

MaxT milking: A case study of implementation at the Lincoln University Dairy Farm

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Background

Long hours spent milking is contributing to the problem of attracting and retaining staff on South Island dairy farms. Slow-milking cows is one factor that can lead to longer milking times. Cuthbert (2008) reported that virtually all (98%) farmers with rotary dairies manage slow-milking cows by allowing them to go around the platform twice, with many farmers also slowing or stopping the platform (25% and 17%, respectively). In the same survey, most farmers with herringbone dairies said that they wait for cows to milk out with 11% stating they wait nearly every side.

Recent DairyNZ research at the Hamilton based Lye Farm and the Westpac Taranaki Regional Research Farm (Jago et al, 2009) has shown that setting a maximum cups-on time (MaxT milking) can reduce the effect of slower milking cows on the overall time it takes to milk the herd, without reducing production or impairing udder health. Extensive studies undertaken in Australia have reported similar outcomes (Clarke et al., 2004; 2006).

Observations at the Lincoln University Dairy Farm (LUDF) in November 2007 indicated that setting a maximum cups-on time, and adjusting the platform speed to match this time, could save up to 37 minutes per milking at peak lactation. This case study evaluates the effect of implementing the MaxT milking routine at the LUDF for 14 weeks from peak lactation in the 2008/09 season.

Methods

Farm and dairy description

The LUDF is representative of a typical, irrigated, South Island conversion dairy farm. It is located 2 km South West of Lincoln University. The peak herd size in the 2008-09 season was 681 cows, managed on a 161ha effective milking platform and milked twice daily through a 50 bale rotary dairy. The farm uses the Protrack herd management system which includes individual electronic identification device (EID), automatic drafting and cow live weight measurement. The dairy is not fitted with automatic cup removers. Typically two people milk at any one time with a third person sometimes assisting with heat detection, the "health herd" (lame cows and/or those with mastitis) or herding cows to pasture and washing down. The milking herd

is managed as one herd with the “health cows” held near the dairy and milked separately once a day.

Approach

As the farm did not have the technology to implement the modified milking routine on only part of the herd, a whole-herd case study approach was used to examine the implications of MaxT milking on a large dairying operation. Of particular interest was the impact on staff and the ability to meet the MaxT target milking durations. Earlier research had reported no negative effects of shortening the milking duration of slower milking cows from peak lactation so the period just after peak lactation was chosen to begin the MaxT milking routine.

The milking routine was assessed for two weeks before implementing MaxT and indicators of milking efficiency calculated. Using these data the target rotation times were determined and staff were requested to reduce the number of cows completing a second rotation and to increase platform rotation speed. Herd production, bulk milk somatic cell count and the incidence of mastitis were monitored over the subsequent 14 weeks.

Setting the MaxT target

Milking data were collected from 31 Oct 2008 (week 1 of monitoring), corresponding to peak lactation for the herd. To determine the appropriate target milking speed, the yield per cow was calculated from the average volume of bulk milk supplied (obtained using Fonterra data available on the Fencepost website) during week 1. Maximum milking times were determined from the Australian Maximum Milk Out Time (MMOT) guidelines (CowTime Project, Department of Primary Industries, Ellinbank, www.cowtime.com.au) for total daily yield per cow (21.75L) and a milking interval of 10hr/14hr, giving a milking speed of 5.6 and 7.7 cows/min (equating to a platform speed of 9.0 and 6.5 min/rotation) for the morning and afternoon milkings, respectively. In the baseline period, milking speeds averaged 4.3 and 4.8 cows/min (platform speed of 10.6 and 9.6 min/rotation) for morning and afternoon milkings, respectively. The adjustment required for the afternoon milking was therefore more substantial, and staff were advised to implement the change gradually. The new milking routine was implemented at the beginning of week 3 and continued until the end of week 17 (26 February, 2009). Data from a further 2 ½ weeks were collected following termination of the MaxT routine to monitor any reversion to slower milking speeds or increase in the proportion of cows sent around for a second rotation.

Data collection

The data routinely and automatically collected by the Protrack herd management software (milking reports and log files) were used to determine milking efficiency measures before and after implementation of MaxT milking routines. Data included date, cow ID, time of walking onto the platform (EID reader positioned at the

entrance to the platform), time of exit (reader located approximately 25m from platform exit), time of passing beneath the reader for the second time (if completing a second rotation) as well as any special instructions or details for the cow (e.g. draft, mastitis treatment).

