Advantage
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Contents

Use of a portable capstan winch and associated hand tools in manual thinning

Abstract

FERIC evaluated the use of a small, portable capstan winch to move felled trees to the extraction trail in a first thinning operation. The winch and appropriate hand tools increased efficiency and productivity, since manual handling of processed wood in "cut-and-pile" operations makes the work strenuous and lowers productivity.

Keywords:

Manual thinning, Simpson model SP portable capstan winch, Synthetic-fiber rope, Hand tools.

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Background

Manual "cut and pile" operations are physically demanding. Furthermore, productivity is generally low and wood costs are usually high compared with mechanized systems in larger-scale industrial operations. Carrying the bolts from within the strip to the extraction trail and piling them is an arduous and time-consuming task for the feller. In previous FERIC studies, these activities have accounted for 21 to 39% of the total work cycle. Prewinching tree-length or full-tree stems to the extraction trail for further processing prior to extraction alleviates this problem.

In November 1999, FERIC conducted a field trial of a portable, low-cost capstan winch (Figure 1) and various hand tools to move pre-bunched stems to the extraction trail in a manual, commercial first thinning operation. The study site was approximately 8 km southeast of Normandin, in the Lac-St-Jean region of Quebec.

Figure 1. Using the capstan winch to move tree-length stems to the extraction trail.

Winch description

The Simpson model SP portable capstan winch (Figure 2) used in the present trial has two major components: a cast housing which contains a gear drive that transmits power from the motor to the capstan's spool, and a 30-cc Tecumseh motor. The 7.3-kg winch costs around $975. Its rated winching capacity is 910 kg, with an average line speed of 13.7 m/min (45 ft/min). The capstan's spool, which

only holds the portion of the rope that is wrapped around the spool to provide traction, is 9.7 cm in diameter and 7.6 cm long, which provides room for up to five wraps of rope (depending on the rope's diameter). The drive train has a gear reduction ratio of 125:1 and is equipped with an anti-reversing brake.

A polyester sling attached to two safety hooks on the winch secures the winch to suitable anchor trees. In this design, tension must always be applied to the uptake end of the rope to maintain friction as the rope winds around the spool. The rope's incoming end is aligned on the spool during winching by a guide hook; a similar hook aligns the uptake end of the rope as it leaves the spool and is "taken up" by the operator (Figure 2).

The capstan design lets the winching speed and load capacity remain constant as the rope winds through the spool. In contrast, drum winches lose some line-pull capacity as the cable accumulates on the drum, thereby increasing the drum's diameter and thus line speed. The winching distance is only limited by the available length of rope, since the rope does not accumulate on the spool. However, the operator must deal with the accumulation of rope as it pays out onto the ground behind the winch. Some capstan winches use a secondary "uptake" reel to store the rope.

A 20-m DBK-2312 (polyester/Kevlar) synthetic-fiber rope (9 mm [3/8 in.] in diameter) was used with the winch (Figure 3). The polyester covering protects the Kevlar core from abrasion and from damage by UV light. The rope has a minimum breaking strength of 3710 kg. Its safe working load limit is 742 kg, with a 1% elongation factor at this load. The 20-m length used in the study weighed 1.4 kg and cost approximately $4.30/m. The rope's high strength-to-weight ratio and minimal stretch are unique features. The feller occasionally used an open-face, self-releasing snatch block, attached to a residual tree, to alter the line direction and avoid potential hang-ups during winching. A resilient plastic skidding cone (Figure 4) let the bunched trees slide more easily and deflect over or around obstructions (e.g., debris, residual trees, stumps) and reduced friction with the ground. The cone weighed 5.0 kg.

The feller used a 49-cc Jonsereds 2149 chain saw with a 33-cm bar and a weight of approximately 5.5 kg. This saw was well suited for thinning work because of its low weight, high power, and rapid acceleration.

Hand tools (Figure 5) improve the efficiency of manual thinning crews. In FERIC's study, the feller used lifting hooks to manipulate felled stems and pile shortwood. He also carried a small, telescoping "side-step" felling lever for small trees and

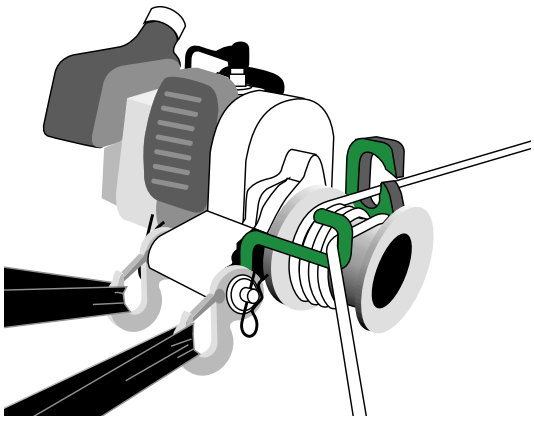

Figure 2. Rope is aligned on the spool with guide hooks.

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Figure 3. (*left*) The capstan winch, Kevlar™ rope, slotted hooks, and chain chokers with sliding rings and pull-through needles.

Figure 4. (*right*) Fitting the skidding cone over the butt end of a turn of stems.

an 80-cm-long felling lever with an integral cant hook for dislodging hung-up trees and for directional felling of difficult trees. A retractable logger's tape accurately measured log lengths. All this equipment was easily accessible from his tool belt, except the larger lever, which the operator left at a convenient location in the stand.

