More Summer Milk – a further investigation into improving summer milk production

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Abstract

An on-farm demonstration designed to increase summer/autumn milksolids (MS) production was continued during the 1997/98 dairying season. The study investigated the combination of an early-summer application of nitrogen (N) fertiliser and a 40-day grazing rotation (the treatment), compared with each trial farm's normal farming practice (the control). The study began on 1 November 1997 with the equal split of herds and farms into farmlets. On the treatment farmlets, 60 kg N fertiliser/ha was applied in November. All treatment herds were on a 40-day rotation from 15 December until drying off. The average rotation for the control herds was 25 days, varying between 18 and 30 days. The season was warmer and drier than average, with four of the five farms experiencing a drought from January to early March. The treatment grew an additional 3.3 tonnes DM/ha to the beginning of June, 49% of the response occurring within the first 42 days of applying N fertiliser. The extra pasture grown on the treatment farmlet had little effect on daily MS production, and overall there was a net loss of $86/ha to the treatment. Possible reasons for this lack of response include over-estimation of pasture growth, poor pasture utilisation, and low protein levels. Despite the additional pasture available in mid lactation, the advantage to MS production occurred only at the end of the season, allowing the treatment cows to milk for 8 extra days.

Keywords: milksolids production, pasture production, grazing management, rotation length

Introduction

The seasonal growth patterns of New Zealand's mainly perennial ryegrass–white clover pastures and the predominance of late-winter/early-spring calving, mean that maximum milk production occurs in the spring, declining through to drying off in April/May. In the Waikato, milk production peaks in late October, then declines by an average of 14% per month. As a result, 75% of milk is produced in the first 175 days of lactation (Macmillan & Henderson 1987).

The "More Summer Milk" project was set up on commercial dairy farms in the greater Waikato in the spring of 1994, to investigate means of reducing the seasonality of milk production. The project was initiated by the Waikato Pasture Joint Action Group comprising Anchormilk, AgResearch, Dairying Research Corporation (DRC) and Livestock Improvement Advisory. The aim was to reduce the decline in post-peak milk production to the theoretically possible 7% per month, by providing an extra 4 kg DM/cow/day during January and February. Such an increase in milk over summer and autumn would improve the utilisation of processing plants, thus providing greater financial returns to the farmer.

The project compared milk production responses from different summer feed options (the treatment) with the existing commercial farming system (the control). Results from the first three years of the trial have been previously summarised by Exton *et al.* (1996), Shaw *et al.* (1997), and McGrath *et al.* (1998). The most profitable strategy was a late-spring application of N fertiliser.

If nitrogen (N) fertiliser applied in late spring boosts summer pasture growth, a longer grazing rotation may effectively ration the extra feed through a deficit, thus reducing the effects of summer-dry periods. Penno *et al.* (1996) demonstrated that a 40-day summer rotation increased both pasture and milksolids (MS) production at no extra cost. Hence, this study investigated the combination of N applied in late spring/early summer with a long summer rotation (the treatment), compared with the normal farming practice (the control).

Project design

The study involved five commercial dairy farms, four representing the more summer-dry areas of the Waikato – Pokeno, Netherton, Maungateparu, Kereone – and one in a wetter area, Te Awamutu (Table 1). Each farm was split equally into control and treatment farmlets on the basis of soil type, topography, pasture type and pasture cover. Cows were allocated equally on the basis of condition score, age and production index. At the beginning of the trial (start of November 1997), the 10 trial farmlets averaged 131 cows on 43 ha (3.1 cows/ha), with a 20-day rotation and 2310 kg DM/ha average pasture cover (APC).

Table 1 Farm details at the beginning of November 1997.

Farm location	Farm area (ha)	Number of cows	Stocking rate (cows/ha)	Rotation length (days)	APC (kg DM/ha)
Pokeno	58	162	2.8	18	2450
Netherton	96	259	2.7	24	2200
Maungateparu	96	278	2.9	20	2400
Kereone	100	300	3.0	17	2400
Te Awamutu	80	312	3.9	20	2100

At the start of November, 60 kg N/ha was applied as urea on 50% of each treatment farmlet, followed 10 days later by extending the rotation length to 30 days, and applying 60 kg N/ha on the rest of each treatment farmlet. All treatment herds were on a 40-day rotation from 15 December until the end of the season. The control farmlets were managed according to each farmer's "normal" farming practice. No N fertiliser was applied in late spring/early summer, and rotation length averaged 25 days for the five control farmlets. Pasture deemed surplus for both treatment and control herds was harvested as silage or deferred, and fed back to the farmlet of origin during February and March.