Total herd milking duration was calculated from the time the first cups were attached to when the last cups were removed. This was used to calculate the average rotation time for each milking. The frequency and identity of cows sent around twice were extracted from the log files. Data were used from the main herd only; milking data collected from the sub-herd of lame/treatment cows were removed from the data set. Milkings where infrequent events, such as herd testing and pregnancy scanning, affected milking times were also omitted from the data set.

Daily herd production details (total yield, milk solids and bulk milk somatic cell count) were obtained from Fencepost. Individual cow production and somatic cell counts (SCC) were monitored by monthly herd tests. A herd test (individual milk yield, fat, protein, SCC) was conducted three days prior to implementing MaxT to identify any cows with SCC higher than 900,000 cells/ml for treatment.

Teat condition was scored visually using the method described by Mein *et. al.* (2001) after the morning milking for approximately 15% of the herd three days prior to MaxT implementation, and five days after ceasing restrictions (rotary speed then being determined by farm staff). The presence of rings, swelling, warts and lesions was recorded, and teats were scored (0-5) for hyperkeratosis.

All cases of clinical mastitis (cows treated with antibiotics) were recorded by farm staff in a diary throughout the season. These data were collated and used to monitor the changes in incidence of clinical mastitis before and after the implementation of the MaxT milking routine. Any repeat cases were omitted from the trial data set, as repeat clinicals were most likely caused by factors other than milking time restrictions potentially increasing the risk of infection.

Farm staff involved in the project were asked four questions relating to MaxT milking after completion of the study: (1) What initial concerns did you have before and in the early stages of increasing the platform speed? (2) After the first month or so, did you feel it was having any negative effects and what were they? (3) What were the positive outcomes? (4) What do you think would make it easier/more acceptable to implement the faster milking speeds?

Data analysis

As this was a case study, no attempt has been made to evaluate statistically the impact of the modified milking routine on production, bulk milk somatic cell count or clinical mastitis.

Using data from the baseline period (2 weeks prior to implementing MaxT), 25 cows were identified that completed a second rotation for a minimum of 50% of milkings. These cows (3.7% of the herd) were categorised as “twice-around” cows (TA). All other cows were categorised as “once-around” (OA). Descriptive statistics have been used to describe the production, SCC and teat condition for the TA and OA cows.

Results

Peak herd milk production occurred in late October to early November, with maximum production of 15,841L (1,280kg MS) on 2 Nov 2008. During the baseline period average platform rotation time was 10.6 and 9.6 minutes for the morning and afternoon milkings, respectively. Platform rotation time was declining for both morning and afternoon milkings prior to implementing MaxT at the start of week 3, but the rate of decline increased from week 4 (Figure 1). It was not until late lactation that the target of 5.6 cows milked per minute at morning milkings was achieved (Figure 2). The maximum recorded speeds were 5.6 cows/min (3 milkings during weeks 16 and 17) and 6.7 cows/min (1 milking in week 16) for morning and afternoon milkings respectively. At no point was the target of 7.7 cows/min reached for the afternoon milking.

The average time saved per day, relative to the baseline period, increased throughout the trial (Table 1). This improvement in milking time would not have been entirely due to the MaxT routine as declining yields would also have contributed to faster milking times. Figure 3 shows morning and afternoon total milking durations against the initial targets set and if those targets had been recalculated every 4 weeks based on herd yields (recalculations of the MaxT time would normally be done fortnightly to monthly depending on yield changes).

Figure 1. Weekly average platform rotation time before, during and after the implementation of MaxT milking in which a target of 9.0 and 6.5 min/rotation was set for morning and afternoon milkings, respectively. Bold points indicate the start and finish of the MaxT implementation period.

