Once-a-day milking: possible and profitable?

M.J. TONG[1], D.A. CLARK[2] and C.V. COOPER[2]
[1]*Whareroa Research Centre, RD 12, Hawera*
[2]*Dexcel, Private Bag 3221, Hamilton*
dexcel.taranaki@netsource.co.nz

Abstract

Once-a-day (OAD) milking offers a major opportunity to improve labour output on New Zealand farms. However few full lactation studies have been undertaken to investigate the effect of this strategy on the productivity of the farm system. A trial was established in 2000 to measure the effect of milking frequency and breed in farm systems where stocking rate was adjusted to equalise per hectare feed demand in different herds. There were four treatments: two herds of 35 Friesian and 42 Jersey cows, at 3.5 and 4.2 cows/hectare respectively, were milked OAD for the entire season. Another two herds of 30 Friesian and 36 Jersey cows, at 3.0 and 3.6 cows/hectare respectively, were milked twice a day. A higher stocking rate was used for the two OAD herds in an attempt to compensate for the effects of the expected decrease in feed eaten. In the Jersey herd, milking OAD resulted in decreased milksolids (MS) yield per cow and per hectare of 22% and 9% respectively. In the Friesians the corresponding decrease was 31% per cow and 19% per hectare. OAD milking resulted in significantly higher protein and milksolids concentrations, and lower lactose concentration. Mean individual somatic cell count was significantly increased by OAD milking, despite the absence of any differences in levels of bacterial infections between herds. The reduction in MS yield per cow and per hectare was smaller for the Jersey herd than the Friesian herd, indicating that the Jersey cow is perhaps better suited to OAD milking.

Keywords: farm system, Friesians, Jerseys, milksolids, milk composition, once-a -day milking, somatic cell count

Introduction

New Zealand dairy farmers have traditionally accepted twice-a-day (TAD) milking as the optimum frequency of milk removal. More farmers are now considering once-a-day (OAD) milking as a strategy to reduce shed expenses, increase labour productivity, improve the utilisation of the milking plant, and create opportunities for alternative employment. However the economic viability of OAD milking over a full lactation period is uncertain because of the decrease in milk production.

Few full lactation studies have compared OAD with TAD milking. Claesson *et al*. (1959) reported a production loss of 50% in the first lactation and 40% in the second lactation to OAD milking compared with TAD milking using Swedish red and white cows, purebreds and crossbreds. In New Zealand, Holmes *et al*. (1992) and Cooper (2000) reported production losses of 35% and 30% respectively to OAD milking over a full lactation. In the former trial, pairs of Jersey, Friesian and crossbred cows were used while the latter trial used Friesian crossbred cows.

For OAD milking to be economically viable, strategies to overcome the decrease in milk production per cow must be implemented. Cows milked OAD have a reduced dry matter intake and heavier liveweight relative to TAD milked cows (Holmes *et al*. 1992). Therefore, an increased stocking rate under OAD milking could help to maintain efficient pasture utilisation and reduce the decrease in milk production per hectare.

A farmlet study was undertaken in 2000 to investigate the effect of breed and milking frequency on milksolids (MS) production and productivity.

Methods and materials

Treatments

The trial was based at the WestpacTrust Agricultural Research Station Normanby site and used two groups of Friesian cows and two groups of Jersey cows. The four herds were balanced for age, calving date, liveweight, condition score, breeding worth (BW), and MS (MS) production (kg/cow) for the previous season. The mean BW and liveweight of the Friesian herds was 59 and 486 kg respectively while the Jersey herds were 48 and 372 kg respectively. The Jersey herds were comprised of 19% two year olds, 17% three year olds and 64% mixed age cows while the Friesian herds were comprised of 20% two year olds, 17% three year olds and 63% mixed age cows. Two herds, of 35 Friesian and 42 Jersey cows respectively were milked OAD for the entire season. Another two herds, of 30 Friesian and 36 Jersey cows respectively were milked TAD. Throughout this paper the following abbreviations are used: FOAD = Friesians milked once daily, FTAD = Friesians milked twice daily, JOAD = Jerseys milked once daily, JTAD = Jerseys milked twice daily.

Each farmlet was 10 hectares so that the stocking rates were FOAD, 3.5 cows/ha; JOAD, 4.2 cows/ha; FTAD, 3.0 cows/ha; JTAD, 3.6 cows/ha. The OAD herds were managed at higher stocking rates (+17%) in order to compensate for the effects of the expected decrease in

pasture eaten per cow for the OAD herds. The level of increase in stocking rate was based on results from previous OAD milking trials (Davis *et al.* 1998).

