The effect of block and paddock grazing in winter on cow behaviour, cow performance and herbage accumulation

T.G. JUDD, N.A. THOMSON[1] AND M.L. BARNES

Taranaki Agricultural Research Station, P.O. Box 711, Hawera, New Zealand.

ABSTRACT

Two management methods for wintering dry cows on pasture (block and paddock) were compared at the Taranaki Agricultural Research Station over a 45 day period. Treatment effects on aggressive behaviour, grazing behaviour and liveweight gain were measured in addition to effects on pasture treading damage and subsequent herbage accumulation.

The block grazed group had an area of 25 m^2/cow/day, and were confined to a new area (0.1 ha) of pasture each day. The paddock grazed group had an area of 125 m^2/cow/day, grazing the total paddock area (0.5 ha) over five days. There were 32 cows and 8 heifers in each treatment group.

Agonistic activity in the paddock group was 50% lower in week one and 28% lower in week six, than the block group. Paddock cows and heifers gained more liveweight ($p<0.01$) than block cows and heifers; 0.22 and 0.24 kg/animal/day more respectively. Herbage accumulation over the subsequent three months (July - September) was 290 kg DM/ha lower ($p<0.05$) on the paddock grazed areas compared to block grazed areas.

Paddock grazing reduced agonistic activity among heifers and cows and gave higher liveweight gains. Some of this advantage could possibly be negated by lower herbage accumulation in the subsequent three months.

Keywords: Winter grazing; cow density; aggressive behaviour; liveweight gain; herbage accumulation.

INTRODUCTION

Trial work investigating the effect of wintering systems on the performance of dairy cows by Thomson *et al* (1991) and Thomson and Barnes (1992), highlighted behavioural characteristics within a herd as possibly an important factor affecting dairy production. The conventional grazing system designed for wintering non-lactating cows on pasture in New Zealand is termed block grazing. Under such a system, cows are confined to a small area (0.8 - 1.2% of total farm area/day) and shifted to fresh pasture daily. The density of cows, under this system, is high (300-400 cows/ha). As a result, aggressive behaviour will increase (Kondo *et al*, 1990) and heifers will be the major recipient of the aggression (Young, 1992). In association with an increase in aggressive behaviour, liveweight gain is limited as less time is spent grazing (Friend and Polan 1977, Young 1992).

Thomson *et al* (1991) reported that when heifers and cows were wintered separately, at the same stock density as mixed-age herds, liveweight gain improved for both age groups compared with cows and heifers in the mixed-age herd. When the age groups were joined at calving the liveweight advantage was lost within a month, and production over the first four months of lactation was unaffected by wintering method. The lack of response in milksolids to the extra liveweight was attributable to a possible increase in aggressive behaviour due to the introduction of new cows to an established social hierarchy (Bremner, 1975).

To overcome these problems, an alternative wintering system, 'paddock grazing' was devised. Heifers were introduced to the herd at the start of winter and cow density was reduced, while maintaining a long winter rotation. Under this system, cows are given a larger area but are maintained on the area for longer, thus retaining the desired rotation length and maintaining the desired level of pasture rationing. This method of wintering, termed 'paddock grazing' was evaluated in comparison with block grazing at the Taranaki Agricultural Research Station over June and July 1992.

MATERIALS AND METHODS

The study comparing block and paddock grazing commenced on 18 May 1992 and ran for 45 days. Sixty four cows from the Taranaki Agricultural Research Station's reserve herd and 16 heifers were randomly allocated to the two grazing treatments, balanced for age, liveweight, condition score, breed, BI, and calving date. The heifers had no previous experience of grazing with mature cows and were introduced to the experimental herd at the commencement of the trial.

Nine, 1 ha paddocks were selected for the trial and half of each paddock was allocated to one of the grazing treatments. The block cows were confined with temporary electric fences to 0.1 ha/day (25m^2/cow, or a cow density equivalent to 400 cows/ha) and shifted daily to a new area. The paddock cows were allocated 0.5 ha on which they remained for five days, giving 125m^2/cow or a cow density equivalent to 80 cows/ha. Grazing was organised to offer an average pasture allowance of 9 kg DM/cow/day. Silage was fed to achieve a total daily intake for all cows of 6.0 kg DM/cow/day. Block cows were fed silage and shifted to a new break of pasture each day at 9.30 am. The paddock group was fed the same total

[1]Dairying Research Corporation, Private Bag 3123, Hamilton, New Zealand.

amount of silage but it was fed on days 3, 4 and 5 only, at a similar time each day to the block cows.

Animal Measurements

Liveweight and condition score assessments were taken before the trial began (for treatment randomisation), and at the start and end of the trial. On each occasion, at 9.00 am, cows were weighed, off pasture, and condition score assessed.

Grazing and aggressive behaviour of cows and heifers was assessed over two, five day monitoring periods; days 1-5 (week one) and days 36-40 (week six). At the commencement of behaviour monitoring periods, all heifers were marked across the back with brightly coloured raddle to aid identification. The behaviour of each treatment group was recorded daily by one trained observer and each day the two observers alternated between groups. The same two observers were used throughout the trial.

