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Contents

Evaluation of a swing-boom grapple skidder

Abstract

The Morgan SX-706 SB skidder differs from most conventional grapple skidders: it has bogie wheels in the rear and a pivoting, boom-mounted grapple. The pivoting boom allows the skidder to load bunches without leaving the trail and to unload without climbing onto roadside piles. This potentially offers improved protection of regeneration and decreased stem breakage. FERIC studied this skidder working in Témiscamingue (QC) to evaluate its productivity and its ability to protect regeneration and reduce stem breakage.

Keywords:

Skidding, Morgan SX-706 SB, Productivity, Fiber breakage, Regeneration, Full trees.

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Introduction

A new type of grapple skidder has recently appeared on the market in eastern Canada. The Morgan SX-706 SB skidder, produced by International Silvatech Industries Inc. (Langley, BC), differs from most conventional skidders: it uses a hydrostatic drive, has rear bogie wheels, and most interestingly, uses a pivoting, boom-mounted grapple (Figure 1).

The swing-boom lets the skidder load without having to articulate its chassis or leave the trail the way a conventional grapple skidder must do. This potentially offers improved protection of advance regeneration. The swing-boom also lets the driver avoid climbing onto the wood piles at roadside, thereby potentially decreasing the stem breakage caused by this practice.

To quantify the potential advantages provided by this type of machine in terms of productivity, protection of regeneration and soils, and stem breakage, FERIC studied a Morgan skidder owned by a contractor working for Tembec Industries Inc.'s Témiscamingue division during the summer of 2004.

Figure 1. The Morgan SX-706 SB skidder.

Description of the machine

The Morgan SX-706 SB skidder, which is distributed in eastern Canada by Federal Equipment Ltd., is equipped with a 194-kW (260 hp) engine and a hydrostatic transmission. The hydrostatic drive provides better control of the power transmitted to the six wheels, but this flexibility comes at the expense of energy efficiency, which is lower

than that of a mechanical transmission; fuel consumption is about 30 L/h. In terms of size, weight (17 700 kg), and power, the Morgan lies midway between conventional grapple skidders and clambunk skidders. Thanks to the swing-boom, the grapple can swing 70° to either side of the machine's central axis, and can grab bunches up to 3.9 m from the center of the trail. The seat pivots 355°, thereby giving the operator ample flexibility to select an optimal working position. The SX-706 SB currently costs around $540 000. For more detail on the technical specifications of the machine, please visit the supplier's Web site (http://www.silvatechfluidpower.com/morganforestry/products.htm).

Results

FERIC studied three aspects of the skidding operations: the productivity, the machine's ability to attain the objectives of careful logging, especially the protection of advance regeneration and reduced occupancy of the site by trails, as well as the quantity of broken or damaged stems.

Table 1. Results of the productivity study

Mean stem volume (m^3)	0.17
Bunches/trip	1.34
Mean volume/trip (m^3)	2.55
Average distance (m)	50
Observed productivity (m^3/PMH)	60.0
Estimated productivity @ an average extraction distance of 150 m (m^3/PMH)	37.3

Productivity

The machine's productivity was evaluated in an operation around 65 km east of Témiscaming (QC). The extraction distances were short (a maximum of 150 m) and the terrain was generally favorable (CPPA class 2(3).1.1). Table 1 presents the main results of the productivity study.

Figure 2 presents the relationship between productivity and extraction distance, as well as the corresponding average productivity curve for conventional grapple skidders provided by FERIC's *Interface 2003* simulation software. The productivity of the Morgan skidder was greater than that of conventional grapple skidders, probably due to the shorter work cycles. Additional studies would be required to generalize this result to other operating conditions.

The swing-boom permits fast loading of bunches because no time is lost positioning the machine. The swing-boom also facilitates positioning of the first bunch so as to facilitate the loading of a second bunch on top of the first.

Unloading time is also quick because, unlike machines that must climb onto the piles to unload, the Morgan does not have to slow down. Instead, the operator moves the grapple laterally to a position above the pile, then opens the grapple once the stems are properly positioned. There is thus little time lost pushing the stems into position, and the machine loses no time returning to the cutover. After unloading, it travels backwards onto the cutover.

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Protection of regeneration and soils

Table 2 presents the density and stocking of regeneration outside the extraction trails before and after harvesting. In general, the results meet the protection levels required in Quebec. Residual regeneration remained abundant, and the observed decreases in density were comparable to those previously reported with a conventional grapple skidder (Plamondon and Brais 2000).

The 3.6-m width of the Morgan, which is wider than more common grapple skidders (3.2 m), appeared to have no adverse effects on the occupancy of the site by trails because there was less expansion of the trail widths after repeated passes by the skidder. With 19-m felling corridors, the Morgan produced very satisfactory trail occupancy rates of 23.3 and 25.9% on the two sites visited by FERIC.