Management

Farmlets were run under standard decision rules developed by Dexcel (formerly DRC) to ensure that rational decisions were made in relation to grazing management, conservation, supplementation, drying off and culling (Macdonald & Penno, 1998).

Measurements

Animals

Milk volume, composition (milk fat, protein and lactose) and somatic cell count (SCC) was measured for each cow by fortnightly herd test. Individual SCC data were log transformed ($\log_{10}(x+1)$), analysed for statistical differences, then converted back to 1000 cells/ml. Aseptic quarter samples were taken from each cow at calving, mid-lactation and at drying-off and subjected to bacteriological examination. Cow condition score and liveweight were measured fortnightly, from the planned start of calving (1 August) until drying-off, after which this was done monthly. Detailed mating data were recorded, and analysed to calculate the intervals from calving to first ovulation, calving to first oestrus, and calving to conception.

Pasture

Visual estimates of pasture cover in every paddock were assessed at weekly intervals from July to drying-off, then fortnightly over the dry period. Average farm cover, pasture growth, pre- and post- grazing herbage mass and conserved pasture were calculated from these assessments. The visual estimates were calibrated weekly from twelve quadrats ($0.2m^2$) representative of the current pasture cover. The herbage mass of each quadrat was assessed visually and then the herbage was cut to ground level, washed and dried at 95°C for 48 hours and weighed. The weighed herbage mass was then regressed against the visual estimate of herbage mass to give the calibration equation.

Results

Milk Yield and composition

OAD milking resulted in lower yields of milk fat, protein ($P<0.001$), milk and lactose ($P<0.01$) compared with milking twice daily (Table 1). Mean MS yield per cow and per hectare were significantly lower by 27% and 14% respectively in the OAD herds compared with the TAD herds ($P<0.001$). Within each breed group these decreases due to OAD milking were 22% per cow and 9% per hectare respectively for the Jersey herd; and 31% per cow and 19% per hectare respectively for the Friesian herd.

Table 1 Mean values for the annual yields of the main milk components and their average concentrations over the full lactation. (* P<0.05, ** P<0.01, *** P<0.001, NS = not significant).

	FOAD	FTAD	JOAD	JTAD	Significance J vs F	Significance OAD vs TAD	Significance Interaction
Days in Milk	204	235	208	229	NS	**	NS
Milk (kg/cow)	2434	3588	1919	2573	***	**	*
Fat (kg/cow)	108	157	113	145	NS	***	NS
Protein (kg/cow)	87	123	79	102	***	***	NS
Lactose (kg/cow)	115	172	91	126	***	**	*
MS (kg/cow)	195	281	192	247	NS	***	NS
MS (kg/ha)	682	842	807	891	**	***	NS
Fat (%)	4.43	4.39	5.89	5.63	***	NS	NS
Protein (%)	3.58	3.44	4.14	3.97	***	***	NS
Lactose (%)	4.71	4.82	4.77	4.89	**	***	NS
MS (%)	8.01	7.84	10.03	9.60	***	**	NS
SCC (1000 cells/ml)	135	81	174	98	NS	***	NS

OAD milking resulted in significantly higher protein concentrations ($P<0.001$) and MS concentrations ($P<0.01$) than TAD milking (Table 1). The concentration of fat was slightly higher for OAD milking, but these differences were not significant ($P>0.05$). However lactose concentration was significantly reduced under OAD milking ($P<0.001$).

A significant interaction between milking frequency and breed occurred with yields of milk and lactose per cow ($P<0.05$) (Table 1). With TAD milking the Friesian cows produced 39% and 37% more milk and lactose respectively than the Jerseys cows. However, with OAD milking, the Friesian cows produced only 27% and 28% more milk and lactose respectively than the Jersey cow.

The herds milked OAD had fewer days in milk than those milked TAD ($P<0.01$), because the former were dried off earlier in the autumn due to their lower daily milk yields and higher levels of SCC.

The interaction between age and milking frequency on

yields of milk fat, protein, lactose and MS was not significant (P>0.05) (Table 2). In the Jerseys the heifers and older cows produced 23% and 22% less MS than their TAD counterparts, while in the Friesians the decreases in MS were 38% for the heifers and 29% for the older cows.

Table 2 Mean values for the annual yields of MS per cow for heifers and 3+ years for Friesian and Jersey cows milked either OAD or TAD.

Age (years)	FOAD	FTAD	JOAD	JTAD
2	146	235	142	185
3+	207	292	204	263

Age vs milking frequency interaction P= 0.797

Somatic cell count and mastitis

OAD milking significantly increased average individual SCC for cows milked OAD (P< 0.001) (Table 1). However, bacteriological analyses at mid-lactation and drying off indicated no differences between the groups in the incidence of infection (J. Lacy-Hulbert pers. comm. 2001).