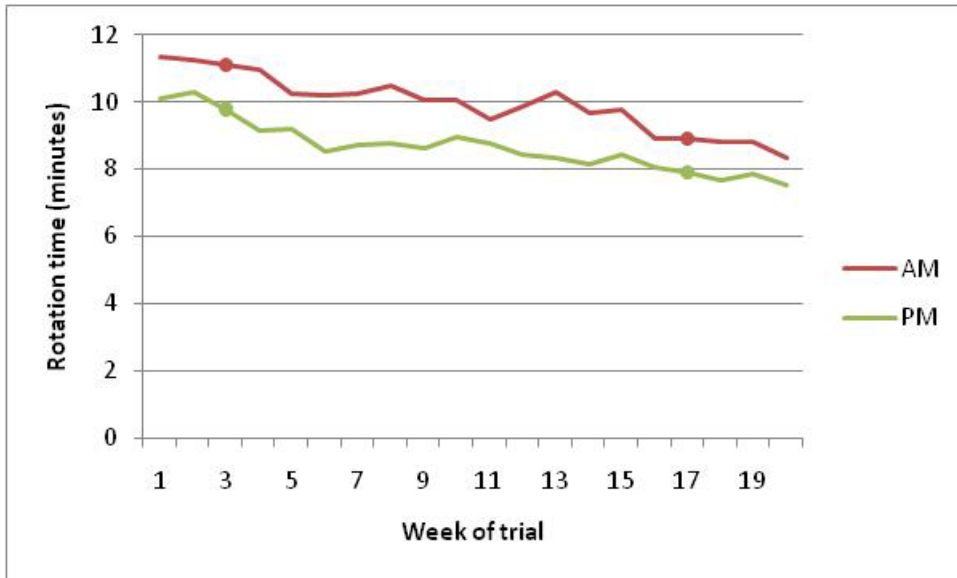


Figure 2. Weekly average cows milked per minute before, during and after the implementation of MaxT milking in which a target of 7.7 and 5.6 min/rotation was set for morning and afternoon milkings, respectively. Bold points indicate the start and finish of the MaxT implementation period.

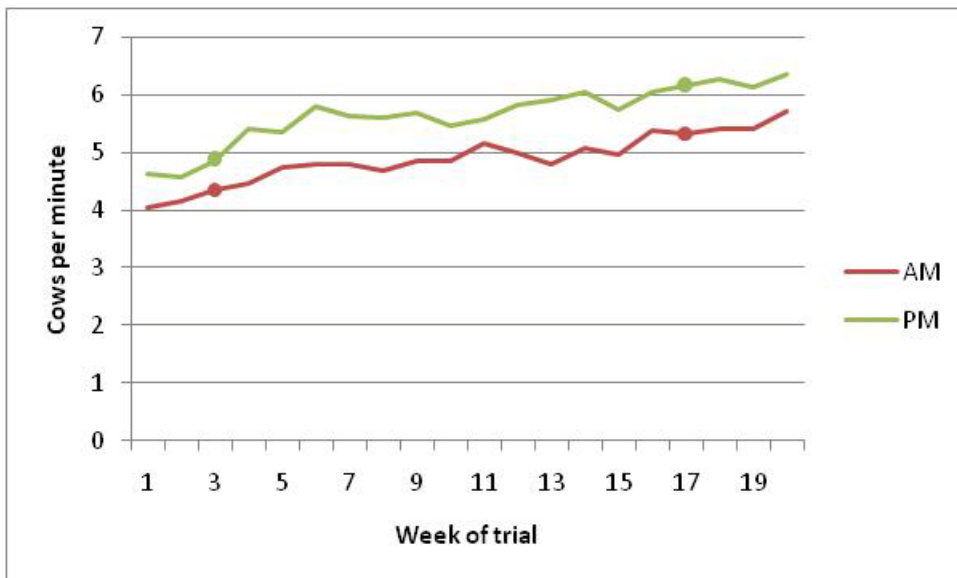
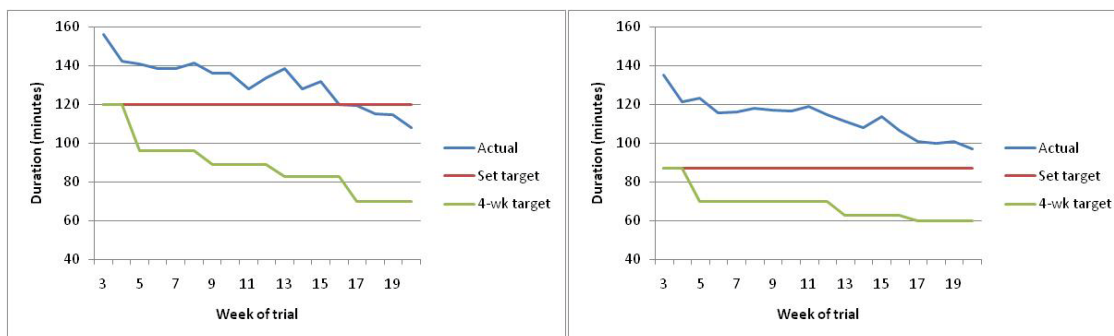


Table 1: Weekly average minutes saved per milking and per day from initiating MaxT milking using the average milking duration for the two weeks prior to MaxT implementation as the baseline.

