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Effect of contrasting spring grazing management on summer-autumn pasture and milk production of mixed ryegrass-clover dairy swards

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ABSTRACT

Research at Massey University has shown that a spring grazing management laxer than the conventional intensive grazing allowing some early ryegrass seedhead development before close grazing at anthesis ("Late Control") may result in improved summer-autumn pasture production. Comparisons between conventional and late control spring grazing managements for dairy cows were carried out, on a paddock scale, during 1992/93. Late control swards showed enhanced dry matter production before (24.5% increase - $P < 0.05$) and after (32.0% increase - $P < 0.10$) the control grazing in early December. Concomitant measurements of animal performance revealed that the increased pasture production during the summer-autumn period could be effectively converted into milk by dairy cows, and resulted in an increase in milk-solids production of about 10% per cow ($P < 0.10$). The implications of these results to dairy management systems are discussed in the context of pasture responses to spring management and alternative conservation strategies.

Keywords: dairy cow; milk production; pasture production; perennial ryegrass; spring management; white clover.

INTRODUCTION

Earlier dairy grazing management research in New Zealand was based on understanding the nature of the pasture regrowth curve (Brougham, 1957) and defining grazing strategies to optimise efficiency of pasture utilisation (McMeekan & Walshe, 1963). Further attempts have been made to fine-tune the systems developed by McMeekan and others and, more recently, research at Ruakura has focussed on grazing mangement regimes which reduce the spring surplus through early control (EC) of reproductive growth (L'Huillier, 1987, 1988). By contrast, evidence gathered at Massey University (Matthew *et al.*, 1989) revealed that there could be benefits to spring and summer-autumn pasture production in perennial ryegrass swards from adoption of a more lenient defoliation regime than the conventional intensive spring grazing used to keep pastures leafy and dense. This approach to spring grazing management has been called "late control" (Matthew, 1991). Since late control (LC) is expected to encourage reproductive growth and increase the spring surplus, this system would be unsuitable for hill country farms where control of the spring surplus is already a problem. However, on most dairy farms it would be possible to accommodate an increased spring surplus, but information is needed on whether this is best accomplished in conjunction with conservation strategy or exclusively through varying grazing management.

In order to answer this question, to evaluate the effects of the LC spring grazing management on pasture and animal responses, and to evaluate two methods of achieving it in a farm situation, a field experiment was carried out at N° 4 Dairy Farm, Massey University, during the 1992/93 dairying season. The present paper reports on the results obtained, drawing attention to the practical implications for dairy systems management.

MATERIAL AND METHODS

Site

The trial was carried out at N° 4 Dairy Farm, Massey University. Pastures were two to three years old and comprised a mixture of perennial ryegrass (*Lolium perenne* L. cv. 'Grasslands Nui'), white clover (*Trifolium repens* L. cv. 'Grasslands Pitau') and red clover (*Trifolium pratense* L. cv. 'Grasslands Pawera') sown on an Ohakea silt loam soil. Original soil nutrient status was medium/low (15 ppm Olsen-P and 0.25 meq Exch-K/100g soil), and due to signs of nitrogen deficiency 30 Kg/ha of nitrogen as urea were applied in October 23 on two of the experimental blocks.

Trial layout

Five (1.7 ha) paddocks were each divided into three strips (plots) by electric fencing. Three grazing treatments were randomly allocated to the three strips in each paddock (block), giving a completely randomised block design with five replicates. During the period of measurement (December 4 to April 29), three groups of seven Friesian dairy cows each were assigned to the experimental grazing treatments. Cows were first drafted from the main herd (250 cows) according to age, lactation days, pregnancy status, levels of milk-fat and milk-protein production in the current lactation, and current liveweight and body condition score. Cows were then randomly selected to comprise the final experimental groups. Experimental animals had an average initial liveweight of 490 Kg and body condition score of 4.4. Each cow was considered an experimental unit, giving a completely randomised design with seven replicates.

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Experimental treatments

During the preparation or pre-control phase (September to November), split paddocks were rotationally grazed (20-day grazing intervals) by the whole herd from September to November to residues of either 1500 (one strip per paddock - EC) or 1800 Kg DM/ha (two strips per paddock - LC). On December 4 a control phase was commenced whereby managements intended to control reproductive growth were introduced on the two LC strips. At this time, groups of cows were transferred to the experimental area and randomly assigned to the three experimental treatments as follows:

(i) Hard grazing (1500 Kg DM/ha residues) continued on EC strips, with a grazing interval of 20 days (4 breaks/strip) and a stocking rate of 2.5 cows/ha.

(ii) LC strips (1800 Kg DM/ha residues) were returned to post-grazing residues of 1500 Kg DM/ha within four weeks (December 4 to January 2) by either:

(a) No conservation: reduction of the grazing interval from 20 to 10 days (2 breaks/strip) without changing stocking rate (2.5 cows/ha) (Very Fast Rotation - LC-VFR);

(b) Simulating conservation: increase stocking rate by 43% to 3.6 cows/ha, corresponding to taking a silage area of 30% of the farm, achieved with the use of three additional cows and a grazing interval of 15 days (3 breaks/strip) (High Stocking Rate - LC-HSR).

