.16	21
Felling	0.13	17
Processing	0.20	27
Operational delays	0.11	15
Total	0.75	100

[a] Based on 4000 PMH/year and excluding supervision, transport, and camp costs, as well as profits and other overhead.

With the exception of operational delays caused by repeated derailment of the cutter chain, the harvester was well adapted to thinning operations. In this first thinning, however, the area occupied by the extraction trails (21%) exceeded the limit set by Quebec's Ministère des Ressources Naturelles (a maximum of 15%) because the trails were excessively wide (more than 1 m greater than the 3.0-m width more commonly observed). Based on FERIC's hypothetical analysis, the operation's estimated total cost (harvesting, forwarding, profit and supervision) would exceed total revenues (wood price at roadside plus stumpage credits). Using a single shift for the forwarder (rather than a double shift) would optimize its payload potential; however, the forwarder would have to produce 12 m^3/PMH in order to reduce wood costs below those of a double-shift situation.

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