During April, farmers extended the rotation length for the control herd to have both herds on the same rotation by early May. Drying off was determined by the condition score criteria used at DRC's No.2 Dairy (Macdonald 1997). Cows at a condition score of 2.5 were dried off in early March, 3.5 in early April, and 4.0 at the end of April. Heifers were dried off at half a score higher than the cows. All remaining cows and heifers were dried off by mid May. Control and treatment herds were managed through autumn to have condition score and farm cover the same at 1 June.

The following measurements were recorded:

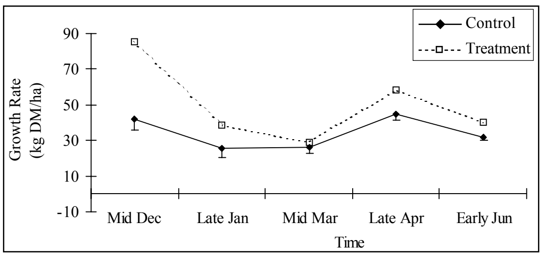
- Daily MS production from the control and treatment herds, using separate vats.
- Pasture production, using two pasture exclusion cages in each of three control and treatment paddocks. Each cage was placed on an area of pasture trimmed to below grazing height. At either 21- (control) or 42-day (treatment) intervals, the pasture in the cages was cut, weighed, oven-dried, and daily pasture growth rate calculated.
- Average pasture cover, using a rising plate meter and seasonal calibration equations developed by L'Huillier & Thomson (1988).
- Cow condition, at 3-weekly intervals by scoring 30 cows randomly from each herd.
- Chemical and botanical composition of pasture samples. During mid January and early April, pasture was collected immediately before grazing from three paddocks in each of the control and treatment farmlets.
- Daily operational costs, management input and the number of cows in milk.
- Profit was then calculated as a gross margin (GM): N fertiliser at $1.20/kg N applied; pasture silage at $0.20/kg DM; MS at $3.50/kg.

Results

The 1997/98 season was warmer and drier than average. Total rainfall from November 1997 to April 1998 was 403 mm, compared with the previous 10-year average for the same period which was 505 mm (data from AgResearch, Ruakura.) Four of the five farms experienced a drought from January to early March.

N application and the extension of the rotation length to 40 days, increased total average pasture production from November to June from 6.9 to 10.2 t DM/ha (an increase of 3.3 t DM/ha) (Figure 1). The effect of the treatment on pasture production was greatest during the first 42-day period, with pasture growth rate 105% greater than the control until mid December. This effect declined until mid March, when growth rate on the treatment dropped to only 13% more than the control. After the drought, the growth rate of the treatment pastures increased, and by the beginning of June pasture growth was 27% greater than that of the control.

Figure 1 Average pasture growth rates from mid December 1997 to early June 1998.



The APC on all farmlets was greatest in mid January, with the control averaging 3180 kg DM/ha and the treatment 3540 kg DM/ha. At this point, APC on the treatment was 11% greater than that of the control. By mid March, this difference declined to 4%, increased to 15% by mid April and by the beginning of May had declined to 5%, continuing to decline (Figure 2). Owing to the higher APC, the treatment cows were consistently 0.1–0.2 of a condition score higher (Figure 3).

Figure 2 Average pasture cover from November 1997 to May 1998.

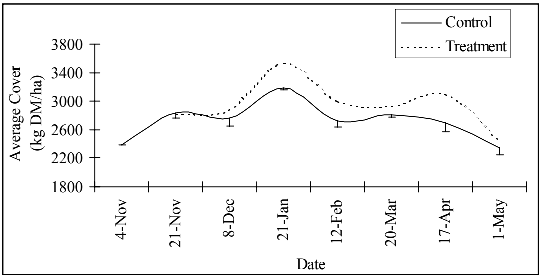


Figure 3 Average cow condition score, from November 1997 to May 1998.

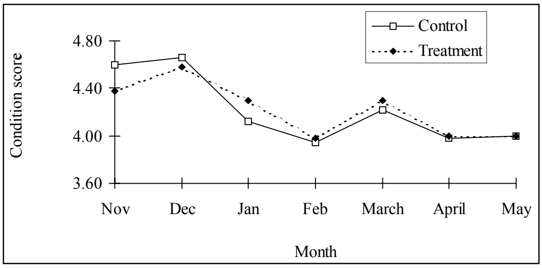


Table 2 shows that by the end of January a small treatment effect on MS was beginning to appear. However, when the drought broke in March, MS production dropped below that of the control herd, but increased again in April and May. Average MS production from 8 November to the end of the season was 444 kg/ha on the control and 460 kg/ha on the treatment. The increase in MS production occurred mainly during April and May, owing to extending average lactation of cows in the treatment herd by 8 days.

Table 2 Average milksolids production (kg MS/ha) recorded for each 30-day period from November 1997 to May 1998.