During the post-control phase from January 3 onwards, extra cows in the LC-HSR treatment were drafted out of the experiment, and common grazing management applied to all treatments (20-day grazing interval up until January 30 and then 30 days; stocking rate of 2.5 cows/ha). Measurements continued until drying-off date (April 29).

MEASUREMENTS

Pasture measurements

Herbage accumulation was determined from 12 random quadrat areas (0.1 m^2) per plot before and after each grazing cut to ground level with an electric shearing hand-piece. Cut herbage was washed to remove soil contamination and then dried at 80 °C for 24 hours in a forced-draught oven. Samples were taken for determination of botanical composition by cutting a hand-piece wide strip alongside each quadrat. Bulked samples for each strip were taken to the laboratory, washed, sub-sampled and the herbage from each of two sub-samples separated by hand dissection into ryegrass leaf and stem, other grasses leaf and stem, clover leaf and stolon, weeds and senescent material. After drying, samples were weighed and the proportions (%) of species components determined. Herbage accumulation (Kg DM/ha) was calculated by the difference between pre-grazing and post-grazing herbage masses for successive grazings.

Animal measurements

Measurements of animal performance were carried out from December 4 to January 2 and January 3 to April 29, the control and post-control phases of the reproductive development of ryegrass plants respectively. Milk yield was measured for each cow on a daily basis by the Ruakura Milk Harvest System installed on the milking machine. Cows were milked twice daily at 7:00 am and 4:30 pm. Milk samples were taken at 7-10 day intervals using a proportioning Milk Meter (Tru Test Co. N.Z.) and composition of representative milk samples was determined by infra-red absorption (Milk-O-Scan; A/S N Foss, Denmark). Prior to the commencement of the period of animal measurements, milk yield and composition for the main herd were measured on a monthly basis, and these results used as covariates during the statistical analysis of the data.

Cows were weighed and condition scored at monthly intervals. For consistency, these measurements were always carried out after the morning milking and were performed by the same person.

Statistical analysis

Pasture response data was analyzed according to a randomised complete block design with 8 degrees of freedom for error, and standard errors were derived from strip means (n=5). Results generated from sequential harvests were analyzed using the "repeated measures" option of the SAS general linear models procedure. Animal response data was analyzed according to a completely randomised design with 18 degrees of freedom for error, and standard errors derived from cow means (n=7). Data were subjected to a repeated measures analysis of covariance, using as covariates the accumulated yield of each cow from calving until one week before the animal measurements started.

RESULTS

Pasture performance

Herbage accumulation during spring (September-November) was increased by the LC grazing regime (LC-VFR and LC-HSR) (Table 1). This increase was a consequence of the reproductive development of ryegrass plants under lax grazing, and was associated with a higher content of grass stem and senescent material in LC-VFR and LC-HSR swards than in EC. During the control period treatments did not differ in total herbage accumulation, although LC-VFR and LC-HSR swards contained a significantly higher proportion of senescent material ($P < 0.01$). After the control phase (January 3 to April 29) the LC-VFR and LC-HSR swards accumulated more herbage than EC swards ($P < 0.10$), with the increase in production being a result of enhanced ryegrass and clover accumulation.

Animal performance

Levels of fat yield and (fat+protein) yield were similar across treatments during the control phase (Table 2), but were greater on treatments LC-VFR and LC-HSR than EC over the summer-autumn period ($P < 0.10$). Changes in liveweight and body condition score of the experimental cows were minor and did not differ significantly between treatments (Table 3).

DISCUSSION

Lax grazing during the spring period resulted in an increased rate of pasture accumulation (Table 1), based on a greater rate of reproductive development (Da Silva *et al.*,

TABLE 1: Herbage dry matter accumulation (Kg DM/ha) during the experimental period

Herbage	Phase[1]	EC	Treatment LC-VFR	LC-HSR	SEM	Signif.[2]
	pre	3400	4440	4030	317	*
Total	control	2020	2650	1650	414	ns
	post	3910	5420	4900	561	+
	pre	3320	3920	3630	303	ns
Green	control	2010	1700	1360	334	ns
	post	4210	5060	5430	673	ns
	pre	900	1360	940	279	ns
Ryegrass	control	860	660	200	195	*
	post	1750	2360	2300	537	ns
	pre	1380	1280	1370	327	ns
Clover	control	830	1120	1230	404	ns
	post	1950	2200	2980	619	ns
	pre	80	520	400	84	**
Senesc.	control	10	950	290	202	**
	post	-300	360	-530	375	ns

In this and subsequent tables:
1) Pre = Oct-Nov/92; Control = Dec/92; Post = Jan-Apr/93
2) ns = $P > 0.10$; + = $P < 0.10$; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$

TABLE 2: Milk solids production (fat, protein and fat+protein) during the period of animal performance measurement (Kg/cow).

