Effect of winter pasture residuals' and grazing- off on subsequent milk production and pasture performance

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Abstract

Concern at the effect of winter pasture residuals on pasture productivity led to the comparison of different wintering systems at the DRC No. 3 Dairy from May-December 1993. Three farmlets were designed to have 2000 kg DM/ha average farm cover at calving, but with pastures grazed to either 900, 1400 or 1800 kg DM/ha at least once during the winter. A fourth farmlet was spelled from grazing from 25 May-4 July to give an average farm cover at calving of 2900 kg DM/ha. Pasture regrowth, composition and structure, milk yield, liveweight and reproductive performance were measured. A simulation model UDDER was used to generalise from the specific experimental results. Pasture regrowth in July-August was greater on the wintering-off treatment than those grazed during winter, but treatment differences in late spring were inconsistent. Wintering-off decreased ryegrass tiller and white clover growing point densities in August but differences had disappeared by November. Winter grazing treatment had no effect on any component of milk production from calving to late October. From late October until mid-December milk protein and milksolids yield were less on the wintering-off treatment than the mean of the other three treatments (0.62 vs 0.68 kg/cow/day) and (1.49 vs 1.59 kg/cow/day), respectively. Grazing to different winter pasture residuals had no consistent effects on subsequent pasture productivity, composition or milk yield. Simulation showed that wintering-off can lead to increased milksolids production when average farm cover in September is predicted to fall below 1750 kg DM/ha. Timing and amount of conservation become critical after wintering-off if pasture quality and hence milk production are to be maintained in late spring.

Keywords: dairy cow, milksolids, milk yield, pasture regrowth, pasture residual, pasture structure

Introduction

Over the past 30 years New Zealand dairying has adopted high stocking rates associated with low per cow milk yield. This system relies on the establishment of long winter rotations to ration pasture at maintenance intake with little supplementary feeding and consequently low pasture residuals (Bryant & Sheath 1987). Early calving has been used to complete a greater proportion of the lactation before the summer decline in perennial ryegrass growth rate and quality. Average farm cover at calving and in September are key factors in the success of high-stocked systems. Pasture rationing slows the decline of average farm cover in the first 6 weeks of lactation. This system produces high milksolids/ha but results in underfeeding of cows, but has the potential to damage soil by pugging and may delay the onset of regrowth. Some commentators (e.g., Stakelum 1994) have suggested the use of more nitrogen fertiliser to produce better quality silage for improved winter nutrition. Wintering-off all or part of the herd for 4-6 weeks after drying-off is used as a means of increasing farm cover at calving (Robertson 1994).

Recent work in the Waikato (Chapman 1994) and Southland (Greenwood & McNamara 1992) has shown the deleterious effect of intensive livestock farming on soil physical parameters. There is also concern at the loss of ryegrass plants and the perception that dairy pastures in the Waikato need to be frequently undersown. The present experiment examined the issue of winter pasture residuals and the effect of average farm cover at calving using farmlet systems at Dairying Research Corporation (DRC), Hamilton, in the winter-spring of 1993.

Methods

Site

The DRC No. 3 Dairy farm at Ruakura, Hamilton was used for the experiment from 25 May-15 December 1993. Soil types were Te Rapa silty peat, Te Kowhai silty clay loam and Motumaoho silty peat. Average winter and spring rainfall are 340 and 294 mm respectively; rainfall during the trial period was 279 mm in winter and 199 mm in spring.

Treatments

The experiment used four herds stocked at 3.75 Friesian cows/ha with 24 cows per treatment. Blocks of several 0.4 ha paddocks randomly allocated to treatment gave 16 paddocks per treatment. Table 1 gives the experimental treatments.

Table 1 **Winter grazing management treatments.**

Treatment		Winter (mid-May - mid-August) pasture residual (kg DM/ha)
1	'SPELL	Spelled (25 May-4 July)
2	'900	900
3	'1400	1400
4	'1800	1800

Management

Treatments 2, 3 and 4 were managed to have 2000 kg/ DM/ha average farm cover at planned start of calving on 15 July, to avoid confounding the effects of winter pasture residual with pasture cover. Rotation lengths of 112, 80 and 40 days in winter achieved the residuals of 900, 1400 and 1800 kg DM/ha respectively. Herds 3 and 4 received silage to achieve planned residuals. Cows were re-allocated to herds at calving to avoid confounding the effect of different condition scores resulting from the winter treatments. Herds were balanced for breeding index, age, liveweight (LW), condition score (CS) and calving date. Not all paddocks on treatment 2 had been grazed to 900 kg DM/ha at calving, so these were grazed to that level in early lactation (10.50 kg DM/ha mid July-early August).