Cow behaviour was observed for ten, 20 minute periods throughout the day; 9.00-9.20 am, 9.30-9.50 am, 10.00-10.20 am, 10.30-10.50 am, 11.00-11.20 am, 11.30-11.50 am, then 2.30-2.50 pm, 3.00-3.20 pm, 3.30-3.50 pm, 4.00-4.20 pm. Over each period total agonistic encounters were recorded, including initiation and avoidance of threatening activity, head butts, head swinging, chasing, or displacement by passive movement, for heifers and cows. At the end of each 20 minute period a record of grazing behaviour was made by recording the number of cows and heifers grazing, standing or sitting.

Pasture Measurements

Herbage mass before and after grazing, of each paddock, was assessed using the rising plate meter. Meter readings were converted to herbage mass (kg DM/ha) using the equation for winter published by L'Huillier and Thomson (1988). The information obtained was used to calculate herbage allowance and the rate of DM disappearance (kg DM/cow/day) to ensure that feeding levels of pasture and silage remained constant for the two treatments throughout the trial.

An estimate of pasture treading damage was made after the grazing of every second paddock (five assessments) using a point analysis of bare ground, clean pasture and dirty pasture. Clean pasture was noted when pasture was green, free of mud and soil. Dirty pasture was noted when pasture was muddy, with little or no green leaf visible. On the 'block' area, five frames were placed along a randomly selected 10 metre line, across each of the five breaks. On the same day, 25 frames were placed along a randomly selected 50 metre line, across the 'paddock' area.

Net herbage accumulation was measured from each paddock for two grazings following the application of the winter grazing treatments. From estimates of herbage mass (rising plate meter) before and after each subsequent grazing, herbage accumulation was calculated by the difference method.

RESULTS

Behaviour

Over both weeks more agonistic encounters were initiated by cows than heifers, however the encounters received were similar from the two age groups (Table 1). In week one of the study block grazed heifers and cows initiated and received twice the number of agonistic encounters as that observed in the paddock grazed group. By week six, agonistic activity for both groups had declined, the decline being greater under block grazing but remaining 28% higher than paddock grazing.

On days when silage was fed to the paddock group in both weeks one and six (Table 1), average agonistic encounters initiated and received by heifers and cows increased to levels similar to those in the block group.

TABLE 1: Agonistic activity of heifers and cows in week one and week six (agonistic encounters/cow/day).

	Week 1		Week 6	
	Paddock	Block	Paddock	Block
Initiated				
Heifers	4 (7)*	9 (10)	3 (4)	5 (4)
Cows	9 (15)	16 (17)	7 (10)	10 (10)
Received				
Heifers	9 (15)	15 (15)	8 (12)	9 (10)
Cows	7 (13)	15 (16)	5 (8)	8 (9)

* Bracketed figures are encounters/cow/day when silage was fed to both groups (day 4 and 5).

Within each group the grazing behaviour of heifers and cows was similar (Table 2). In week one, 71% of paddock animals were observed grazing in the morning compared to 96% of block animals. Paddock animals continued grazing into the afternoon (73%) while grazing activity of the block group dropped to almost half that of the morning. By week six, the percentage of paddock animals grazing in the morning had increased to 81% and continued at this level into the afternoon, whereas in the block group, grazing activity had dropped to 82% in the morning, and increased to 63% in the afternoon. Paddock and block animals, if not grazing, tended to stand around rather than sit.

TABLE 2: Grazing behaviour of paddock and block grazed animals throughout the day (% of animals).

		Week 1		Week 6	
		Paddock	Block	Paddock	Block
Grazing	am	71	96	81	82
	pm	73	49	79	64
Standing	am	29	4	17	18
	pm	26	43	20	33
Sitting	am	0	0	2	0
	pm	1	8	1	3

Liveweight and Condition

Paddock heifers and cows gained 5 and 10 kg of liveweight ($p<0.01$), respectively, over the 45 day trial period, whereas block heifers lost 6 kg and block cows maintained liveweight (Table 3). In contrast, there were no differences between treatments for condition score. However, regardless of treatment, heifers lost more condition than cows.

TABLE 3: Effect of winter grazing management on change in liveweight and condition score.

	Paddock	Block	SE	Significance
Liveweight Gain (kg/45days)				
Heifers	5	-6	1.5	**
Cows	10	0	1.5	**
Condition Score Change				
Heifers	-0.3	-0.4	0.04	NS
Cows	-0.1	-0.1	0.04	NS

Dry Matter Disappearance and Residual Herbage Mass

The rate of dry matter (DM) disappearance (kg DM/cow/day) during the trial was similar for both treatments (Table 4) although marginally lower than the 6 kg DM/cow/day that was aimed for. Consequently no difference between treatments in residual herbage mass was recorded (Table 4).

TABLE 4: Pasture parameters: residual herbage mass, DM disappearance, pasture damage, and herbage accumulation.