Liveweight and condition score

The differences in mean liveweight between both Jersey herds milked OAD or TAD were small throughout the year. However, the differences in the Friesian herds were much larger (Figure 1). From late October the FOAD herd was consistently heavier than the FTAD, and on two occasions this difference was greater than 25 kg per cow (or 0.7 condition score).

From November both OAD herds gained in condition while the TAD herds remained constant (Figure 2). From January, the OAD herds continued to increase in condition while the TAD herds lost condition until there was a

Figure 1 Mean liveweight for Friesian and Jersey cows milked either OAD or TAD for 2000/01.

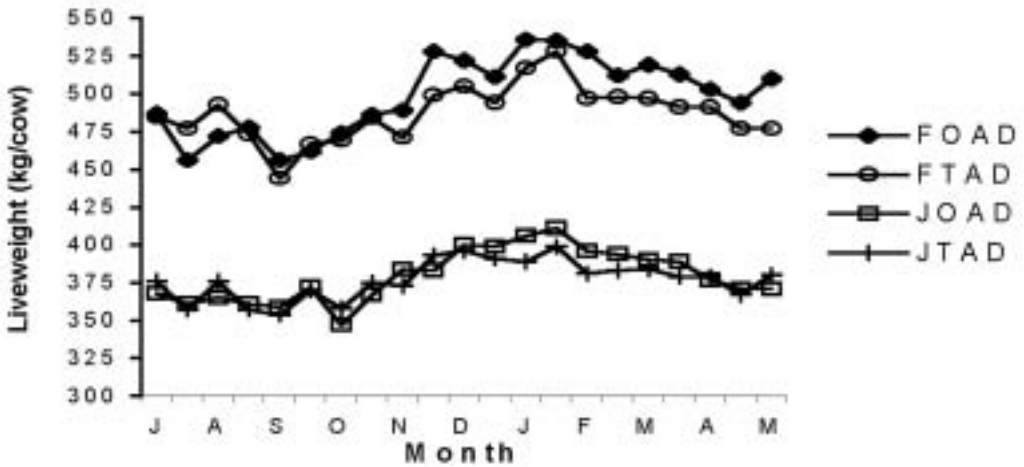
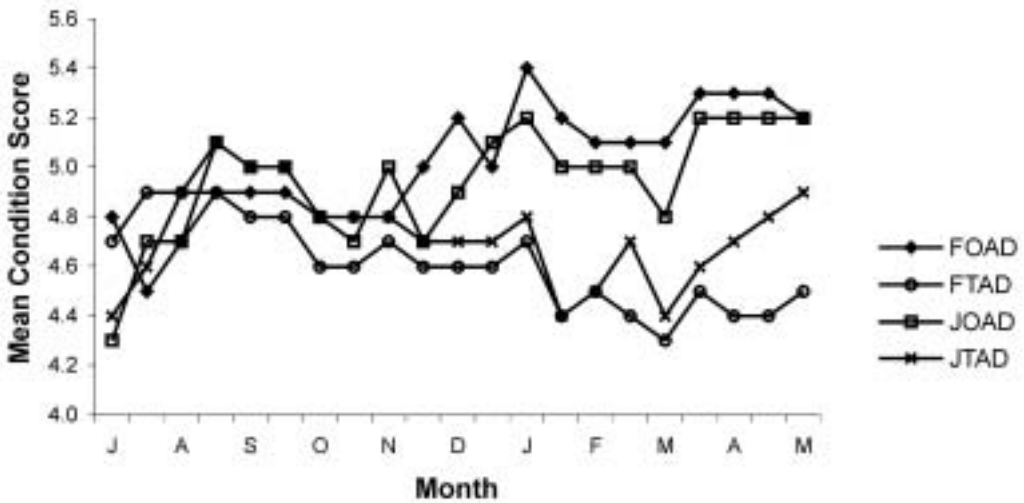


Figure 2 Mean condition score for Friesian and Jersey cows milked either OAD or TAD for 2000/01.



difference of almost one condition score between the Friesian herds and 0.5 a condition score difference between the Jersey herds. In the Friesians the difference was maintained until the end of lactation. However, in the Jerseys the TAD herd increased in condition to reduce the difference to 0.3 units.

Reproduction

Milking frequency did not influence the intervals from calving to first ovulation or calving to first oestrus. However, the mean number of days from calving to conception was 10 days longer for the TAD herds than for the OAD herds ($P<0.05$) (Table 3).

