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Field Note N°: Felling-7
Previous Reference Sheet N°: None

THE DENIS FELLER-DELIMBER PROTOTYPE

BACKGROUND

With the changes in laws and regulations related to the use and regeneration of the forest, the forest industry has begun to look for economical methods to protect the advance regeneration on cutovers, and eliminate delimbing residues along forest roads. A potential solution to these problems is to delimb before skidding. Thus, the slash (source of seeds and nutrients) is scattered over the cutover and the problem of delimbing residues accumulating at roadside is eliminated. Moreover, a felling machine with a long reach would permit harvesting a wider swath, resulting in a greater concentration of wood and a reduction of the skidding impact on advance regeneration.

In response to this need, Équipements Denis Inc., a manufacturer of forestry equipment, developed a prototype multifunction machine: the feller-delimber (Figure 1).



Figure 1. Prototype of the Denis feller-delimber.

PROTOTYPE DESCRIPTION

The manufacturer made use of an already proven product, their stroke delimber from which the boom was shortened to 11 metres. The delimbing head also was modified by adding a light chain saw felling attachment

powered by a hydraulic motor. The felling head was designed to pivot on a hinge from the felling to the delimbing position during the fall of the tree. The maximum cutting capacity of the prototype was set at 51 cm.

Since the principal aim of the trial was to evaluate the felling/ delimbing concept in the forest, the manufacturer installed the system on a Hitachi EX-200 carrier, better suited for delimbing than for felling.

FIELD STUDY

Trial Conditions

The machine was observed in June 1989 while it operated on the limits of Daishowa Inc., north of Forestville, Quebec. Data were recorded during four daytime work shifts, as well as for a few hours during the night shift.

The day operator, responsible for maintenance of the machine, had little experience in operating feller-bunchers and delimiters but had been operating the machine for more than two months. The night operator had considerable experience in operating feller-bunchers and delimiters, but only three weeks on this machine.

Table 1 shows the site and stand conditions encountered during the study.

Table 1. Site and stand conditions

1. Terrain	
- ground strength	good
- ground roughness	low
- slope	10 to 15%, rarely more than 25%
2. Stand	
- type	black spruce
- merchantable density	2200 stems/hectare
- mortality	10%
- non-merchantable density	850 stems/hectare
- mortality	60%
- regeneration	1100 stems/hectare
- avg volume/stem	0.09 m ³
- DBH/stem	10-20 cm

Results

The average productivity of the day operator during the study was 59 trees/Productive Machine Hour (PMH) ($5.3 \text{ m}^3/\text{PMH}$), whereas the night operator was recorded at 68 trees/PMH ($6.1 \text{ m}^3/\text{PMH}$). The night operator reached a peak production of 85 trees/PMH ($7.6 \text{ m}^3/\text{PMH}$) for almost two hours while operating under excellent conditions.

Table 2 shows the average duration of the work cycle elements for the day operator, as well as the proportion of productive time that they represent.

Table 2. Work cycle of the prototype feller-delimber (day operator)

Work cycle elements	Average duration/cycle (min)	% of productive time (%)
move for felling*	0.08	8
position on the tree	0.14	14
fell and place in delimbing position	0.20	20
delimb	0.13	12
swing and pile	0.23	22
brush*	0.08	8
prepare a mound for piling*	0.03	3
piling delays*	0.03	3
mechanical delays (felling head)*	0.07	7
other delays*	0.03	3
mean time per cycle (min)	1.02	100
cycles/PMH	59	

* Occasional elements pro-rated over all the cycles.

Delays related to the felling head represented more than 7% of the productive time and consisted mainly of changing the saw chain or the bar. The chain was changed 2 to 3 times per work shift (10 to 15 minutes each time).

The distance between felling swaths ranged from 15 to 20 metres, depending on terrain conditions.

DISCUSSION

Though the stability of the machine was good on level terrain (with slopes up to 25%), the operator had to proceed very slowly when moving on the steeper sections and used the counterweight of the felling boom to stabilize the machine.

The carrier chosen for the trial was not ideal because the low position of the cab hampered the operator's vision. Consequently, he had to brush more frequently, thus destroying a large part of the advance regeneration.

Positioning the felling head on the stem caused no problems, *once access to the tree was cleared* of dead trees and underbrush which represented either physical or visual obstacles. Therefore, the machine was much more sensitive to poor visibility caused by the understory than conventional feller-bunchers would be. Felling large stems (more than 30 cm at the stump) was slow and required more attention on the part of the operator. Since the articulation of the felling head was limited to vertical tilt and the felling boom had limited lifting capacity, felling longer stems in dense stands presented difficulties; trees frequently remained hung up, and broke when the operator applied more pressure to bring them to the ground. After having been felled, the tree had to be grabbed again (about 3 metres from the butt) to be brought into the delimbing position.

The low proportion of hardwoods in the study block did not permit an assessment of the problems the machine might encounter in mixed wood stands. However, during earlier trials, the machine had to cut almost all the hardwood stems to operate efficiently.

CONCLUSION

Whether combined with felling or carried out separately, delimbing before skidding is of potential interest. The main advantages of this concept are the increased distance between cutting trails, the distribution of slash over the cutover, and the possibility of carrying heavier loads while skidding. The Denis feller-delimber concept showed potential even though the prototype studied had some problems. Shortly after the trial, the manufacturer took it back to the shop for major modifications.

FERIC plans to continue to monitor trials of delimbers working at the stump to evaluate the potential output and productivity.

NOTE: A video of the prototype in operation is available at a reasonable cost from FERIC.

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