Rotation length on all treatments was 80 days on 1 August, 48 days on 1 September and 16 days from 1 October until the end of the experiment, the only exception being the removal of 12.5% of the farm from grazing from 3 October-19 November on treatment 1 to allow silage conservation.

Measurements

Animal

Individual cow milk volume was measured at two consecutive milkings each week. A bulked sample for each cow was analysed for fat and protein content, these two components were used to calculate milksolids (MS) yield. Cows were weighed and scored for condition at fortnightly intervals throughout the experiment. Routine measures of reproduction (calving date, days to 1st oestrus, days to conception, submission rate and conception rate) were recorded or calculated.

Pasture

Farm cover was assessed at weekly intervals by assigning a visual score to each paddock and converting these to kg DM/ha based on weekly calibration cuts. Pasture regrowth over a 6 week period was measured on one recently grazed paddock per treatment by cutting four, 0.25 m^2 areas on each treatment to ground level at weekly intervals. A new series of measurements started each month on: 12 July, 9 August, 6 September, 4 October, and 1 November. Forty tiller plugs (5 cm diameter) per treatment were counted fortnightly for: parent and daughter ryegrass tillers, clover growing points and other grass tillers. In a separate survey 40 tiller plugs per paddock were taken from 8 paddocks per treatment on 12 July and 29 November and counted for: clover growing points, ryegrass, *Poa* and other grass tillers. Visual assessments of botanical composition were made on each paddock at monthly intervals. Two observers were trained in visual assessment based on botanical dissection of plant material from a range of experiments.

Simulation

A dairy farm simulation model UDDER (Larcombe 1990) was configured with the results from the actual treatments. It was then used to analyse what might happen at different stocking rates with or without wintering-off. The effect of wintering-off was related to the key parameter of minimum farm cover in September.

Statistical analysis

Milksolids, LW and CS were analysed by covariance analysis using days since calving as a covariate for 3 periods: 16 July-3 September, 3 September-22 October, and 22 October-15 December. Pasture regrowth was analysed as 2 separate periods: start-week 3, week 3-week 6 using ANOVA. Subsamples were used to obtain an estimate of error. Tiller plug data were analysed by ANOVA after square root transformation. Treatment effects on the presence and absence of species in plugs were determined by chi-square analyses.

Results

Pasture

The greatest proportionate difference in regrowth in the first 3 weeks after grazing occurred in August: SPELL > 1400 > 1800 > 900 ($P<0.05$). Significant effects for other months were not consistent (Table 2). The SPELL treatment produced 49% more regrowth from week 3-6 for the August closure than the mean of the other three treatments ($P<0.05$), but was less than all other treatments for September ($P<0.05$). Again, significant effects for other months were inconsistent.

The effect of winter grazing treatment on the proportion of tiller plugs containing either white clover, *Poa* spp., or perennial ryegrass is shown in Table 3. No treatment effects on any species were apparent in July. By November the SPELL treatment had fewer ($P<0.05$) plugs containing white clover, and *Poa* spp. ($P<0.05$).

Table 2 Effect of winter grazing treatment on pasture regrowth (kg DM/ha) in weeks (O-3) and weeks (3-6).

	Winter Treatment				
Week O-3	**SPELL,**	**900**	**1400**	**1800**	**SED**
July	432	546	241	300	42
August	044	151	577	408	29
September	1383	1515	1397	861	68
October	2252	2195	1785	2052	68
November	970	589	1021	964	124
Week 3-6					
July	805	940	814	780	49
August	1632	1129	1051	1107	63
September	172	1617	1853	2189	118
October	1404	1303	2156	3195	137
November	2767	3198	3816	2917	185

Table 3 Effect of winter grazing treatment on proportion of tiller plugs containing either white clover, *Poa* spp., or perennial ryegrass in July and November. (Chi-square test based on all possible species combinations plus absence of all species.)

