Animal & Grassland Research and Innovation Centre

Moorepark

Moorepark Dairy Levy Research Update

Breeding Strategies for an Expanding Dairy Industry

Moorepark Animal & Grassland Research and Innovation Centre
Dairygold Research Farm Open Day

Wednesday 9th April, 2014
Series 23

teagasc
Agriculture and Food Development Authority

Dairygold

Combining automatic milking with grazing

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Summary

- Automatic milking (AM) has been adopted at an accelerating rate in Europe, but cow grazing systems have not yet been well adapted to AM
- Successful integration of AM into a grass based milk production system was achieved in this study; however, adoption of the technology at farm level will depend on the economic viability.
- A preliminary study has showed that at the end of lactation it is possible to reduce the milking frequency (MF) from 2.0 to 1.5 milkings/day without reducing milk production. This has the potential to increase overall milk output from an AM system as a higher cow number could be maintained on the AM unit when accompanied by reduced MF.
- Potential advantages of AM systems include reduced labour input, more time available for management as opposed to manual labour and the ability to expand cow numbers on fragmented land bases. Increased data collection by the AM system at each cow milking could also facilitate greater precision in animal management.

Introduction

During the last several decades, new milking management systems have been introduced, amongst which the development of AM systems is a significant step forward. AM has become an established management system, and is recognised as an alternative to conventional manual milking methods, particularly in Western Europe (Jago, 2011). Uptake of AM systems is increasing, and it is envisaged that up to 20% of cows in Europe will be milked automatically by 2020. Indoor feeding systems have been well adapted to AM; however, grazing systems have not. This is leading to a decrease in grazing on farms with AM (Van den Pol-van Dasselaar *et al.*, 2011). This is undesirable since grass-based systems of animal production have a positive impact on milk quality, reduce the environmental footprint associated with milk production and increase animal welfare standards.

In a production system where grazing constitutes a significant proportion of the cow diet, such as in Ireland, grass has to be the main motivator for cows to move voluntarily from the field to the AM installation. Thus, new grazing technologies are needed to optimize integration of AM and grazing. The combination of AM and grazing has potential beneficial effects on labour, utilisation of cheaper feed (grazed grass) and milk quality. This system also offers possibilities for precision management of individual cows in a herd, freeing up of labour and allowing the cow greater control of her activities.

The objective of this study was to determine the feasibility of integrating AM with cow grazing.

Farm system description

A milk production system trial was established at Teagasc, Moorepark. The farm-let associated with the AM system consisted of a 24 ha milking platform. During 2013, 70 cows were milked in the system with a mean calving date of 19th February (range 2nd February-15th March). This herd comprised Holstein Friesian, Jersey Holstein cross and Norwegian Red cross cows. The land area was divided into 3 grazing sections of 8 ha each (A, B, C) which were further divided into 1 ha paddocks. Water was located at the dairy. Maximum distance to the furthest paddock was ~750m. The dairy featured one Merlin AMS unit (supplied by Fullwood for research) installed adjacent to the existing shed. The infrastructure incorporated a pre-milking waiting area and a post-milking area. There were two selection gates, one positioned at the entrance to the dairy that drafted cows to the pre- or post-milking area depending on readiness for milking and a second positioned at the dairy exit which drafted cows to the grazing areas (Section A, B or C). Automatic milk diversion (colostrum, antibiotic) was included and extensive milking and cow information was recorded at each milking (e.g. milk yield, milking time, conductivity [an indicator of SCC], concentrate dispensed).

Grassland management

Daily grass allocation was used to dictate the optimal frequency of cow visits to the AMS unit (to avoid overly frequent or infrequent visits). Cows grazed defined areas or portions of each of the 3 grazing sections during each 24 h period (Figure 1). Cows were allocated 5 to 6 kg DM in each of the 3 grazing sections (A, B and C) over each 24 h period. Cows moved between the grazing Sections A, B and C at 12:30 am, 9:30 am and 4:30 pm, respectively. During the May/ June period cows went into grazing areas with grass covers of 1400-1500 kg DM/ha. Pasture mass was estimated twice weekly. Grass covers greater than 1500 kg DM/ha may discourage cow movement to the AM unit and may reduce MF. Cows grazed to a post-grazing height of 3.5-4.0 cm. All cows received approximately 1 kg supplementary concentrate feed per day during the main grazing season.