Stem breakage

The potential advantages offered by the swing-boom in terms of stem breakage were measured on sample truckloads at the mill after unloading. Two complete truckloads produced with the Morgan skidder were compared with two loads produced with conventional skidders equipped with 80-cm (32 in.) tires. In addition, two loads produced in a sector where the wood was extracted by a machine equipped with 112-cm (44 in.) high-flotation tires were also tallied.

Table 3 presents the results of this sampling. The defects considered likely to be affected by the mode of extraction were splitting at the butt and stem breakage, whether at the butt or at the top end.

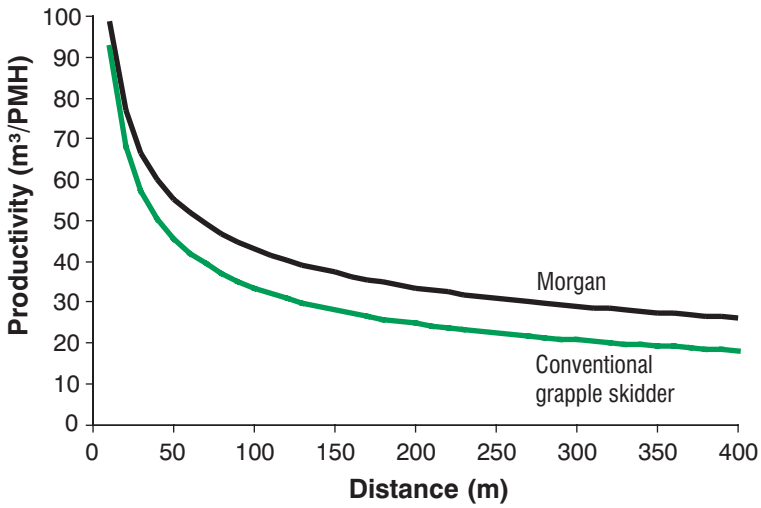

Figure 2. Productivity of the Morgan skidder as a function of extraction distance.

Table 2. Results of the regeneration survey[a]

	Density (stems/ha)			Stocking (%)	
	Before	After	Difference	Before	After
Total	18 478	9 891	-46%	97.8%	89.1%

[a] Regeneration outside the extraction trails, in compliance with the guidelines for harvesting with the protection of regeneration and soils (HPRS) in Quebec (MRNFP 2004).

Table 3. Levels of stem damage in three skidding operations

Type of machine	Morgan		Conventional skidder (112-cm high-flotation tires)		Conventional skidder (80-cm tires)	
	No. stems	%	No. stems	%	No. stems	%
Total number of stems evaluated	755		656		771	
Broken or split stems	67	8.9	59	9.0	98	12.7
Improvement compared with 80-cm tires						
Absolute		-3.8		-3.7		
Relative		-29.9		-29.1		

Although the results could have been affected to some extent by differences in stand conditions, the relative quantity of stem breakage was 29.9% lower for the sample loads produced with the Morgan skidder compared with the levels produced with a conventional grapple skidder equipped with 80-cm tires. The results for the skidder equipped with high-flotation tires were nearly identical to those with the Morgan. These results suggest that the wider tires permitted a better distribution of the machine's weight, thereby decreasing the impacts when the machine traveled over the ends of the piles.

Implementation

At a purchase price of around $540 000, the Morgan SX-706 SB skidder is more expensive than most conventional grapple skidders in the same power class. However, the results of our productivity study demonstrated potentially higher productivity than the average for conventional machines, primarily due to the reduced loading and unloading times.

In terms of an HPRS operation, the results were good, without, however, demonstrating a clear advantage for this machine configuration. If several bunches must be loaded to create a full load, the need to temporarily drop the load beside the trail while picking up an additional bunch could negate the advantage offered by the swing-boom (the ability to load and extract a bunch without having to articulate the machine). When the stand conditions permit, the feller-bunchers should create larger bunches so as to permit getting a full load from a single bunch.

It is beneficial that the machine does not have to turn around at roadside or in the trail during the extraction operations, both in terms of productivity and from an environmental perspective. Traveling as much as possible in straight lines helps avoid the shearing of soil that is caused by the wheels during turns. It also reduces the expansion of the trail width caused by repeated passes and reduces the number of turnarounds that would be required for a 7.3-m-long machine. The use of bogie wheels also reduces the nominal ground pressure exerted by the rear axle.

The ability to unload laterally using the swing-boom avoids the need to climb onto the piles when space is tight at roadside. This facilitates the construction of piles without increasing stem breakage.

NOTE: A four-wheeled model (the SX-704) also offers the advantages of a swing-boom grapple, but at a lower cost than that of the six-wheeled model.

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