Month	Control	Treatment	Difference
28 November	128	124	-4
28 December	105	102	-3
27 January	78	82	4
26 February	50	52	2
28 March	51	50	-1
27 April	30	37	7
27 May	2	13	11
Total	**444**	**460**	**16**

The treatment had no effect on botanical or chemical pasture composition (Table 3). The average pasture crude protein content was 12.6% on the four summer-dry farms and 20.1% on the one summer-moist farm in late January, and 24.1% on all farmlets in early April.

To 1 June 1998, the treatment had an average pasture yield advantage over the control of 3260 kg DM/ha (Table 4). An average of 790 kg DM/ha of supplements were conserved as either silage or deferred pasture and fed back to the treatment herds during summer. However, the average MS advantage to the treatment was only 16 kg/ha, owing mainly to an additional 8 days in milk at the end of the season. The overall difference in GM showed a loss of $86/ha for the treatment (Table 4).

Table 3 Average botanical and chemical composition of pasture.

A. Botanical composition (%)

Sample collected	Farmlet	Perennial ryegrass	Other grasses	White clover	Unknown	Weeds	Dead
January	Control	28.1	6.1	4.8	6.7	1.8	53.1
	Treatment	32.7	3.9	5.3	5.7	3.1	49.4
	SED	4.43	2.61	1.53	3.25	2.12	3.58
Early April	Control	69.9	8.3	9.2		4.6	7.7
	Treatment	69.3	8.8	6.4		4.0	10.9
	SED	1.64	3.33	3.18		1.89	1.51

B. Chemical composition (g/100g DM)

Sample collected	Farmlet	Crude protein	Fibre: NDF	In vitro digestibility	Metabolisable energy
January	Control	14.1	55.5	64.9	9.7
	Treatment	14.1	55.5	64.7	9.6
	SED	0.55	1.25	1.60	0.24
Early April	Control	25.1	41.5	74.9	11.2
	Treatment	23.2*	43.8	73.2	10.9
	SED	0.44	1.11	0.67	0.10

* = $p<0.05$

Table 4 Summary of the outputs to applying N fertiliser and extending grazing rotation to 40 days in November/December.

Farm location	Pasture production (kg DM/ha)	Supplements* (kg DM/ha)	Milksolids (kg/ha)	Days in milk	GM ($/ha)
Pokeno	1740	110(s)	5	-7	-76
Netherton	3060	1350(s)	17	12	-282
Maungateparu	4210	2200(d)	5	6	-55
Kereone	3420	290(s)	20	16	-59
Te Awamutu	3870	0	32	15	40
Average:	3260	790	16	8	-86

(s) pasture silage (d) deferred grazing * fed out to the treatment herd over summer

Discussion

From previous trial work at DRC (Penno *et al.* 1996), it was expected that the long grazing round would allow 39% more pasture to be accumulated (1.7 t DM/ha) from November to May. The N was expected (McGrath *et al.* 1998) to produce an additional 0.9 t DM/ha. Hence, this summer feed option was expected to provide an extra 2.6 t DM/ha above base growth from December to May, or at a stocking rate of 3 cows/ha, an increase in available feed of 5 kg DM/cow/day.

Only 43% of the extra pasture production was harvested as either silage or extra MS (Table 4). There are several possible reasons for this apparent poor utilisation.

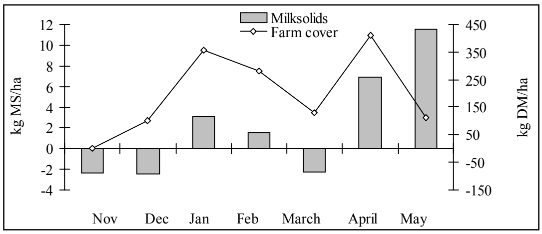
It is possible the increase in pasture production was over-estimated by the cage technique. The cutting intensity adopted to ensure all pasture within the cage area was cut to below grazing height before cage placement may have lengthened the lag phase of the sigmoidal growth (Brougham 1956), thus exaggerating the production difference between the 21- and 42-day cutting treatments.

The pre-grazing herbage mass required (between November and April) to feed the control herd adequately and maintain pasture control (Hainsworth & Thomson 1997) was 2800 kg DM/ha. The actual amount measured was 3100 kg DM/ha. Since the control farmlets had surplus pasture, the additional pasture on the treatment farmlets would have been ineffectively utilised. Poor pasture utilisation may also have resulted from the lack of recognition of surplus feed (Hainsworth & Thomson 1997), or to losses of DM incurred during silage making (Thomson & Wrenn 1996).

The differences between the treatment and control herds in APC and MS production (Figure 4), show that poor MS production may have been owing to insufficient pasture growth to sustain the long rotation and fully feed the cows. From this graph, we can postulate that in order to sustain a 40-day compared with a 25-day rotation, an additional 300-350 kg DM/ha in APC was required. At the break of the drought during early March, there was insufficient farm cover to sustain cows on the 40-day rotation. While farm cover on the 40-day rotation was recovering, cows grazing on the shorter rotation were better fed (Thomson *et al.* 1998). This result confirms the previous observation that the cutting method adopted may have over-estimated differences in pasture production.