	SPELL	900	1400	1800
White clover				
July	81.2	70.0	80.6	70.5
November	50.3	65.0	62.6	62.8
***Poa* spp.**				
July	34.4	33.7	33.7	32.5
November	21.3	35.0	31.7	29.4
Perennial ryegrass				
July	59.7	70.6	69.6	61.3
November	63.1	71.0	68.8	70.3
July	χ^2 = 25.4 ns	df = 21		
November	χ^2 = 44.2 p<0.01	df = 21		

There were also fewer plugs with all three species present, and more plugs containing none of the three species (P<0.001). By November, all treatments had fewer plugs containing white clover than in July, but the proportion of plugs containing perennial ryegrass remained unchanged.

The SPELL treatment had lower perennial ryegrass parent (2740 vs 4980 tillers/m^2) and daughter density (57 vs 214 tillers/m^2) (P<0.05) and white clover density (620 vs 1280 growing points/m^2) (P<0.001) in August than all other treatments. However, these densities increased during spring and by November there were no significant treatment differences. The SPELL treatment contained less clover (P<0.05) than the mean of the other three treatments (11.2 vs 15.5%) and more dead matter (15.8 vs 7.2%) (P<0.001) in July. There was also more dead matter in October (6.8 vs 4.9%) (P<0.001). Other winter grazing treatments had no effect on perennial ryegrass, white clover or dead matter content.

Animal

Table 4 gives treatment effects on milksolids and milk protein yield per cow and liveweight changes. For periods 1 and 2 (16 July-22 October) the only treatment effect was greater milk protein yield in Period 1 for the 1800 compared to the 1400 treatment.

Table 4 The effect of winter grazing management on milksolids and milk protein yield (kg/cow/day), liveweight change (kg/cow) and average farm cover (kg DM/ha) for period 1 (16 July-3 September), period 2 (3 September-22 October) and period 3 (22 October-15 December). (Least squares means adjusted for days since calving.)

	SPELL	900	1400	1800	SED
Milksolids					
Period 1	1.53	1.62	1.48	1.58	0.076
Period 2	1.02	1.60	1.79	1.78	0.073
Period 3	1.49	1.57	1.60	1.59	0.054
Milk Protein					
Period 1	0.64	0.68	0.62	0.69	0.033
Period 2	0.60	0.78	0.79	0.78	0.033
Period 3	0.62	0.67	0.69	0.66	0.025
Liveweight change					
Period 1	-44	-87	-66	-62	10.8
Period 2	-3	39	30	11	5.7
Period 3	10	16	25	24	6.5
Average farm cover					
Period 1	2580	1910	2000	1960	
Period 2	2820	2370	2390	2360	
Period 3	3240	2820	2950	2920	

In period 3 (22 October-15 December) milk protein yield from the SPELL treatment was less than the 1400 (P<0.01), 1800 (P<0.05) and 900 (P<0.1) treatments. Milksolids yield from the SPELL treatment was less than the 1400 and 1800 treatments (P<0.1). At no stage were significant treatment differences in milk fat yield detected.

Liveweight losses in period 1 are largely due to calving. However, liveweight was regained less quickly for the 900 treatment and was significantly less than the SPELL treatment (P<0.05). In period 2 cows on the SPELL treatment continued to lose LW, while those on all other treatments gained (P<0.05), and in period 3 the SPELL treatment continued to gain less LW than either the 1400 or 1800 (P<0.05).

Days to first oestrus were less on the 1400 treatment (3 1 days) than on the other three treatments (mean = 43 days) (P<0.001). There were no significant differences in days to conception, submission rate or conception rate.

Simulation

Model simulations were run at 3.4-3.9 cows/ha for a 40 day wintering-off period from late May-July and an on-farm wintering system. Both systems were optimised for pasture allocation (rotation length) from July-November. Table-5 shows the advantage to milksolids/ha from wintering-off compared to on-farm wintering for a range of realistic minimum farm covers. in September. Wintering-off only. produces extra milksolids/ha when on-farm wintering will lead to average farm covers below 1750 kg DM/ha in September. It is not a linear relationship - yield responses become increasingly large as farm cover declines.

