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COMMERCIAL THINNING USING THE JM 2000 CUT-TO-LENGTH SYSTEM

Roderick H. Ewing, Researcher, Small-scale Operations
Jacques Lirette, For. Tech., Silvicultural Operations

INTRODUCTION

The JM 2000 cut-to-length system (a harvester, a forwarder and hybrid models of each) represents further conversions of Ford–New Holland's 75-kW bidirectional tractor, which has gained acceptance as a prime mover for various forestry tasks. The JM 2000 units involve modifications to the cab end of the 9030 by removing the rear differential, pto, three-point-hitch, and axle unit and replacing them with a single-axle or a bogie-axle rear section and bunk.

MACHINE DESCRIPTIONS

In September 1997, FERIC studied the productivity of the Patu SH400 stroke-type harvester head on a JM 2000 model 444B carrier, as well as the JM 2000 model 667 forwarder.

Patu SH400 head: Patu 395-kg SH400 head has a felling capacity of 45 cm, and a delimbing force of 4.1 tonnes at 220 bar. It requires a hydraulic flow of 70 to 120 L/min, and a minimum power of 20 kW. Delimbing speed is 0.76 m/sec, with a combined feeding-delimbing speed of 0.59 m/sec. The head mounts on a 6.5-m Patu 915 boom.

JM 2000 444B harvester: This 4.5-tonne, four-wheel drive carrier can convert quickly into a forwarder by replacing the Patu head with a grapple. The pivoting headboard raises to permit forwarding and lowers to improve visibility during felling. The bunk accommodates 2.4-m wood, but can extend to accommodate 3.6-m logs. The 2.3-m-wide carrier uses hydraulic stabilizing cylinders that automatically lock the front axle when the machine is stationary and during operation of the crane. The carrier has about 48 cm of ground clearance, and a turning radius (to the outside wheel-track) of approximately 6.3 m.

JM 2000 667 forwarder: This 7-tonne six-wheel-drive (bogie axle) machine uses a 6.5-m Patu 655 boom. The 667 is 2.3 m wide, with a 4.5-m bunk length. The pivoting stakes "toe in" slightly at the top to minimize damage to residuals, but the turning radius is approximately 30% greater than that of the 444B. Noise levels inside both cabs ranged from 74 to 78 dBA.

Figure 1. The JM 2000 444B carrier with a Patu SH400 head.

Figure 2. The JM 2000 667 forwarder.

STUDY CONDITIONS

The study stand was a 44-year-old Norway spruce plantation (2×2 m spacing) on level, well-drained soils (CPPA class 3.1.1) located 30 km south of Matane (Que.). The prescription called for removal of 50% of the basal area. The

harvester operator removed every 7th row then selected trees within reach of the harvester (i.e., three rows on either side of the machine). Poor-quality trees, competing smaller trees, and a proportion of the dominant trees were removed. Table 1 present the results of the pre- and post-treatment stand assessments.

Table 1. Pre- and post-treatment stand conditions

	Pre-treatment	Post-treatment	Difference (%)
Density (merch. trees/ha)	2372	947	-60
Merch. volume (m³/ha)	286	169	-41
Basal area (m²/ha)	55.7	30.0	-46
Average DBH (cm)	17.3	20.1	+16
Average volume/tree (m³)	0.12	0.18	+50

PRODUCTIVITY

Tables 2 and 3 summarize harvester and forwarder productivities and estimated costs, plus a breakdown of the work cycle time elements. The harvester produced 2.4- (77%), 3.0- (11%) and 3.6-m (12%) logs, and approximately 93% of the logs were within 10 cm of their target lengths.

Operating conditions were excellent, but heavy branchiness on large stems increased the "position head" time element. Tight crown closure made it difficult for some trees to break through the canopy and increased the "fell" time. Delimbing slash was placed ahead of the harvester to create a protective mat for both machines to travel upon. Much of the forwarder's "loading" time element resulted from the need to sort more than one product.

Table 2. Harvester productivity and work cycle elements

Average volume/tree (m³)	0.144	
Harvester productivity		
trees/PMH	35.9	
m³/PMH	5.2	
Direct operating cost ($/PMH)[a]	99.85	
Harvesting cost ($/m³)	19.28	
	Time (min/tree)	Proportion (% of total)
Work elements		
Move	0.19	11.1
Brush	0.01	0.6
Position head	0.19	11.6
Fell	0.28	16.5
Process	0.83	49.9
Move slash	0.04	2.6
Cut unmerchantables	0.01	0.7
Delays	0.12	7.0
Total	1.67	100.0

[a] Direct cost based on 2000 SMH/year for 5 years, and excluding transport and supervision costs, and other overhead.

Table 3. Forwarder productivity and work cycle elements

Average extraction distance (m)	87	
Bolts/load[a]	130	
Volume/load (m³)	5.95	
Forwarder productivity		
bolts/PMH	243	
m³/PMH	11.0	
Direct operating cost ($/PMH)[b]	82.53	
Forwarding cost ($/m³)	7.49	
	Time (min/load)	Proportion (% of total)
Work elements		
Travel empty	1.32	4.1
Load	14.06	43.8
Move to load	4.17	13.0
Travel loaded	0.48	1.5
Unload	9.08	28.3
Delays	2.99	9.3
Total	32.10	100.0

[a] Combined average for 2.4-, 3.0- and 3.6-m bolts.

[b] Direct cost based on 2000 SMH/year for 7 years, excluding transport and supervision costs, and other overhead.

DISCUSSION

Damage to the residual stand was less than 4%, with an average wound size of 230 cm² . Wound was shallow (outer bark removed but wood fiber intact), and generally resulted from the tires or the forwarder's grapple rubbing residuals along the extraction trails.

However, productivity was average for a stroke-type head, and would decrease in natural stands if brushing were required. In unmanaged plantations, pruning larger trees with a chain saw prior to harvesting would improve harvester head efficiency (i.e., facilitate head positioning), but would have to be cost-justified.

At the time of the study, the 444B harvester cost $235 000, versus $225 000 for the 667 forwarder. The JM2000 machines now offer an optional Mowi parallelogram boom and Pan, F1, or Tapio single-grip harvester heads. The 667's wheelbase has been shortened by 30 cm to improve the turning radius. For further information, please contact:

Mr. Jocelyn Marquis, JM2000
194, rue du Carrefour, Saint-Antonin, Que. G0L 2J0
Tel.: (418) 867-5880, Fax: (418) 867-8654

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