Week	AM Saving	PM Saving	Daily Saving
3	1	9	10
4	15	22	38
5	17	21	37
6	19	28	47
7	19	28	47
8	16	26	42
9	21	27	48
10	22	27	49
11	29	25	54
12	24	29	53
13	19	32	51
14	29	36	65
15	26	30	56
16	38	37	75
17	38	43	81
18	43	44	87
19	43	43	86
20	50	47	96

Figure 3. Actual milking durations plotted against the initial MaxT targets set and targets calculated 4-weekly for morning (left) and afternoon (right) milkings. Bold points indicate the start and finish of the MaxT implementation period.



The percentage of cows sent around for a second rotation decreased from 8% in week 1 to between 1 and 3% from weeks 3 to 15 (Figure 4). At approximately week 16 the percentage of cows sent around for a second rotation increased in response to a perceived increase in the incidence of clinical mastitis by farm staff, thought to be caused by not allowing cows to milk out completely. This increase in the percentage of the herd sent for a second round on the milking platform had little correlation with overall milking duration (Figure 5). Platform speed, however, was highly correlated with overall milking duration (Figure 6).

Figure 4. Weekly average of percentage of cows sent for a second round at milking at the LUDF herd. Bold points indicate the start and finish of the MaxT implementation period.

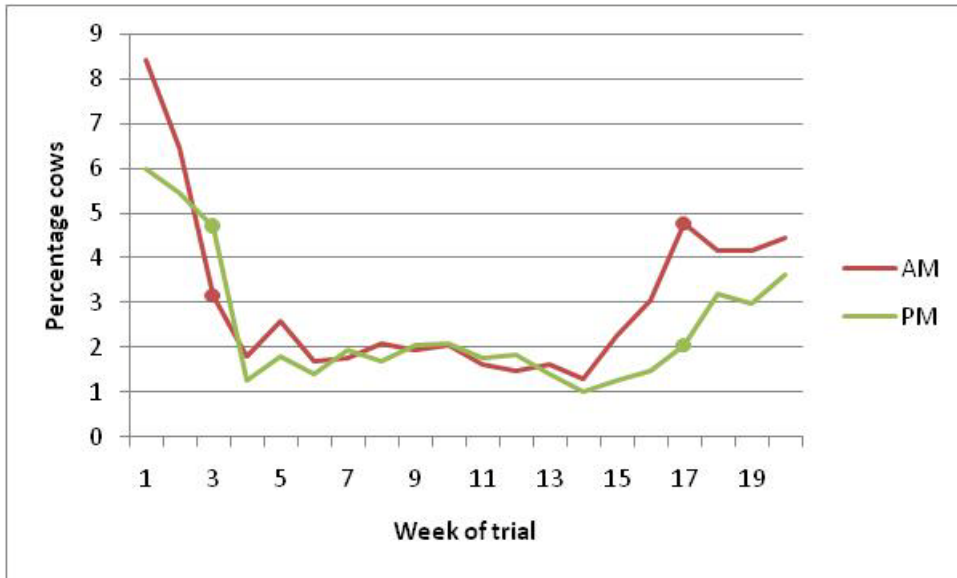


Figure 5. Correlation between total milking duration and percentage of the herd sent around twice.