Table 5 Effect of minimum farm cover in September on milksolids advantage to wintering-off as simulated by UDDER.

Minimum farm cover - on farm wintering (kg DM/ha)	Milksolids advantage to wintering-off (kg/ha)
1400	75
1600	25
1800	-9
2000	-11
2200	-13

Discussion

Pasture

The much greater-regrowth in the first 3 weeks after *grazing for* the SPELL treatment *in August was* unexpected. This could not be attributed to differences in grazing residuals because these were the same for all treatments. Brougham's (1956) work indicated that a high pasture mass in late winter as a result of autumn-saved pasture will have a deleterious effect on both pasture quality and subsequent regrowth. This has been attributed to a reduction in tiller and stolon density and lack of available nitrogen. In the present experiment both ryegrass tiller density and white clover growing points decreased in August on the SPELL treatment. However, there is now evidence (Chapman et al. 1983) that tiller density is not a good indicator of total pasture yield. The lack of any treatment differences in either ryegrass or white clover density by November, demonstrate the recuperative ability of these pastures. However, presence and absence data on tiller plugs in November showed that the SPELL treatment had larger areas without white clover, larger areas of bare ground and a reduced distribution of Poa spp. The reduced light environment in the SPELL swards from June onwards may be responsible for lower germination and/or survival of *Poa annua.*

The inconsistent treatment effects on regrowth from monthly closures, reinforces the notion that factors other than grazing management determine the total yield of pasture when grazed under feasible systems (Bryant & Sheath 1987). It implies that a wide range of wintering options can be adopted without concern that subsequent lactation performance will be compromised.

Animal

The three winter grazing residuals had no effect on total milksolids yield, or on pattern of milksolids production during the spring. This agrees with the similarity in total farm cover at calving and pasture regrowth in the first 3 weeks after grazing. There was no advantage in milksolids/cow to any treatment from calving to 22 October, implying no advantage to the 30-40% higher pasture allowance, as a result of higher pasture cover, in early lactation for the SPELL treatment.

From 22 October until 15 December the SPELL treatment produced less milksolidslcow than the 1400 and 1800 treatments, and less milk protein than all other treatments. This was probably due to the lower digestibility of the SPELL pasture during this period, resulting. from the higher 'average farm cover carried throughout the spring (Hoogendoorn et *al.* 1988). With hindsight, silage should have been made a month earlier in mid-October rather than mid-November. Hoogen-doorn *et al.* (1988) recommended residual herbage mass of no more than 1500 kg DM/ha throughout spring, if depression of milk yield by decreased pasture quality was to be avoided.- In the present experiment mean September-October residual herbage mass was 1750 kg DM/ha averaged over the three winter grazed treatments, compared with 2125 kg DM/ha for the SPELL treatment,

The liveweight data (Table 4) show the nutritional profile of cows on the different treatments. From calving to 3 September SPELL cows lost less LW than cows on the 900 treatment indicating better nutritional status post-calving. However, from 3 September onwards the SPELL cows gained only 7 kg while the average for the other three treatments was 48 kg - a reflection of the better quality pasture on the latter treatments. No explanation is offered for the much shorter period to first oestrus for cows on the 1400 treatment compared with the rest.

Simulation

The UDDER simulations predicted that wintering-off becomes a sensible option for increasing milksolids if average farm cover is likely to fall below 1750 kg DM/ha in September. Feed budgeting in autumn can help predict the likelihood of this happening. In the present experiment average farm covers in September for the three winter grazing treatments reached minima of approximately 1900 kg DM/ha (Table 4). Simulations suggest that at this level there would be no production advantage to wintering-off.

Implications

The combined experimental and simulation data suggest that wintering-off will:

- Not lead to serious changes in pasture composition
- Allow more silage to be conserved
- Make the timing and amount of conservation critical if pasture quality is to be maintained in late spring and a decline in milksolids avoided
- Lead to increased milksolids/ha when average farm cover in September will fall below 1750 kg DM/ha if cows are wintered-on.

Provided adequate pasture covers are 'achieved at calving and in early lactation, a wide range of wintering options can be used without affecting the subsequent lactation,

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