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Comparison of 2 systems of pasture allocation on milking intervals and total daily milk yield of dairy cows in a pasture-based automatic milking system

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ABSTRACT

Cows milked in pasture-based automatic milking systems (AMS) have greater milking intervals than cows milked in indoor AMS. Long milking intervals greater than 16 h have a negative effect on milk yield and udder health. The impact of 2 systems of pasture allocation in AMS on milking interval and yield was investigated at the FutureDairy AMS research farm (Elizabeth Macarthur Agricultural Institute, New South Wales Department of Primary Industries, Camden, New South Wales, Australia) in late November to early December 2010. Two- (2WG) versus 3-way grazing (3WG) allocations per 24-h period were compared in a field study to test the hypothesis that an increase in the frequency of pasture allocation would reduce the milking interval and, therefore, increase milking frequency. The study involved the entire milking herd of 145 cows, with (mean ± SD) DIM = 121 ± 90 d, 7-d average milking frequency = 1.52 ± 0.41 milkings/cow per day, and 7-d average milk yield = 21.3 ± 7.6 kg/cow per day. Cows were milked using 2 DeLaval VMS milking units (DeLaval International AB, Tumba, Sweden). Cows in the 3WG treatment had 31% reduced milking interval, 40% greater milking frequency, and 20% greater daily milk production compared with 2WG. Increased milking frequency and milk production for 3WG was associated with greater utililization levels of the AMS milking units throughout the day. These results support the recommendation that, wherever possible, farmers installing AMS should incorporate sufficient infrastructure to accommodate 3WG, which provides additional flexibility with managing extremely long (and short) milking intervals.
Key words: milking interval, feed allocation, automatic milking system, pasture based

INTRODUCTION

The introduction of automatic milking systems (**AMS**) in the early 1990s enhanced the possibility of milking cows more frequently without significant extra labor input and consequently achieving higher milk yields (Garcia and Fulkerson, 2005; Stockdale, 2006). In 2001, the technology was introduced into pasture-based systems in a commercial installation in Victoria (Greenall et al., 2004) and with the establishment of the Greenfield Project in New Zealand (Jago et al., 2002). These were followed by the AMS research farm within the FutureDairy Project in Australia in 2006 (Garcia et al., 2007).

Under pasture-based conditions, milking frequency (**MF**; defined as the number of milking events/cow in any 24-h period), and daily milk yield (**DY**; defined as the kilograms of accumulated milk production of individual milking events in a 24-h period) are usually lower than those reported in indoor housing systems (Garcia and Fulkerson, 2005). Moreover, milking intervals (**MI**; the interval between consecutive milking events, measured at every milking session in hours since the previous milking event) for pasture-based AMS dairy cows are higher and more variable than those housed indoors. In a historic data analysis from a pasture-based AMS, up to 30% of milking events occurred with intervals above 16 h (N. A. Lyons, unpublished data). These extended milking intervals have a negative effect on milk yield (Schmidt, 1960; Delamaire and Guinard-Flament, 2006) and udder health (Hammer et al., 2012). Yet, Rémond et al. (2009) found that cows could compensate for a long MI (over 17 or 19 h), if the following milking occurred shortly after (7 or 5 h, respectively). In that case, DY was not different from that in a conventional system with 2 milking events/d (11- to 13-h or 10- to 14-h MI, respectively). In the same study, cows with a very short and very long MI (3 and 21 h) had an 11.5% reduced DY compared with those milked with an 11- and 13-h MI regimen. Therefore, it is likely that cows may not be flexible enough to accommodate for extremely long MI. In AMS, cows may have consecutive milking events with extended MI and, therefore, no opportunity for compensation would exist.

Increasing MF per cow by decreasing MI is an option for those systems aiming to increase the amount of milk collected per milking unit. Management strategies that increase cow traffic around the system are likely to

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have an effect on system performance and utilization. For the purpose of this study, cow traffic is defined as the visitation of cows to the dairy facility, either voluntarily or as a result of being fetched, which results in a milking event.