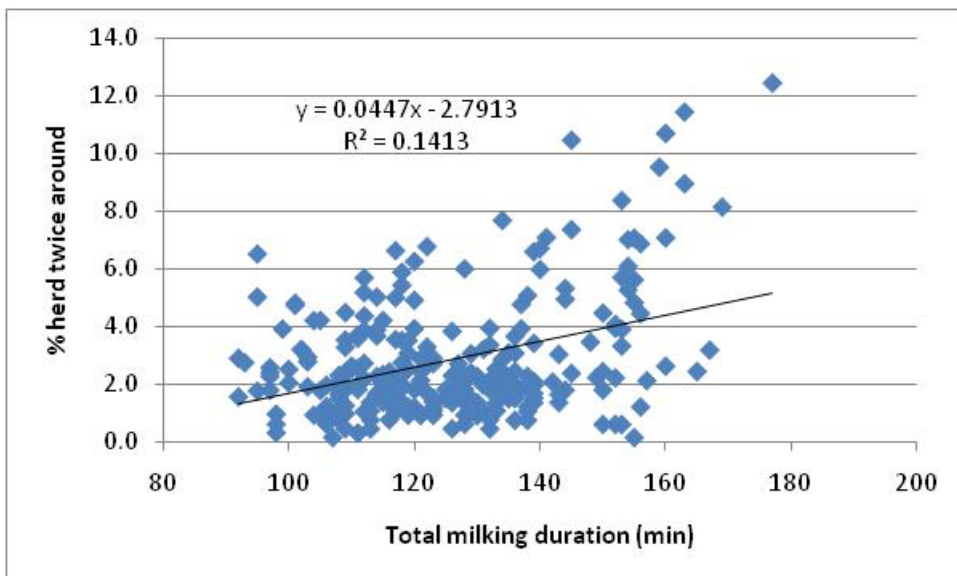
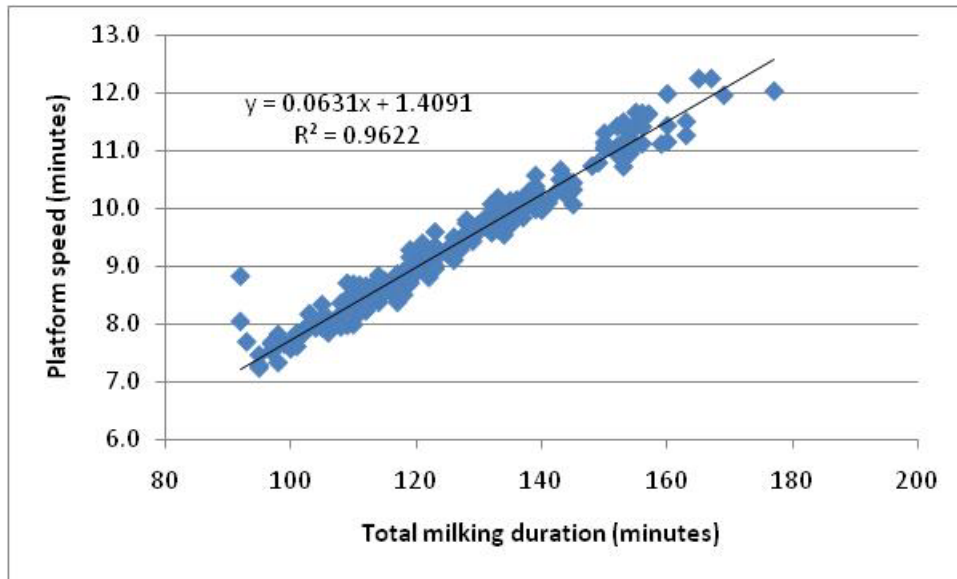


Figure 6. Correlation between total milking duration and platform speed (minutes per rotation).



The bulk milk solids supplied was declining prior to initiating MaxT. As this was a case study, it is not possible to state whether MaxT milking reduced herd milk production (Figure 6). The change in milking routine does not appear to have influenced BMSCC with the weekly average ranging between 182,000 and 258,000 cells/ml during the study period (Figure 7).

Figure 6. Weekly average of supplied milk solids (Fencepost data). Bold points indicate the start and finish of the MaxT implementation period.

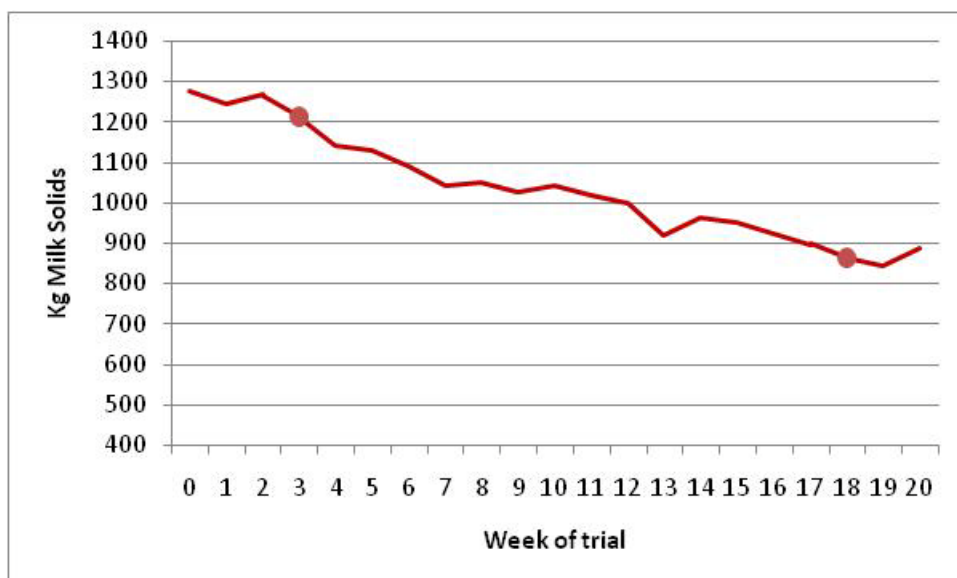
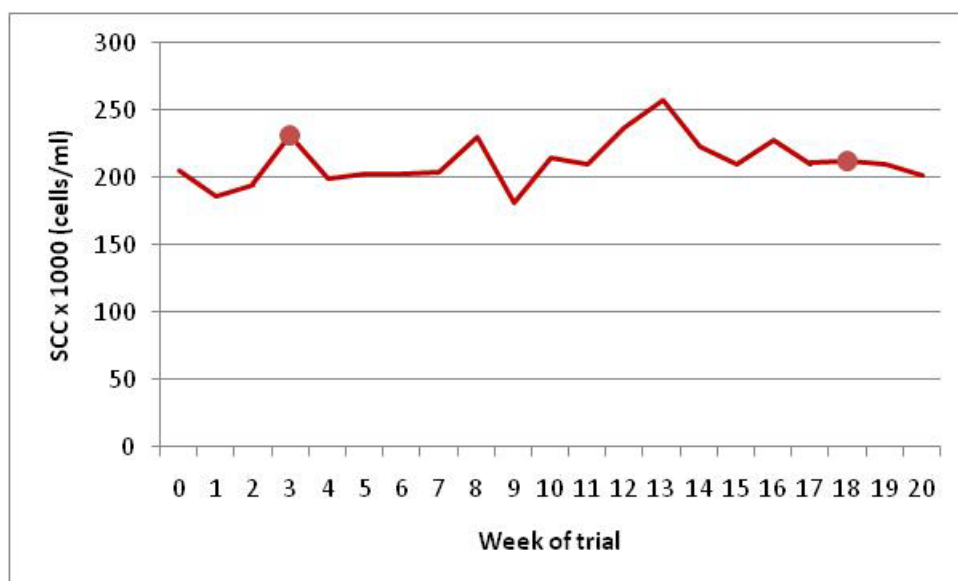


