FPInnovations

INFO NOTE

February 2020 – no. 01

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A 3 in 1 trail system for operating on soft soils

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Introduction

Harvest operations on soft soils can be particularly challenging in order to respect site and soil disturbance guidelines as well as operational requirements. To address the challenges of operating on soft soils, FPInnovations has worked on solutions designed to reduce disturbance on weak soils while minimizing implementation and investment costs by using machines already being used in the operation.

One approach to address weak soil challenges is to alter the harvesting and extraction trail layout in order to minimize the occupancy of extraction trails in the harvest block which is of importance in jurisdictions that have trail occupancy and rut limit compliance targets. In Quebec for example, the trail occupancy limit is 25% of the harvest area and significant soil disturbance (ruts) may occupy no more than 25% of the trails. While changing the harvest method may impact productivity, if the cost is less than the alternative cost of temporarily halting the harvest operation, floating to the next block and coming back at a later date (current approach), then the method may not only offer a direct cost savings, but also increased flexibility.

FPInnovations conducted a study of the productivity and site disturbance of an alternative trail layout system in a cut-to-length operation in Quebec managed by EACOM, Val D'Or division. Equipment utilized in this study included a Komatsu 921 harvester and a John Deere 1410G forwarder.

The 3 in 1 trail system

The 3 in 1 trail system concentrates the wood from three harvest trails into one central extraction trail. This approach limits the traffic of the skidder/forwarder to the central trail as a means of limiting the disturbance area which would otherwise potentially affect all trails on sites that are prone to disturbance during the extraction phase. The work phases for this system include:

1. On the first trail, the harvester processes the trees from both sides of the trail towards the central trail (brown). The operator must place the logs in the adjacent standing strip. The trail spacing is a function of the forwarder's maximum reach to minimize unnecessary machine movements.

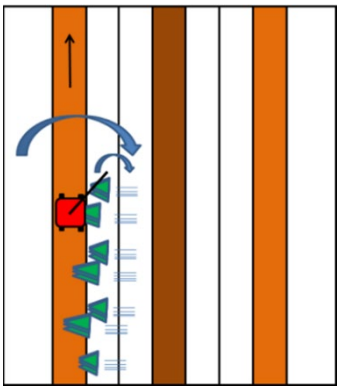

Figure 1. Harvester working on the first trail, processing the trees only towards the central extraction trail (brown).

2. On the central (extraction) trail, the harvester works normally to position log piles on both sides of the trail, ensuring a good slash cover on the trail to help flotation of the extraction machine.

3. On the third trail, the trees are processed by the harvester only towards the central trail. The logs must be piled within reach of the forwarder that will be working from the central trail.

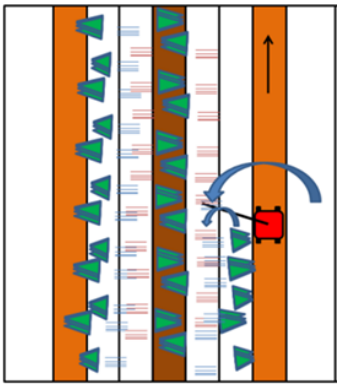

Figure 2. Harvester working on the third trail, processing the trees only towards the central extraction trail (brown).

4. The forwarder travel is restricted to the central extraction trail and uses conventional loading methods except that the boom needs to be extended to maximum reach more frequently to access all the log piles from the first and third trails.

Results

During the study, FPInnovations observed that the harvester experienced a 6% productivity loss representing an additional cost of $0.73/m³, compared to conventional operations, after adjusting productivity to account for stem size differences. This productivity loss was attributed to the additional moves needed to position the log piles so that they could be reached by the forwarder from an adjacent trail.

The forwarder experienced a 20% productivity loss for an additional cost of $1.42/m³, compared to a traditional operation. This productivity loss was a result of the frequent use of the full extension of the telescopic boom to reach the logs from two of the three trails.

The effect of this method on overall trail coverage and compliance was measured during the trial. The results showed a total trail occupancy of 20%, below the maximum of 25% required by Quebec regulations. Under a trail layout plan that would target a 25% trail coverage, the trails in a 3 in 1 system could be spaced 11 m closer together (51 m to 40 m) as compared to the spacing used in this study. This would reduce the negative impact on productivity observed in this study.

Implementation

Further study is required to evaluate the potential for further implementation of the 3 in 1 trail system, but this study highlighted a few key learnings, including:

1. This approach may be cost-effective as an alternative to shutting down the operation, floating to another block, or being non-compliant to trail coverage or soil disturbance requirements.
2. This approach may not be feasible over an entire harvest block due to the potential added costs but may be considered as an alternative tool to provide options to continue harvest operations when weather or site conditions deteriorate, or over small problematic areas of the cut blocks.
3. Productivity losses for the machines can be reduced by ensuring an optimized trail spacing that reduces boom extensions yet still meets trail occupancy targets.
4. This approach restricts the forwarder to a third of the total trails. On sensitive sites, best practices, such as adequate brush mats, must be used to ensure rutting remains below the required limits.