Table 3 Effect of milking frequency and breed on fertility parameters.

	FOAD	FTAD	JOAD	JTAD	Significance FvsJ	OADvs TAD	Interaction
Calving to 1st Ovulation (days)	33.3	37.8	29.0	30.5	*	NS	NS
Calving to 1st Oestrus (days)	46.2	56.1	39.7	42.4	**	NS	NS
Calving to Conception (days)	78.1	92.1	80.7	88.2	NS	*	NS

Pasture

There was no significant difference in the calculated values for pasture production between the treatments (Table 4).

Table 4 Annual pasture production for the four treatment farmlets for 2000/01.

Treatment	Annual pasture production (tDM/ha)
FOAD	17.6
FTAD	17.3
JOAD	16.2
JTAD	17.4

Discussion

OAD milking reduced MS production per cow by 22% and 31% for the Jersey and Friesian cows respectively. These decreases in yields per cow were lower than those reported by Holmes *et al.* (1992) and Claesson *et al.* (1959) of 35% and 40-50% respectively, in trials that used the same stocking rates for both milking frequencies. In the current trial the OAD herds were managed at higher stocking rates than their TAD counterparts. Therefore, higher losses per cow would have been expected in the current trial. It is almost certain that the genetic merit of the cows for milk production in the current trial was higher than in the previous trials. Friesian OAD per cow and per hectare MS production losses were similar to a trial conducted by Cooper (2000). Results from the one-year trial recorded milk production losses of 30% and 18% per cow and per hectare respectively.

There was no effect of age on losses of milk fat, protein, lactose and MS from OAD milking which was consistent with findings by Cooper (2000). However, this is contradictory to results reported by Attrill & Holmes (1993) who indicated that heifers in a commercial herd milked OAD produced considerably less than heifers on the national database milked TAD. The reduction in lactose concentration from OAD milking was consistent with results reported by Holmes *et al.* (1992).

The increase in SCC from OAD milking is consistent with previous full lactation studies (Holmes *et al.* 1992; Cooper 2000) but its cause is not obvious. It may be partially due to a 'concentration effect' in which the number of cells entering the milk is not changed but the SCC is increased due to a decline in milk yield (Kamote *et al.* 1994). It is unlikely that the increase in SCC is due to increased bacterial infections as bacteriological analyses at mid lactation and dry-off indicated no differences between the treatment groups, in agreement with the results of Holmes *et al.* (1992) and Cooper (2000). Holmes *et al.* (1992) suggested the increase in SCC must be due to the effects of physical and/or physiological conditions in the secretory tissue caused by OAD milking.

Herds milked OAD were dried off at earlier dates than the TAD herds, based on decision rules relating to milk yields of < 4 l/cow/day and high somatic cell count at that time. To produce comparable MS per hectare, OAD herds need to have the same or greater days in milk than the TAD herds. If the constraints of low milk yields and increasing SCC levels in late lactation can be overcome, then the OAD herds have the capacity for increased lactation length as they finished with higher values for body condition score and average farm cover.

Milking OAD significantly reduced the number of days from calving to conception, possibly as a result of improved energy balance in early lactation. Holmes *et al.* (1992) and Auldist & Prosser (1998) both observed significant increases in plasma glucose concentration for cows milked OAD. A low level of glucose in the blood plasma is an indication of inadequate feeding levels. Negative energy balance, either as a result of lower feed intake and/or greater milk production during early lactation, has been suggested as a cause of post-partum anoestrus in New Zealand dairy cows. Reducing the number of days from calving to conception may result in

more days in milk for the OAD herds in the long term as a result of a compact calving spread.

As a result of OAD milking there was a decrease in MS production and consequently a decrease in gross farm income. Nevertheless, there are also decreases in input costs that may compensate for this loss in production. For example, OAD milking offers the opportunity for a change in the operation of a dairy farm and hence a change in labour requirements. There are opportunities to reduce operating costs by employing fewer staff, improve the productivity of existing staff, or create opportunities for part-time employment off farm. There are also obvious improvements in lifestyle and reduced stress, both of which are hard to evaluate in monetary terms. There is also scope to reduce other operating costs and improve the utilisation of existing capital.

Conclusion

OAD milking reduced MS production per cow and per hectare but the decreases were smaller in the Jersey herd than the Friesian herd, indicating that Jersey cows may be better suited to OAD milking. However, there was wide variation among cows within each breed, with some cows from both breeds performing well when milked OAD.

Declining milk volumes and increasing levels of SCC in late lactation have been the major factors limiting lactation length. If these constraints can be overcome then the difference in production between the OAD and TAD herds will be further reduced.

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