Figure 7. Weekly average of bulk milk SCC (Fencepost data). Bold points indicate the start and finish of the MaxT implementation period.



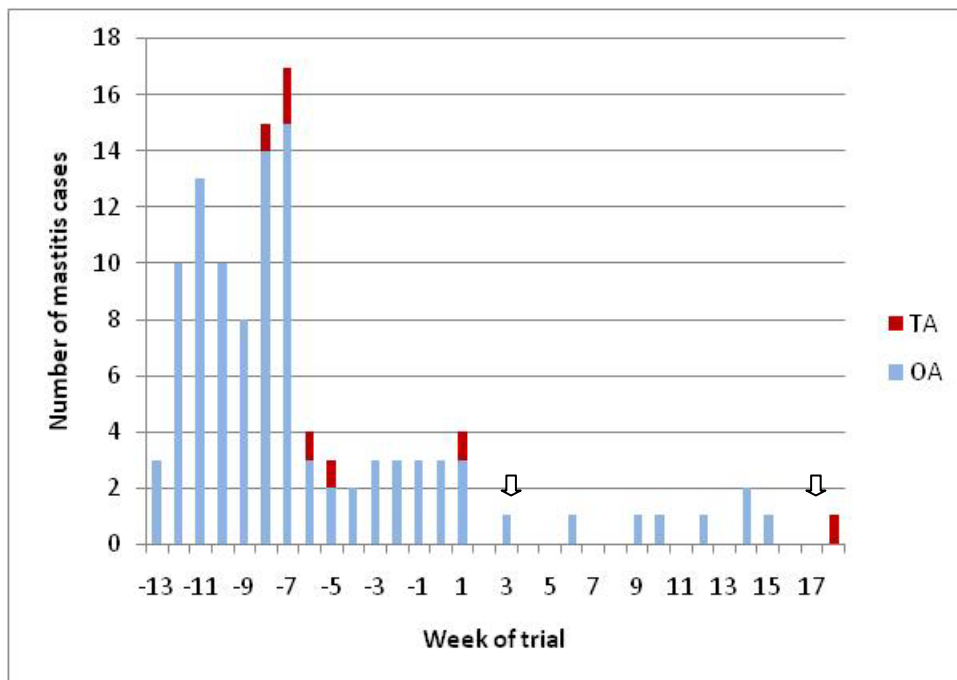
There was considerable variability in the frequency that individual cows were sent around for a second rotation. During the baseline period (week 1) 196 of the 654 cows (29.9%) completed a second rotation for at least one milking, but only 25 cows (3.7%) completed a second rotation for at least 50% of milkings. These cows were on average older (6y v. 4y), averaged 9 fewer days in milk, and were higher producers at peak and late lactation (25.3 v. 23.4 kg milk on 11 November 2008 herd test and 17.4 v. 16.0 kg milk on 23 February 2009 herd test). Using a log transformation, the SCC was consistently higher for the TA group throughout the season compared with the OA group (Table 2). Between weeks 3 and 17, only 6 cows were consistently sent twice around the platform for more than 50% of milkings. Of these, 5 were from the original TA group identified before the MaxT routine was implemented. The 6th cow was a late calver and was not present in the milking herd at the time of selecting the original TA cows. Between weeks 3 to 17, OA cows were sent around on average for 3% of milkings, compared with 26% for TA cows.

