Milking and operator efficiency of herringbone and rotary parlours

Ryan Prendergast\textsuperscript{1,2}, Fergal Buckley\textsuperscript{1,2}, Michael D. Murphy\textsuperscript{2} and John Upton\textsuperscript{1}

\textsuperscript{1}Teagasc, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork; \textsuperscript{2}Department of Process, Energy and Transport Engineering, Munster Technological University, Co. Cork

Summary

• Milking efficiency was documented on Irish dairy farms using herringbone and rotary milking systems through the use of video cameras, infrastructure surveys and farm milk yield data. The metrics of 1) cows per hour (cows/h), 2) cows per operator per hour (cows/op/h) and 3) litres of milk harvested per hour (L/h) were used to evaluate farm performance.

• The average milking efficiency on farms using herringbones was 94 cows/h, 70 cows/op/h and 1,015 L/h. In comparison, average milking efficiency on rotary farms was 170 cows/h (+81%), 132 cows/op/h (+89%) and 1,534 L/h (+51%).

• For farms using herringbone (H) and rotary (R) milking systems, with two operator systems, more cows were milked per hour (+19% H, +33% R) and more litres of milk were harvested per hour (+21% H, +21% R) but less cows were milked per operator per hour (-35% H, -12% R) when compared to one operator parlours.

Introduction

Milking efficiency is often defined as the number of cows milked per hour, cows milked per operator per hour or litres of milk harvested per hour. Achieving high levels of milking efficiency is dependent on the successful engagement of factors related to milking system infrastructure, automation and management. Ireland’s dairy herd has increased by 46% from 2011-2022 with recent statistics showing that the average Irish dairy farm is currently around 93 cows. Milking is a significant task and accounts for approximately 30% of a dairy farmers daily workload. This paper will describe the milking efficiency values of a sample of Irish dairy farms with respect to infrastructure (system size and type), levels of automation and operator efficiency.

Materials and methods

A sample of 17 farms using herringbone (H) and 10 farms using rotary (R) milking systems were selected for study participation. Farmers were chosen for inclusion in this study based on their willingness to participate in data recording, share farm data and manage dairy farms that are representative of future Irish dairy farms. Data were collected using video cameras, infrastructure surveys and national milk yield databases. Recordings were taken over two periods to account for seasonality: period one from 28/07/2020 to 23/10/2020 and period two from 12/04/2021 to 19/05/2021.

Table 1. Milking assistance automations, their descriptions and applicability to herringbone and rotary farms

<table>
<thead>
<tr>
<th>Automations</th>
<th>Descriptions</th>
<th>H\textsuperscript{1}</th>
<th>R\textsuperscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto gates</td>
<td>Allows cows entry/exit to milking parlour</td>
<td>A\textsuperscript{3}</td>
<td>N/A\textsuperscript{4}</td>
</tr>
<tr>
<td>Backing gate</td>
<td>Moves cows from holding yard to parlour</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Custer removers</td>
<td>Removes cluster when milking finished</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Feeders</td>
<td>Allocates feed to cow bail</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Rapid exit</td>
<td>Bails lift : whole row walks under and out</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>Row lift</td>
<td>Bails lift : cows exit conventional direction</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>Teat spray</td>
<td>Post-milking teat spray application</td>
<td>N/A</td>
<td>A</td>
</tr>
</tbody>
</table>

\textsuperscript{1} Herringbone, \textsuperscript{2} Rotary, \textsuperscript{3} Applicable, \textsuperscript{4} Non Applicable

Milking efficiency was evaluated through three distinct metrics: 1) cows milked per hour (cows/h), 2) cows milked per operator per hour (cows/op/h) and 3) litres of milk harvested per hour (L/h). Milking efficiency KPIs were calculated using ‘total process time’ (defined as time...
from arrival of cows to the holding yard until cleaning of facilities was completed), as opposed to the ‘cups-on to cups-off’ metric used in some studies, in order to account for time dedicated towards setting up the parlour before milking as well as cleaning of the facilities after milking. Automations identified on herringbone and rotary farms are listed and described in Table 1.

Results

Herringbone

The average herd size on farms using herringbone milking systems was 180 cows, average system size was 20 clusters, average number of operators present was 1.4 and the average number of rows per milking was 10. The average milking efficiency on farms using herringbones was 94 cows/h, 70 cows/op/h and 1,015 L/h. 81% of farms using herringbone milking systems had cluster removers, 56% had auto gates, 50% had row lifts, 38% had feeders, 19% had backing gates and 13% had rapid exits. One-operator farms had system sizes of 18 clusters with an average of two automations and achieved an average milking efficiency of 88 cows/h, 84 cows/op/h and 940 L/h. In comparison, two-operator farms had system sizes of 23 clusters with an average of three automations and achieved an average milking efficiency of 105 cows/h (+19%), 55 cows/op/h (-35%) and 1,136 L/h (+21%) (Figure 1).

Rotary

The average herd size on farms using rotary milking systems was 425 cows, average system size was 50 clusters, average number of operators present was 1.5 and the average number of rotations at milking was 10. 100% of farms using rotary milking systems had feeders and cluster removers and 60% had teat spray and backing gates. The average milking efficiency values on farms using rotary’s was 170 cows/h, 132 cows/op/h and 1,534 L/h. One-operator farms had system sizes of 48 clusters, an average of three automations and achieved an average milking efficiency of 147 cows/h, 142 cows/op/h and 1,396 L/h. In comparison, two-operator farms had system sizes of 55 clusters, an average of three automations and achieved an average milking efficiency of 196 cows/h (+33%), 125 cows/op/h (-12%) and 1,690 L/h (+21%) (Figure 1).

Conclusions

On average, farms using rotary milking systems achieved higher levels of milking efficiency (+81% cows/h, +89% cows/op/h, +51% L/h) than farms using herringbone milking systems. For farms using herringbone and rotary milking systems, two-operator parlours achieved more cows/h (+19% H, +33% R) and more L/h (+21% H, +21% R) yet less cows/op/h (-35% H, -12% R) when compared to one-operator parlours. The results of this study show that on average, there were only marginal efficiency gains in cows/h and L/h for farms using herringbone and rotary milking systems by adding a second operator, which also resulted in a detrimental effect on the key operator metric of cows milked per operator per hour. Hence, one-operator milking parlour installations can maximise milking efficiency and labour utilisation at milking.

Figure 1. Milking efficiency values for one operator and two operator parlours on herringbone and rotary farms. L/h has been scaled down by a factor of 10

Conclusions

On average, farms using rotary milking systems achieved higher levels of milking efficiency (+81% cows/h, +89% cows/op/h, +51% L/h) than farms using herringbone milking systems. For farms using herringbone and rotary milking systems, two-operator parlours achieved more cows/h (+19% H, +33% R) and more L/h (+21% H, +21% R) yet less cows/op/h (-35% H, -12% R) when compared to one-operator parlours. The results of this study show that on average, there were only marginal efficiency gains in cows/h and L/h for farms using herringbone and rotary milking systems by adding a second operator, which also resulted in a detrimental effect on the key operator metric of cows milked per operator per hour. Hence, one-operator milking parlour installations can maximise milking efficiency and labour utilisation at milking.