Previous studies under pasture-based conditions have addressed the effect of supplementary feeding (Jago et al., 2007); water availability and location (Jago et al., 2003); minimum MI (Jago et al., 2004); stage of lactation (Jago et al., 2006); and premilking teat preparation (Davis et al., 2008) on the general performance and throughput of AMS. Recognizing that feed is the main incentive for cows to move around the system in a voluntary and distributed manner (Prescott et al., 1998a,b), some initial reports have depicted the potential importance and effect of incentives put in place per day (Jago et al., 2004, 2007). Yet, to date, no research has been published that quantifies the actual effect of number of feed allocations on either animal or system performance in pasture-based systems. An increase in cow traffic has the potential to benefit cows in early lactation, which are in higher energy demand and more willing to move around the system compared with late-lactation cows (Garcia and Fulkerson, 2005; Jago et al., 2006). Any reduction in MI, and associated increases in MF, needs to translate into a higher milk yield (per cow and per milking unit); otherwise, the general efficiency of the system would decline. It is also recognized that in some cases it may be more efficient to increase the number of cows milked rather than increase the number of milkings per cow (Woolford et al., 2004).

The aim of this study was to determine the effect of increasing the number of pasture allocations per day from 2 to 3 on the occurrence of extended MI (>16 h), MF, DY, and system performance. It was hypothesized that an increase in frequency of feed allocation would result in increased cow traffic, MF, and DY. Also greater system utilization (operating time and kilograms of milk collected per day) would be achieved.

MATERIALS AND METHODS

General Farm Management and Description

A pilot study was conducted between November 20 and December 8, 2010, at the FutureDairy AMS research farm (Elizabeth Macarthur Agricultural Institute, New South Wales Department of Primary Industries, Camden, New South Wales, Australia) to investigate the impact of 2 different grazing systems. The allocation of 2-way grazing (**2WG**) versus 3-way grazing (**3WG**) per 24-h period was investigated. Ethics approval was granted through the Elizabeth Macarthur Agricultural Institute Animal Ethics Committee (project number M10/12) before commencement of the project.

The herd had traditionally been operated under a 2WG system; however, cows had been exposed to 3WG before the commencement of this study. The study consisted of a 7-d adaptation period, during which cows were managed with 3WG, followed by a 4-d measurement period with 3WG. At the conclusion of the 3WG treatment period, the pasture management was reverted back to the traditional 2WG treatment with a 3-d adaptation period and a 4-d measurement period. The trial could not be replicated as in a traditional crossover design because of limiting pasture availability and high cow numbers within the herd. Anecdotal observations conducted at the FutureDairy AMS research farm indicate that within 48 h, naive heifers exposed to some training were trafficking around the farm system voluntarily (Kerrisk, 2009). Furthermore, traffic data during the measurement period in the study was stable, which suggests that a 7-d adaptation was adequate as exposure to a new treatment.

The herd consisted of 145 cows (predominantly Holstein-Friesian and approximately 10 to 15% Illawarra breed), 30% primiparous and 70% multiparous. Before commencement of the study the herd had an average (mean ± SD) of 121 ± 90 DIM, 7-d average MF of 1.52 ± 0.41 milking events/cow per day, and 7-d average DY of 21.3 ± 7.6 kg of milk/cow per day.

Each cow was fitted with an electronic identification transponder, which was necessary for passage through the automatic drafting gates (DeLaval Smart Selection Gate; DeLaval International AB, Tumba, Sweden) and for recognition at the milking stations. The transponder ensured that the details of all milking and trafficking events were recorded electronically by the herd management software (DeLaval VMS Client; DeLaval International AB). Cows were milked through 2 single box milking units (DeLaval VMS; DeLaval International AB) and milk yield recorded individually (DeLaval MM15; DeLaval International AB).

Pasture [predominantly a mix of Kikuyu (*Pennisetum clandestinum*) and ryegrass (*Lolium perenne* and *Lolium multiflorum*)] was allocated to cows based on a target intake of 18 kg of DM/d. In addition to pasture, cows were supplemented in the milking station with a set daily concentrate allowance of 6 kg of DM/d (with a maximum daily carryover of 50%) aimed to achieve an intake of 4 kg of DM/d (Dairy Elite Pellet, 16% CP; Weston Milling Animal Nutrition, Enfield, Australia). Cows were offered their daily pasture allocation in equally sized portions according to the established treatments. In the 2WG treatment, cows were allocated 9 kg of DM/cow in each of 2 allocations, whereas during