Table 3. Log₁₀SCC averages, SED and p-value for OA and TA cows.

Date of herd test	OA	TA	SED
01 October 2008	2.04	2.19	0.12
11 November 2008	1.82	2.11	0.12
02 December 2008	1.75	2.10	0.11
22 January 2009	1.80	2.00	0.10
23 February 2009	1.98	2.39	0.10

Most clinical mastitis occurred in early lactation, prior to MaxT being implemented. In total, 28% of TA cows had clinical mastitis compared with 16% of OA cows. No new cases of clinical mastitis (first occurrence this lactation) occurred in the TA group during the MaxT period (as indicated by arrows in Figure 8) compared with 1% for the OA group (8 cases). Overall, there was no apparent effect of MaxT on the incidence of new cases of clinical mastitis.

Figure 8. Total number of new cases of clinical mastitis by week detected from start of lactation for twice around (n=25) and once around (n=656) cows. Arrows indicate start and end of MaxT.



Teat abnormalities were more frequent at the first assessment (peak lactation), and were more prevalent in TA cows (Table 3). At the end of the study the percentage of cows with teat abnormalities had declined, except for a slight increase in teats scored high for hyperkeratosis in the TA group.

Table 3. Percentage teats with abnormalities and percentage teats scored for low, medium and high hyperkeratosis pre and post implementing MaxT for OA and TA COWS.

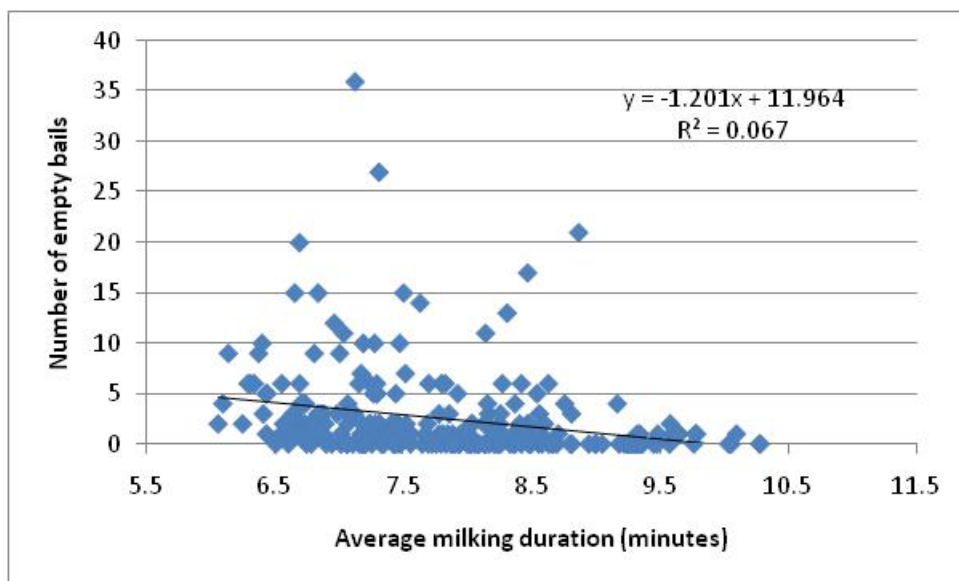
	Pre		Post	
	OA	TA	OA	TA
Number of cows observed	100	15	89	8
% teats with rings at top	47	63	20	13
% teats end hard, wedged or swollen	0	2	1	0
% teats with rough skin	2	7	0	0
% teats with lesions	1	3	0	0
% teats with warts	1	3	1	0
HYPERKERATOSIS				
% teats low score (0-1)	86	87	91	88
% teats medium score (2)	8	12	6	9
% teats high score (3-5)	6	2	3	3