Milk	Phase	EC	Treatment LC-VFR	LC-HSR	SEM	Signif.
Fat	control	27.0	27.0	27.0	1.06	ns
	post	90.0	94.0	99.0	3.47	+
Pro	control	20.5	20.5	20.0	0.69	ns
	post	65.0	68.0	69.0	2.06	ns
Fat+pro	control	47.5	47.5	47.0	1.60	ns
	post	155.0	162.0	168.0	5.10	+

TABLE 3: Average change in liveweight (Kg/cow/month) and body condition score (units/cow/month) during the overall animal measurement period (December 4 to April 29).

Milk	EC	Treatment LC-VFR	LC-HSR	SEM	Signif.
Liveweight	11	9	9	1.550	ns
Cond. score	0.11	0.14	0.00	0.105	ns

1993). Such a pattern of response is in agreement with results reported previously by several authors (Korte, 1982; Korte *et al.*, 1982,1984; Thomson *et al.*, 1984; Butler, 1986; Bryant & L'Huillier, 1986; L'Huillier, 1987,1988; L'Huillier & Aislabie, 1988; Hoogendoorn *et al.*, 1992). Reproductive swards frequently show higher growth rates than vegetative swards due to a more efficient utilization of the incident light (Leafe *et al.*, 1974), though the possibility that increased leaf area (Bircham & Hodgson, 1983) was also a factor in increased herbage production on LC-VFR and LC-HSR strips during the pre-control phase must be acknowledged. During the control period (December 4 to January 2) LC-VFR and LC-HSR swards were restored to their vegetative state. Even though no difference was observed in total herbage accumulation for this period, late controlled swards accumulated more senescent material than EC, particularly LC-VFR (Table 1).

The increased herbage accumulation by LC-VFR and LC-HSR swards during the summer-autumn period (post-control) was a consequence of increases in both ryegrass and clover accumulation (Table 1). Although LC-VFR swards showed a slightly higher total herbage production than LC-HSR, no difference was observed between them in terms of green material accumulation. Most of the additional senescent material accumulated by LC-VFR was generated during the control and early post-control phases, demonstrating that heavier grazing pressure (LC-HSR), equivalent to removing paddocks from the rotation for forage conservation, was a faster and more effective way to control pastures than moving to a short rotation (LC-VFR). Enhanced herbage accumulation after a period of reproductive development interrupted at anthesis has been reported previously in perennial ryegrass (Matthew *et al.*, 1989; Xia *et al.*; 1990; Matthew, 1992). It has been postulated to be a consequence of an enhancement in tillering activity, due to a re-distribution of reserve carbohydrates stored in the reproductive stem towards the sites of new tiller formation (Matthew, 1992). White clover plants have also been demonstrated to benefit from a lax defoliation regime, allowing the storage of more reserve carbohydrate and resulting in bigger stolons and more competitive plants (Grant & Barthram, 1991; Davies, 1992; Barthram & Grant, 1993).

Individual cow performance was not affected during the period of control of reproductive growth on treatments LC-VFR and LC-HSR, despite the higher proportion of grass stem and senescent material in those swards than in EC swards. During the period of common management, once the vegetative state of the swards was re-established, individual cow performance as expressed by milk-fat and milk solids yields was higher for those treatments with a greater rate of herbage accumulation (LC-VFR and LC-HSR), particularly LC-HSR. During this post-control period, animals on each of the three treatments were offered similar areas to graze daily, resulting in a better level of feeding to those grazing swards with a higher herbage accumulation rate. Levels of significance obtained for the January-April period were only marginal ($P < 0.10$) probably due to the small number of animals used, but became more significant towards the end of the season (March-April) ($P < 0.05$) (Da Silva, 1994). Changes in liveweight and body condition score were small, there being no treatment differences in body condition score at drying-off (4.5).

Pasture production data gathered during three consecutive years revealed an advantage to late control treatments over the conventional intensive spring grazing management (Da Silva *et al.*, 1993). The evidence from this latest trial supports the view that the increased pasture growth from late controlled swards can be converted to increased milk production, but further confirmation of this would be desirable.

Implications for farm practice

On a farm scale, late control could be implemented by either a delay in shutting up paddocks for conservation or strategic use of supplementation in early spring in order to decrease grazing pressure on pastures and allow early seedhead development. Under those circumstances, post-grazing residuals would be around 500 Kg DM/ha higher than those conventionally used, and the normal average pasture cover over the whole farm would increase by the same amount. Control of reproductive growth would be achieved later, at anthesis, with paddocks being taken out for silage in December rather than in November. Such a grazing management could improve animal performance in early lactation through higher herbage allowances, and in late lactation through increased herbage accumulation which could be used either for increased milk production or to extend lactation. The incorporation of such a grazing practice into a farm system context is dependent upon further research providing a strong knowledge base to support the decision making process.

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