Lower pasture quality could have reduced pasture utilisation, as the four summer-dry farms were deficient in crude protein in late January (averaging 12.6%). Low pasture protein levels during summer periods of moisture stress have previously been reported by Ross *et al.* (1978) and Shaw *et al.* (1997). NRC (1989) suggested that 15% crude protein would be necessary to maintain milk production in mid to late lactation. This poses a dilemma for farmers because supplementary feeds available for overcoming summer feed shortages are also low in protein. The finding does, however, highlight an important issue in the feeding of dairy cows during periods of moisture stress.

Figure 4 Difference between treatment and control in milksolids production and average farm cover at monthly intervals from November 97 to May 98.



Results suggest that greater benefits from a long rotation may have resulted if the rotation length had been shortened when the drought broke. In general, unless running a very high stocking rate such as the Te Awamutu farm (3.9 cows/ha), the combination of a late-spring application of N fertiliser with a 40-day rotation would not be recommended. The best management option from the More Summer Milk programme remains the application of up to 60 kg N/ha in November/December with no change in summer rotation length.

Conclusions

The early-summer application of N fertiliser (60 kg/ha) and the extension of the rotation length to 40 days did not achieve the increase in MS production expected from previous studies. There was an increase in pasture production as a result of the treatment, but failure to achieve a MS response may have been owing to over-estimation of pasture growth, poor pasture utilisation, low protein levels, or a combination of some of these factors. From the study it is assumed, for this year, that the adoption of the 40-day rotation negated any benefits that may have resulted from the application of N fertiliser in November/December.

ACKNOWLEDGEMENTS

The farmers involved in the trial: Andrew and Karen Singer, Peter and Megan Corlett, Gary and Donna Tomsett, Jonathan and Joanne Leigh, Bill and Pauline McLeod, and Shane Whittaker. Deanne Waugh for technical assistance. Rhonda Hooper for statistical analysis.

REFERENCES

Brougham, R.W. 1956. Effect of intensity of defoliation on regrowth of pasture. *Australian journal of agricultural research* 7: 377.

Exton, P.R.; Dawson, J.E.; Thomson, N.A.; Moloney, S. 1996. More Summer Milk – Progress To Date. *Proceedings Ruakura Farmers Conference 48*: 34–41.

Hainsworth, R.; Thomson, N.A. 1997. Identifying a feed surplus. *Proceedings of the Ruakura Farmers Conference 49*: 100–105.

L'Huillier, P.J.; Thomson, N.A. 1988. Estimation of herbage mass in ryegrass–white clover dairy pastures. *Proceedings of the New Zealand Grassland Association 49*: 117–122.

Macdonald, K.A. 1997. Profitable dairying. Published by The Dairyman.

Macmillan, K.L.; Henderson, H.V. 1987. Trends in monthly milk production of cows in seasonal dairy herds in New Zealand. *Proceedings of the New Zealand Society of Animal Production 47*: 57–59.

McGrath, D.F.; Dawson, J.E.; Thomson, N.A.; Simons, H.P. 1998. More Summer Milk – the opportunities identified. *Proceedings of the Ruakura Farmers Conference 50*: 85–94.

National Research Council, 1989. Nutrient requirements of dairy cattle. *6th rev. ed. Washington, DC.* National Academy of Sciences.

Penno, J.W.; Bryant, A.M.; Carter, W.A.; MacDonald, K.A. 1996. Effect of nitrogen fertiliser and summer rotation length on milk production in a dry Waikato summer. *Proceedings New Zealand Society of Animal Production 55*: 64–66.

Ross, D.J.; Molloy, L.F.; Collie, T.W. 1978. Influence of fertiliser nitrogen on nitrogen fractions and non-structural carbohydrates in grazed grass-clover herbage. *New Zealand journal of agricultural research 21*: 231–239.

Shaw, R.J.; Thomson, N.A.; McGrath, D.F.; Dawson, J.E. 1997. More Summer Milk – an on farm demonstration of research principles. *Proceedings of the New Zealand Grasslands Association 59*: 149–155.

Thomson, N.A.; McGrath, D.F.; Dawson, J.E.; Simons, H.P. 1998. nitrogen fertiliser and rotation length – an interim report on the 1997/98 MSM Project. *Proceedings of the Ruakura Farmers Conference 50*: 95–98.

Thomson, N.A; Wrenn, N.R. 1996. Costs of making hay and silage. *Proceedings of the Lincoln Animal Industries Workshop, Silages and Hay – Production and Use:* 31–43.

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