Initial concerns by the farm manager and staff regarding MaxT were loss of production, cows having cups removed with high residual milk remaining, increased risk of mastitis and poor cow flow resulting in more empty bails due to the faster platform speed. Staff considered the positive outcomes to be shorter milking durations and better teat condition. Once MaxT was implemented staff felt there were losses in production, and more mastitis, but they also suggested these were probably not caused by MaxT, with production already declining and bulk milk SCC being high from early lactation. Staff felt cow flow was compromised, with the handler at cups-on having less time to assist with cows moving onto the platform, resulting in more empty bails. This effect was not apparent until weeks 15 and 16 when the average number of empty bails per milking increased dramatically (Figure 9). In week 15, between 10 and 36 empty bails were recorded for 4 afternoon milkings, and in week 16, between 10 and 20 empty bails were recorded for 2 morning and 3 afternoon milkings. However, the number of empty bails showed no correlation with milking speed (Figure 10). Because the incidence of high numbers of empty bails was restricted to a small number of milkings, the increase in empty bails for these milkings may have been caused by an unfamiliar cups-on operator or other unknown factors. Thoughts on improving adoption focused on attaining a suitable speed where cow flow was not affected and the use of other strategies such as allowing all slow-milking cows to be sent twice around at the morning milking only, allowing faster afternoon milking times (a tactic LUDF had used in the season prior to this case study).

Figure 9. Weekly average number of empty bails occurring per milking. Bold points indicate the start and finish of the MaxT implementation period.



Figure 10. Correlation between the number of empty bails and the average milking duration (cups on time).



Summary

Implementing MaxT milking reduced the time spent milking by approximately 40 minutes per day when first introduced at the LUDF. Udder health was not compromised; however, effects on production were unable to be quantified due to the study method.

The MaxT milking routine is reliant on farm staff and managers being confident in adopting the strategy, and having the physical ability and work routine to milk a greater number of cows per minute. In this case study, although total milking durations decreased as the trial progressed, there was a noticeable hesitancy in implementing the faster milking speeds in the first week and, overall, milking times failed to reach the targets set by the Australian CowTime guidelines. Although the time savings appeared to improve through the season, these savings will have been achieved in part by declining yields, so the absolute time savings attributed to shorter milking times cannot be quantified accurately. Adjustments in milking speed to account for declining yields were not implemented due to the difficulty in attaining the initial MaxT calculated. Figure 3 indicates that shifting targets to account for declines in yield would result in more significant time savings than achieved in this case study, but would be dependent on staff being able to cup cows at a faster speed. For example, using the 4-weekly targets at week 17 at LUDC, the cups-on operator would be required to cup more than 10 cows/min to milk 620 cows (number remaining in milk) in an hour. This would be an extremely difficult pace to maintain, highlighting the constraint on achievable shorter milking times in this size of rotary. The lack of a marked increase in the rotation time after MaxT ceased indicates that the platform speed was set at a comfortable rate for cupping, and not necessarily for reducing milking times. If handlers at cups-on were cupping at an uncomfortable rate, an increased rotation time would be expected as milkers reverted back to slower speeds.

Of importance to potential adopters of this strategy are the effects on production, bulk milk SCC and incidence of clinical mastitis. Milking times were improved in this case study by 37-48 minutes during peak lactation. During this period, no effect was apparent on bulk milk SCC, and there was no increase in the incidence of new cases of clinical mastitis. Effects on production are unknown due to the nature of the study method. Previous research has indicated no adverse effects on production and udder health when milking times were reduced by 34% from mid to late lactation on 16 slow-milking cows when compared to controls with ACR (automatic cup removers) set at 200ml/min (Clark et al., 2004). Recent studies by Clarke et al., (2008) also showed no association between increased residual yield and mastitis.

Unexpectedly, sending cows around a second time had very little effect on the overall milking duration. In week 17 approximately 5% of the herd was sent around twice, without affecting the number of cows milked per minute for the same week. The most important factor in decreasing milking times appears to be the actual speed of the platform. It will be important to establish the critical proportion of the herd that could be sent twice around the platform without greatly affecting efficiency. This information may be crucial in improving adoption on commercial farms despite there being strong evidence that shortening the milking duration on these cows will not adversely affect udder health. If 3-5% of the herd could be sent around twice,

farmers may have greater confidence that this system of milking will not increase bulk SCC or clinical mastitis.

This case study has examined important issues for implementation and adoption of MaxT milking on large herds milked in rotary dairies and indicated they are largely unfounded. In particular,

- deeply ingrained beliefs that high residual milk will result in mastitis
- perception that increasing the platform speed may inhibit cow flow onto the platform
- recommended milking durations may be difficult to achieve in some dairies
- the question of optimal dairy size for large herds to maximise the benefits of a shortened milking duration.

References

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