Fuel consumption and productivity for two tractor-mounted chippers in relation to knife wear and raw material

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Supply chain costs

• Comminuting is the major part of the supply, depending if it is the main product or only a by-product of timber production

• Presently in Sweden (and even elsewhere) chipping is mostly performed at the landing or in the forest

• It’s crucial to investigate fuel consumptions in order to reduce chips supply costs and energetic balance besides environmental impact

• Wood chips quality is also important
Case study within the Cost Action FP0902

- Aim of the study
- Location
- Machine
- Material/methods
- Results
- Conclusions
Influence of knives sharpness and raw material on:

- Productivity
- Fuel consumption
- Particle size distribution
Location in four different chipping spots in the South-West of Sweden:

**DRUM CHIPPER**
- logging residues at Skultorp (N 58 20.268 E 13 51.267),
- tree sections from a thinning near Tibro (N 58 25.216 E 14 04.980).

**DISC CHIPPER**
- logging residues from a final felling near Mariestad (N 58 35.873 E 13 42.658)
- pulpwood at the biomass terminal in Götene (N 58 31.351 E 13 29.071).
Material and methods

• Jenz 561 powered by a 246 kW Claas Xerion 3300 tractor
• TS 1200 disc-chipper mounted on a John Deere 810D forwarder
• Time study/Weights/Samples
• Fuel measurements
Results drum chipper (1/2)

Passing from a “good” blades status to a “dull” one, there is a 15.7% decrease in productivity for the same kind of raw material. By replacing knives and comminuting thinning there was an increase of 9.5% if compared to the blades in good conditions that were used at the beginning.

ANOVA table for productivity

<table>
<thead>
<tr>
<th>Effect</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F-value</th>
<th>P-value</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>odt h⁻¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Material</td>
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<td>29.339</td>
<td>15.584</td>
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<td>0.962</td>
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<td>11.986</td>
<td>1.090</td>
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<tr>
<td>Blades Status</td>
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<td>39.945</td>
<td>19.973</td>
<td>18.330</td>
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<td>11.986</td>
<td>1.090</td>
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</tbody>
</table>
Concerning fuel consumption, chipping of forest residues required 2.4 l odt$^{-1}$ when blades were in good conditions and 3.1 l odt$^{-1}$ with dull blades. By replacing a new set of blades the fuel consumption was on average 2.3 l odt$^{-1}$ by comminuting thinning material.

ANOVA table for fuel consumption

<table>
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<th>Effect</th>
<th>DF</th>
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<th>MS</th>
<th>F-value</th>
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<th>Power</th>
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<td>1 odt$^{-1}$</td>
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<tr>
<td>1 odt$^{-1}$</td>
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<tr>
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<td>1.000</td>
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<td>0.231</td>
<td>0.23</td>
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</tr>
</tbody>
</table>
Results disc chipper

The only significant impact on productivity was raw material

Particle size distribution: a statistical significant effect, limited to the accepts particles, was detected between forest residues and pulpwood.
Conclusions

- Fuel costs account for a large share of the overall costs for chipper contractors

- Knife wear increases costs and decreases productivity

- It is also one of the few factors that the contractor can control by himself
THANK YOU