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## Operational trial of three tools for pruning

### Abstract

FERIC studied pruning operations in softwood stands to determine the productivity and treatment cost with various tools. A manual tool (the pruning saw) and two power tools (the guillotine and the chain saw) were evaluated. Workers preferred the pruning saw, which also provided the lowest treatment cost and the best work quality. The guillotine provided a comparable treatment cost, but left large branch stubs. The chain saw was the last choice of the workers; its treatment cost was also the highest and it caused the most serious wounds.

### Keywords:

Pruning, Pruning tools, Trials, Manual pruning saw, Powered guillotine, Chain saw, Powered shear.

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### Introduction

In 1998, Quebec's Ministère des Ressources Naturelles (MRNQ) undertook a pilot pruning project in spruce plantations and naturally regenerated fir and spruce stands in the province's Bas St-Laurent region. Experimental plots were set up by

MRNQ's research staff to determine the means of treatment, the optimal pruning intensity, and the nature of the wounding as a function of the tools being used; an additional goal was to model the rate of diameter growth in response to the treatment. This report presents the results of time studies conducted by FERIC to establish the productivity of the workers and the treatment cost for pruning using various tools.

### Sites and operations

FERIC's studies took place between 1998 and 2000 on the operations of Produits Forestiers Alliance Inc. (Ville-Dégelis, Que.). The operations occurred in white spruce and black spruce plantations, and in young natural stands of 15- to 20-year-old fir and spruce that had undergone release or thinning. The treatment prescription consisted of pruning between 350 and 400 high-quality stems per hectare to a total height of 3.2 m (Figure 1).

Figure 1. A worker pruning a tree to a height of 3.2 m.



Time studies were carried out on seven workers during pruning of about 2000 stems with three different tools: a manual pruning saw, a powered guillotine, and a chain saw (Figure 2). These tools cost \$100, \$1300, and \$2500, respectively. The cutting heads of the powered tools were mounted at the end of telescoping poles, and were driven hydraulically; power was supplied via hoses connected to an auxiliary motor carried on the worker's back. A fourth tool (a powered shear) was tested at the beginning of the work, but was subsequently excluded from the study because it was considered unsuitable for this type of operation. The shears had difficulty cutting both small and large branches; the small branches became stuck between the blades, whereas the blades simply bit into

large branches without being able to cut them. In addition, the shear left unacceptably long branch stubs.

## Results and discussion

The stems pruned during the studies had a diameter at breast height (DBH) ranging from 4 to 22 cm, with an average of 11 cm. The number of branches removed per stem averaged 74, and ranged from 20 to 137.

The effective productive time (pruning plus travel between trees) for the workers depended directly on the mechanical availability of the tools. The availability of the tools averaged 100, 95, and 86%, respectively, for the manual pruning saw, the guillotine, and the chain saw.

Figure 2. The three pruning tools.



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The time required for refueling, maintenance, and repairs of the powered tools was the factor that most directly decreased their availability during the work. Refueling, sharpening, and repairs were more frequent for the chain saw than for the guillotine. The manual pruning saw required next to no maintenance or repairs, since the blade was simply replaced when it grew dull.

Figure 3 presents the pruning time per tree as a function of the tool used and number of branches pruned per tree. This time includes only the pruning time, and excludes travel times between the trees, the time required to select trees, and mechanical or personal delays.

In general, the treatment quality was very good, and the workers pruned an average of 374 stems/ha to a height of 3.2 m. The workers were most productive with the guillotine, next-most productive with the manual saw, and least productive with the chain saw. The pruning times for an average tree (75 branches pruned) with the guillotine, the manual saw, and the chain saw averaged 2.8, 3.1, and 3.2 minutes, respectively. The guillotine was easy to use; the worker simply placed the knives of the cutting head around the branch to be cut and activated the head. The configuration of the cutting head helped prevent wounds to the tree, but prevented the head from severing the branches close to the stem; as a result, this tool almost always left long branch stubs (Figure 4).

Workers could have worked faster with the chain saw, but doing so would have increased the rate of wounding of the trees excessively (Figure 5). Given that the chain saw's cutting teeth were very aggressive and that it was difficult to manipulate the saw rapidly at the end of a long pole due to its weight, the risk of wounding the trees was quite high.

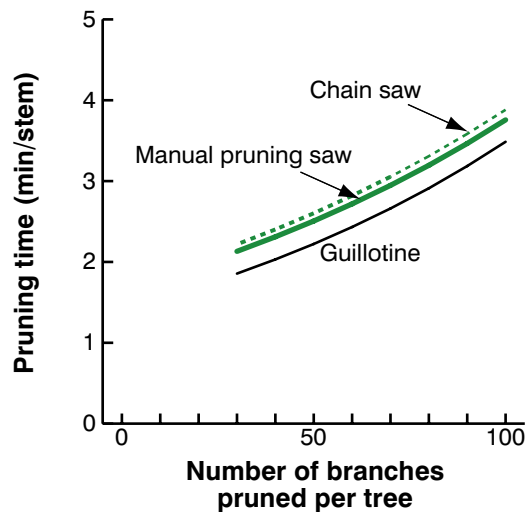


Figure 3. Pruning time as a function of the tool and number of branches pruned.



Figure 4. Long branch stubs left by the guillotine.



Figure 5. Wounds caused by the chain saw.



With the manual pruning saw, workers were able to cut branches close to the tree's stem without damaging the tree. In addition, the saw was equipped with a small blade at the base of the main blade for cutting the bark beneath the branch, thereby preventing the branch from tearing off strips of bark along the stem when the branch detaches from the tree.

The treatment cost for pruning 375 trees/ha with the various tools (Figure 6) was calculated as a function of the productivity of the workers studied, the number of branches pruned per tree, and the operating cost of the tools. This cost was estimated at \$24, \$27, and \$32 per productive hour for the manual saw, the guillotine, and the chain saw, respectively. These costs include the purchase price, the maintenance and repair costs for the tools, the pay for the workers

and foreman, and the transportation costs. Administrative costs and profits were excluded from the costing. The treatment cost with 75 branches pruned per tree thus averaged \$540, \$580, and \$770 per hectare for the manual pruning saw, the guillotine, and the chain saw, respectively.

## Implementation

Despite efforts to mechanize pruning, it appears that the using a manual pruning saw remained the most efficient approach in terms of cost and treatment quality. In addition, workers preferred using the manual pruning saw; they found the powered tools noisy and heavy to carry, and the exhaust from the motor noxious. The guillotine appears to be a viable option, but its treatment quality is not acceptable because it leaves large branch stubs. Using the chain saw is not recommended given its relatively high cost, the wounds it caused to the stems, and the lack of acceptance by the workers.

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Figure 6. Pruning cost by type of tool.