Using the winch

FERIC tested the winch in a 45- to 50-year-old jack pine stand on flat, well-drained sandy soils. Extraction trails (2 m wide) were spaced at 25-m intervals. Each leave strip between these trails was divided in half using flagging, with winching to the nearest trail. Subsequent forwarding was not monitored.

Harvesting began with opening of the extraction trail; trees were felled along the trail's center, then were delimbed, marked at 2.54-m (8 ft) intervals, topped, bucked, and piled at the trail's edge. Harvested trees within the first 5 m from the trail were felled towards the trail (top first), delimbed, marked for length, topped, and manually carried or dragged (in tree-length form) to the trail's edge for bucking and piling.

Target trees 5 to 12 m from the trail were felled away from the trail and were winched (butt first) to the trail's edge in either *tree-length or full-tree* form. In the *tree-length* method, the stems were delimbed, marked at each bolt length, and topped; the butts were then bunched manually and secured with a single chain choker. The Kevlar rope was fed through the nose of the skidding cone and attached to the chain choker with a slotted hook. The "turn" of logs was then winched perpendicular to the trail, with the capstan winch attached to a suitable tree on the opposite side of the trail. In the *full-tree* method, only limited manual bunching of the felled stems occurred; bunching was physically difficult because of the greater weight of the stems plus branches and the

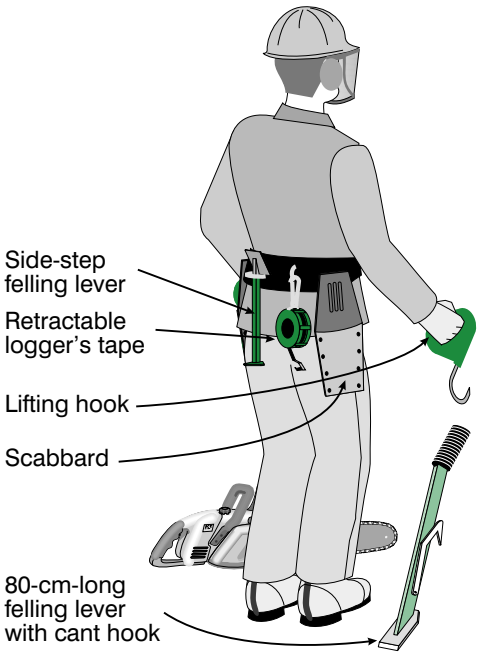

Figure 5. Typical equipment used by fellers to improve their efficiency: felling levers, lifting hooks, a logger's tape measure, and a suitable tool belt.

hindrance caused by residual trees. The turn of stems was then choked and winched to the trail as in the tree-length method.

The worker felled and winched about 15 trees per hour to trailside using *either* the tree-length or the full-tree method for 0.041-m³ stems. Though he had considerable thinning experience, he was relatively new to using the capstan winch in this application (less than 1 month); productivity will probably increase in the future. Further details on productivity and the work-cycle time elements when using the winch are available from the author on request.

To quantify the winch's performance and capacity, we conducted dynamic line-pull tests for tree-length and full-tree turns. The average continuous force required to winch a normal turn of tree-length wood (0.260 m³) was 284 kg; for a turn of full-tree wood (0.299 m³), the force required was 351 kg. Static line-pull tests were also performed to determine the winch's maximum capacity before stalling. In two tests, the winch exceeded its rated capacity of 910 kg, with values of around 1100 kg.

Implementation

The capstan winch performed well during the trial; it generated a surprising amount of pull for such a small engine, and its light weight and compact size made it convenient to transport and set up. Overall, the portable winch is a low-cost option that can easily be integrated into a manual or semi-mechanized thinning operation (e.g., feeding a trailside processor).

- Workers in manual operations might consider using a capstan winch rather than carrying bolts to the extraction trail in "cut-and-pile" operations. The ability to pull out several bunched stems in a single operation could compensate somewhat for the small stem size. The average stem volume and the distance between trails are the most significant influences on the feasibility of manual thinning operations, and the winch can mitigate their effects.
- Increased trail spacing (e.g., 30 to 50 m) would permit fuller treatment of the stand based on the prescription's selection criteria. Longer winching distances would also concentrate more wood at trailside and minimize the number of times the winch must be reinstalled.
- The winch could also prove suitable in sensitive areas (e.g., riparian zones, steep slopes) where machine traffic must be limited to minimize ground disturbance and damage to the residual stand.
- A winch may prove an economical alternative to using an expensive skidder to winch felled stems to trailside, as is commonly done.
- Because fine debris can interfere with the winch's carburator, we recommend installing a protective structure made from lightweight screening.
- Under more rigorous working conditions, workers can attach a 60-cc chain saw powerhead to the capstan of the CS model of the winch to increase the winch's speed and capacity by up to 20%.
- Adding workers might improve efficiency by pairing the feller with someone to choke the trees and operate the winch; however, productivity would have to increase two- or three-fold to offset the additional labor costs.

For further information:

Distributor of winch, skidding cone, Kevlar rope and hand tools:

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Toll free (Canada & U.S.)
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