Calumet County Forage Council Summer Field Day

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University of Wisconsin - Madison

July 06, 2010
1  Mower Conditioners

2  Mergers

3  Forage Harvesting
The cutter bar

The quick-change blade system is standard on all Pöttinger mowers. A spring clip engages with the blade pin to press the blade securely against the mower disc. This solid grip ensures safety. The blade mounting pin is bolted onto the disc and can be replaced cheaply if required. The bolt is recessed to protect it against corrosion and dirt.

Quick-change blade system – it’s this easy:

Longer, harder operation demands the best quality blades. Pöttinger blades are made from high-quality blade steel. Due to their optimised shape the blades glide over each other in the overlap as they counter-rotate. It is easy to change the blades quickly using the quick-change system.

Press the spring clip downwards with the blade key.

Remove the blade and insert the replacement.
Calculating Efficiency

Given
1. Mower conditioner traveling at 6 miles per hour
2. Cutting width 16 feet
3. 15% time spent turning, maintenance, overlap

Solution
1. \[
\frac{6 \text{[mi]} \times 16 \text{[ft]}}{8.25} = 11.6 \left[ \frac{\text{ac}}{h} \right] \times 0.85 = 9.9 \left[ \frac{\text{ac}}{h} \right]
\]
What is Overlap loss?

“Undercutting includes about 8% of precut area” (Hunt, 1986)
What is Overlap loss?
What is Overlap loss?
What is Overlap loss?
On-farm survey

- Mower configurations
  - Pull-type, Self-propelled, Mounted

- Operating speeds
  - 5.5 - 12.5 mph

- Working widths
  - 10 - 32 ft

- With and without guidance
## Overlap

*(Percent cutting width)*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlap</td>
<td>4.99</td>
<td>3.00</td>
<td>0.40 - 16.13</td>
</tr>
<tr>
<td>Type</td>
<td>Overlap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>5.03\textsubscript{a}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic</td>
<td>2.34\textsubscript{b}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LSD = 1.16
Assumptions: Min overlap 2.5%, 4 cuttings yr$^{-1}$
Crop Merging
## Mergers | Tractors: Size

The table below shows the fuel use and fuel savings for different Deere tractors.

<table>
<thead>
<tr>
<th>Tractor</th>
<th>Fuel use (gal h(^{-1}))</th>
<th>Fuel Savings ($ yr(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deere 7630</td>
<td>6.72</td>
<td>946</td>
</tr>
<tr>
<td>Deere 7930</td>
<td>7.17</td>
<td>357</td>
</tr>
<tr>
<td>Deere 8130</td>
<td>7.29</td>
<td>171</td>
</tr>
<tr>
<td>Deere 8430</td>
<td>7.40</td>
<td>0</td>
</tr>
</tbody>
</table>

**Assumptions:** 110 hp required, 500 h yr\(^{-1}\), 3.10 $gal^{-1}$ (3yr average price)
### Tractors: Weight

<table>
<thead>
<tr>
<th>Speed (mi h⁻¹)</th>
<th>Weight (lb (PTO hp)⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light &gt; 6</td>
<td>120</td>
</tr>
<tr>
<td>Moderate 5 - 6</td>
<td>145</td>
</tr>
<tr>
<td>Heavy &lt; 4</td>
<td>180</td>
</tr>
</tbody>
</table>
Mergers | Tractors: Weight

Nebraska Tractor Test Laboratory

Tractor test reports

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Tractor test reports from 1999 to current date are available in .pdf format from the following manufacturers. To order test reports for any other model or year prior to 1999, please go to publications. Acrobat reader 7.0 or higher, is required to view and print all on-line test reports. The most current version of the Reader may be required for these reports.

Select test reports by manufacturer

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Case-IH

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John Deere

Massey Ferguson

McCormick

New Holland

Buhler
Caterpillar
FarmTrac
Fendt
Hurlimann
Kubota
SAME
Valmet
White
Zetor

The Nebraska Tractor Test Laboratory, a component of the Biological Systems Engineering Department of the University of Nebraska, makes official tractor testing results available at little or no cost to all interested parties. The Nebraska Tractor Test Laboratory makes no endorsement of particular tractor models or tractor manufacturers. The Nebraska Tractor Test Laboratory recommends that users of Nebraska Tractor Test reports consider Nebraska Tractor Test reports in their entirety when comparing tractor performance between two or more models.