	Paddock	Block	SE	Significance
Residual Herbage Mass (kg DM/ha)	1370	1390	12.6	NS
DM Disappearance (kg DM/cow/day)				
- Pasture	3.3	3.4	0.18	NS
- Silage	2.6	2.5	0.11	NS
- Total	5.9	5.9	0.11	NS
Pasture Damage				
- % Clean pasture	48	45	5.9	NS
- % Dirty pasture	21	33	1.3	**
- % Bare ground	30	22	4.6	NS
Herbage Accumulation (kg DM/ha)				
- 58 days (July/August)	510	710	32.3	**
- 24 days (September)	440	530	54.7	NS
- Total herbage accumulation	950	1240	67.7	*

Pasture Damage and Net Herbage Accumulation

No difference was recorded between treatments for clean pasture or bare ground although there tended to be more bare ground on the paddock areas (Table 4). There was more dirty pasture ($p<0.01$) on block areas than paddock areas.

Net herbage accumulation (58 days in July/August) was lower ($p<0.01$) from paddock grazed areas compared to block grazed areas (Table 4). By the second grazing (24 days in September) no differences were recorded. Total herbage accumulation from July to September was lower ($p<0.05$) by 290 kg DM/ha on paddock areas compared to block areas.

DISCUSSION

Behaviour and Liveweight

The increase in area/cow (125m^2) under paddock grazing reduced agonistic activity of both heifers and cows. The effect was most notable in week one when heifers were introduced to the herd for the first time. This observation is supported by Bremner (1975) who found an increase in agonistic activity following the introduction of previously unknown cows to a herd. Also, Kondo *et al* (1989) observed that agonistic interaction in adult cattle increased as the group size increased, but decreased rapidly if the area/cow increased. Agonistic encounters received by heifers and cows were higher than those initiated. There are two possible explanations for this, either; the aggressor displaced more than one cow, or the difficulty for observers of determining whether cow movement was in response to a threat or whether the cow moved for other reasons. This suggests that encounters initiated may give a better assessment of aggressive behaviour than encounters received.

When competition for food existed (ie. on feed-out days under paddock grazing) the levels of agonistic activity were similar for both groups. In this situation the total area available/cow was no longer the dominant factor influencing cow behaviour. To minimise the effect of competition for food under paddock grazing, all supplements could possibly be fed out on day one, allowing cows greater choice, and thus reducing competition for food and cow density.

The grazing patterns of paddock and block animals were different. Approximately 75% of the paddock cows and heifers continued grazing throughout the day. Under block grazing, with less space/cow, the combination of close proximity and competition for food led to approximately 90% of animals grazing in the morning, and dropping to 50% in the afternoon as the food supply diminished. This would suggest that the behaviour of cows on the two treatments was influenced partly by the grazing system and partly by the method adopted for feeding silage.

The greater liveweight gain of paddock animals over the trial period was attributed to reduced agonistic activity. In support of this conclusion, Friend and Polan (1978) observed that cows involved in more agonistic activity spent less time eating. Possible differences due to; gut fill at weighing, or paddock cows grazing regrowth are discounted. Estimates of daily DM disappearance on paddock grazed areas (Judd unpublished), show disappearance rates of 13, 2, 6, 4 and 4 kg DM/cow/day. For the four days before weighing DM intakes of paddock cows were similar to or less than those of block cows (5.9 kg DM/cow/day). A minimal effect of grazing regrowth could possibly have occurred. At an average pasture growth rate of 10 kg DM/ha/day in June and July (Roberts and Thomson,1986), an increase of only 0.1 kg DM/cow/day would occur.

Other workers also report negative effects of aggressive behaviour on dairy cow performance. Brantas (1968), Schein *et al* (1955), and Brakel and Leis (1976) reported small short-term reductions in milk production following the introduction of strange cows to the herd, and Moberg (1991) found that behavioural stress could prevent animals achieving normal reproductive success. From these studies, and the results of this study, it would be reasonable to assume that reducing social stress would have benefits in animal production.

Pasture Parameters

The only difference recorded in estimation of pasture damage was an increase in dirty pasture on the block areas

which suggests greater animal movement and is supported by the information on aggressive behaviour presented in Table 1. The increase in subsequent herbage accumulation recorded from the block grazed areas suggests either; minimal damage to pasture from the extra animal movement, or a detrimental effect on herbage accumulation imposed by paddock grazing. The later is supported by Thomson *et al* (1993) who showed a reduction in herbage accumulation rates when cows were allowed to back graze over previously intensively grazed pasture (strip grazing). Paddock grazing would be similar in effect to strip grazing and it appears from these two studies that the longer cows remain on the area the slower the rate of herbage accumulation.

CONCLUSION

While there is a clear benefit to paddock grazing, as implemented in this study, through increased liveweight gain, this must be balanced against losses in subsequent herbage accumulation.

The trial highlights that stock density effects on animal behaviour could influence and bias the interpretation of grazing trials where stock densities vary (eg. pasture allowance studies). The authors suggest that monitoring and reporting of animal behaviour would aid interpretation of trial results. The subsequent effects on pastures should also be considered in short term grazing trials, as in this study, much of the potential benefit to dairy production by paddock grazing was negated due to the detrimental effect on subsequent herbage accumulation.

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