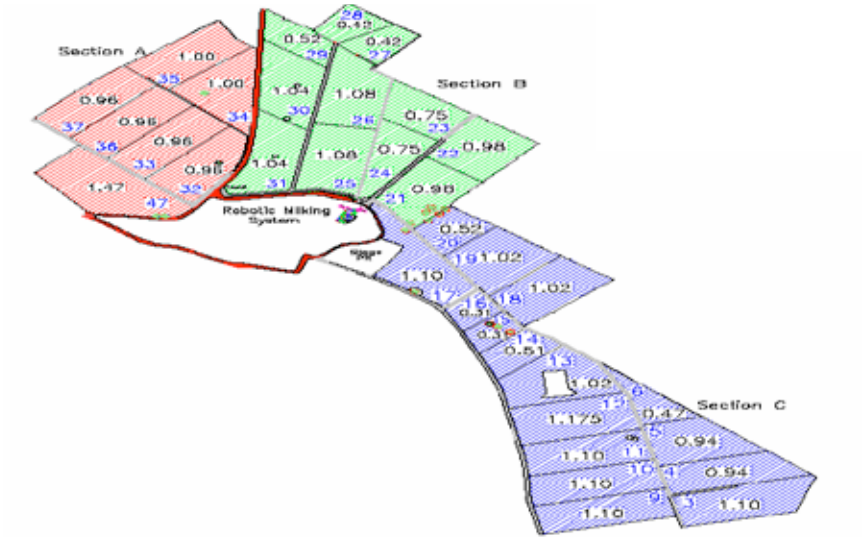

Figure 1. Map of AM farm incorporating sections A, B and C

Results

An average milk yield of 4,222 litres and milk solids yield of 369 kg per cow was achieved during the 2013 lactation, which is comparable with a large proportion of Irish dairy farms. Total milk volume and milk solids produced by the AM unit was 295,540 litres and 25,830 kg, respectively. The average number of milkings per day was 104, ranging from 66 to 128 per day in the March to August period. The average number of milkings/cow per day was 1.8, ranging from 1.6 to 2.1 (the complete 70 cow herd was not in place until May; 31 and 47 cows were milking in March and April, respectively). An average milk somatic cell count of 152,000 cells/ml was observed, while average total bacterial counts were at 10,000 cells/ml in the same time frame.

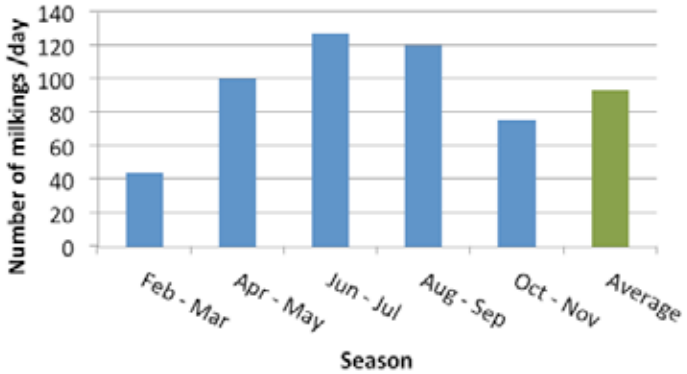

Figure 2. Average number of milkings over a 24 h period

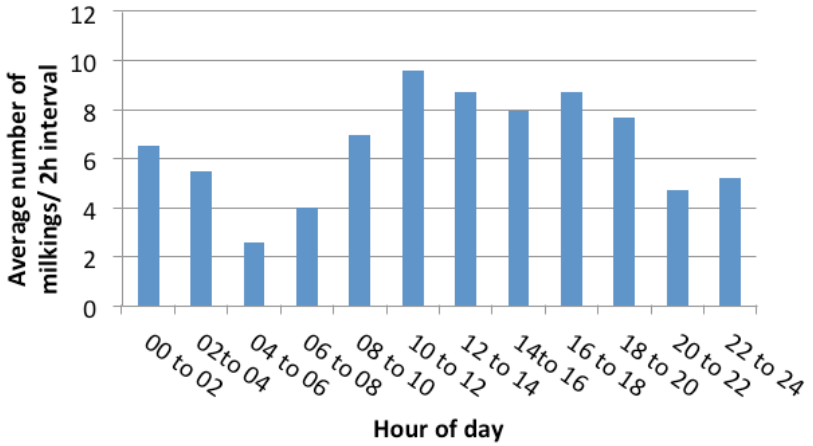

Figure 3. Average distribution of milkings over a 24 h period during the main grazing season

Discussion

The results obtained in this study are in agreement with those conducted in New Zealand in previous years, that AM can be successfully incorporated into pasture based milk production systems with moderate levels of supplementary feed (Woolford *et al*., 2004). The practical challenges to integrating AM and cow grazing include initiating cow movement to visit the AM unit, queuing of cows for milking, achieving high utilization of the AM unit and managing a seasonal calving pattern involving a peak milk yield period. Overall, the integrated AM and grazing system operated satisfactorily. The cows adapted relatively quickly to the system (within approximately 4 days). Milk output was negatively influenced in the first complete lactation for cows on the AM system, but this is considered normal; cow milk yield is expected to be reduced by 10-15% during the first lactation on AM (Wade *et al*., 2004). The grass allocation was critical to optimising cow visits to the AM unit. If automatic milking is to be considered a viable alternative to conventional milking in a grass based system, it has to operate with similar cow nutritional management focused on utilization of grazed grass. Factors such as daily milk yield, milk quality, feeding, cow traffic, grazing, and animal behaviour are essential elements of AM and grazing.