Reference to commercial products or trade names within information provided by the Nebraska Tractor Test Laboratory and the University of Nebraska does not constitute an endorsement by the these entities and does not imply discrimination against other similar products.
Given

1. New Holland T6030, 102[hp]
2. Specific fuel consumption: $11.24\frac{[hp-h]}{[gal]}$
3. Optional ballast: 2,458[lb]

Solution

1. Rolling resistance adjustment: $2,458 \times 0.2 = 492[lb]$

$$\frac{6[\frac{mi}{h}] \times 492[lb]}{375} = 7.9[hp]$$

2. 

$$\frac{[gal]}{11.24[\frac{hp-h}{h}]} \times 7.9[hp] = 0.7[\frac{gal}{h}]$$

3. 

$$\frac{0.7[gal]}{[h]} \times \frac{3.10[\$]}{[gal]} = 2.18[\frac{\$}{h}]$$
Forage Harvesters
Forage Harvester | Energy Use

Whole-Plant Corn

- Blower: 36%
- KP: 23%
- Cutterhead: 15%
- Drive: 13%
- Feedrolls: 5%
- Header: 5%
- Other: 3%

Alfalfa/Grass

- Blower: 44%
- KP: 30%
- Cutterhead: 13%
- Drive: 5%
- Feedrolls: 5%
- Header: 3%
- Other: 3%
Knives & shearbar
Forage Harvester | Knives & shearbar

Source: R.T. Schuler, University of Wisconsin - Madison
Source: McClure and Hall, 1992
Forage Harvester | Knives & shearbar

Figure 8: View of edge of knife. Hard facing on upper right surface (57X).

Figure 9: View of the clearance (steel) surface of the knife edge (200X).


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Summer Field Day
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Crop accelerator / blower
Ground Drive
Energy use comparison (faster vs. wider)

<table>
<thead>
<tr>
<th></th>
<th>8 row - 6 mph (hp)</th>
<th>14 row - 3 mph (hp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chopping, processing, blowing</td>
<td>440</td>
<td>503</td>
</tr>
<tr>
<td>Ground drive</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>Feedrolls</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td>Header</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>Accessories</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>650</strong></td>
<td><strong>655</strong></td>
</tr>
</tbody>
</table>

Krone Big X; 240 ton h$^{-1}$ in WPCS
Hydrostatic transmission performance

- Power [hp]
- Efficiency [%]
- Torque [in-lb]
- Speed [rpm]

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Research Update
2. Mark the support times between individual machine cycles with a zigzag line. Mark both machine loops at their points of interaction.

3. Sum the cycle times required for each machine loop and select the largest to be the system cycle time.

4. Add idle times to the other machine loops to bring their total times up to the total system time. Identify this on the diagram with circles.

5. Field efficiency can now be estimated more accurately when the machine in question is a part of the system.

Outputs from a cycle analysis include system capacity, labor efficiency, and utilization rates for each machine. Basic relationships for capacity and associated parameter ranges for typical field speeds and field efficiencies are required for this analysis and are included in ASAE Standards (ASAE, 2002a, 2002b, 2002c). Table 1 illustrates the spreadsheet implementation of cycle analysis accompanying the cycle diagram of Fig. 1 (a self-propelled Fig. 1. Cycle diagram for the one harvester, four-transporter system of Table 1. Alignment is indicated with zigzag lines and idle time is indicated with circles.)
1. Cycle analysis using GPS loggers
2. Custom CAN DAQ (Fuel)
3. BMPs for forage harvesting
Summary
Take home message

1 Overlap
   - Auto-steer systems can greatly reduce overlap
   - Economics of overlap depend on your situation

2 Merging
   - Some opportunity for fuel savings by tractor and ballast selection
   - Merging light crop can increase fuel efficiency of the forage harvester
   - Economics of merging/chopping system not well known

3 Chopping
   - Wider is better than faster
   - Maintain wear parts (e.g., blower band, spout liner)
   - Sharp knives and proper shearbar clearance save fuel
   - Paddle clearance
Allis-Gleaner Corporation (AGCO)

CNH Global

Claas of America

Deere and Company

Gehl Company

Krone North America

Kuhn North America

Poettinger US Inc.

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