Irish dairy systems normally use high levels of grazed pasture and have seasonal milk production profiles. However, robotic milking systems are capital intensive, and up to now have been considered best suited to year-round milk supply due to the fixed capacity of the technology. Combining AM and a grazing system is possible, however, as long as the distance from the milking parlour to the pasture is reasonably short (Svennersten-Sjaunja and Pettersson, 2008). With proper management routines, it should be possible to achieve milk production levels and animal well-being with AM systems that are at least as good as conventional milking systems.

Preliminary study to optimize cow milking frequency

Introduction

The main objective of this study was to investigate the effect of MF on milk production characteristics and cow traffic. In a grass-based system it is important to focus on the total output of the AM system rather than the output per cow. Thus, a trial was designed to answer the following research question: will milking fewer cows with a relatively high MF and higher daily milk yield result in a more profitable system than milking a greater number of cows with a relatively low MF and lower daily milk yield?

Study details

A preliminary trial was carried out in autumn 2013 (September 1 to 20). Cows were randomised into two groups of 35 cows each and two MF treatments (approximately 1.5 and 2.0 milkings per day). This was achieved by allowing cows to be milked if their predicted milk yield (at the time of the cow visit to the AM unit) was >50% and >33% of their daily yield (averaged over the previous 10 days) for cows allocated to the 1.5 and 2.0 MF treatments, respectively.

Results

Although these milking frequencies were significantly different (1.4 and 1.9 times per day), the milk yield per day (13.4 and 13.7 kg/cow/day, respectively) was not significantly different between groups (Table 1). While concentrate feed allowance was similar, actual concentrate feed intake was higher with the 2 times/day milking group, as the cow was exposed to a greater number of feed allocations due to the increased MF of that group. While the number of times the cows in both groups returned to the AM unit per day was similar, and the waiting time was similar for both groups, the milking interval was longer by ~2.5 hours for the less frequently milked cows.

Table 1. Characteristics of low (Group 1) or high (Group 2) milking frequency treatments

	Group 1	Group 2	P-Value
Milking Frequency (times per day)	1.4	1.9	<0.001
Milk yield per cow (kg/day)	13.4	13.7	0.95
Conc feed allowance (kg/day)	3	3	0.99
Actual conc feed intake (kg/day)	2.3	2.7	<0.001
Number of returns per cow per day	2.8	3.0	0.20
Average return interval per visit (hh:mm)	06:07	05:45	0.14
Average wait time per visit (hh:mm)	01:24	01:16	0.61
Average milking interval (hh:mm)	14:29	11:52	<0.001

Implications

In the later stages of lactation, it is possible to reduce the MF of cows on an automated milking system without compromising milking characteristics of the herd, reducing milk production or affecting voluntary cow traffic performance. There is potential to obtain greater milk production output from AMS with lower MF as an increased cow:AMS ratio could be maintained. This was a preliminary study, however, a similar study over the full lactation is being conducted during 2014. This is necessary because it is a key question for grass based systems: is the AMS output the correct production focus for grass based systems?

Conclusion

Successful integration of AM into a grass based milk production system was achieved in this study; however the economic viability of AM will determine how widely the technology will be adopted. A major challenge with automatic milking currently is the high capital cost but the concept of combining automatic milking and cow grazing has potential advantages which could have a positive impact on the dairy industry in the long term. These include reduced labour input, more time available for herd management as opposed to manual labour, ability to expand cow numbers on fragmented land bases and increased availability of cow performance data to use as a management tool. However, further research needs to be conducted to establish if the concept presents a realistic alternative to conventional milking systems on dairy farms.

Next steps in AM research

The fact that cow grazing systems have not been well adapted to AM to date has led to a decrease in grazing on farms with AM across Europe (Van den Pol-van Dasselaar *et al.*, 2011). This is an undesirable trend since grass-based systems of animal production are becoming increasingly competitive. Allied to this is the positive impact on milk quality and reduced environmental footprint associated with increased quantities of grazed grass in the diet as well as increased animal welfare standards.

Thus, the desire to research the integration of AM and cow grazing both in Ireland and other EU countries has led to a current three-year FP7 funded EU project (coordinated by Ireland) (AUTOGRASSMILK), which commenced in January, 2013 (webpage http://www.autograssmilk.eu). The Irish Grassland Association support this project and are consortium partners within it. Planned outputs include: protocols for optimum feeding strategies; pasture management tools; a sustainability assessment tool; and a web-based decision support tool to optimise economic efficiency of AM in grazing scenarios.

This research has received funding from the *European Union's Seventh Framework Programme (http://ec.europa.eu/)*.

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