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The effect of stocking rate and breed on the period of postpartum anoestrum in grazing dairy cattle

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ABSTRACT

The effects of stocking rate (low, L; and high, H), breed (Jersey, J; and Friesian, F) and age (2, 3, >3 years old) on the intervals from calving to first ovulation and to first oestrus were assessed in pasture grazed dairy cattle using a 2 x 2 design. Cows in the FH herd had longer intervals from calving to first postpartum ovulation (C-ovn1; 49.2 vs. 24.7, 31.1 and 29.4 days) and calving to first oestrus (C-h1; 52.2 vs. 30.9, 38.9 and 35.3 days) than the other 3 herds. Two year old cows had longer C-ovn1 (40.2 vs. 27.2 days) and C-h1 (47.1 vs. 32.5 days) intervals than older cows, with 3 year old cows intermediate. The high stocking rate herds had reduced CS, liveweight and milk production compared to the low stocking rate herds. Condition score and milksolids production were inversely related to the C-ovn1 and/or C-h1 intervals. Increased stocking rates were associated with longer periods of postpartum anoestrum.

Keywords: Friesian; Jersey; postpartum anoestrum; stocking rate.

INTRODUCTION

Postpartum anoestrum (PPA) has been identified as a problem in pasture-grazed New Zealand dairy herds and is a result of interacting managerial, physiological, pathological and nutritional factors (Macmillan and Clayton, 1980). Following parturition, energy provided by feed intake is insufficient to meet the demands for milk production, so most cows are in negative energy balance (NEB; Butler *et al.*, 1981). Both the extent and duration of NEB have been associated with length of the interval from calving to first ovulation (C-ovn1) (Canfield and Butler, 1990). Liveweight, body condition score (CS) and milk production provide indirect measures of the energy balance. Cows with extended periods of postpartum anoestrus (PPA) have been shown to be in NEB longer, to lose more CS, to eat less and produce less milk than cows ovulating earlier postpartum (Staples *et al.*, 1990).

A farm's stocking rate is positively correlated with the total economic return to the farm-owner (Deane, 1993) which has led to increases in stocking rate on many New Zealand farms. Increased stocking rates may be associated with reduced feed intake for individual cows which may prolong the period of postpartum NEB and PPA.

The aims of the present trial were to quantify factors affecting variation in the C-ovn1 and calving to first oestrus (C-h1) intervals in cows of different breeds and ages grazed at different stocking rates.

MATERIALS AND METHODS

One hundred and ten mixed age dairy cows were formed into 4 herds on 1 June, 1990 in a 2 by 2 factorial arrangement on the basis of breed (J and F) and at 2 stocking rates (L and H; Table 1; Albhorn and Bryant, 1992). Each herd was designated to a farmlet (7.5 ha) which consisted of 18 equal-sized paddocks, of predominantly ryegrass/white clover pasture, grazed in rotation. Pasture mass was estimated before and after grazing three times weekly and the dry matter disappearance/cow (DMD) rate derived.

Following calving, which occurred between 2 July and 27 August 1991 (mean = 24 July ± 1.9 days) oestrous detection occurred on a twice daily basis and milk volume, milkfat and protein production were estimated weekly. Twice weekly milk samples (20 ml) were taken for subsequent progesterone (P_4) analysis from 20 cows from each herd. First ovulation was defined as occurring 5 days before the first sample contained >2.5 ng/ml of P_4. All cows were weighed and CS (1 = thin, 10 = fat) was estimated at fortnightly intervals throughout the trial.

Continuous data were analysed by GLM using repeated measures where appropriate. The effect of age (2, 3, >3 years), breed and stocking rate on the C-ovn1 and C-h1 intervals were examined by general linear models. The calving date was included as a covariate in all models. The relationships among the independent variables and the C-ovn1 and C-h1 intervals were examined by stepwise regression. Categorical data were analysed by χ^2 analysis.

TABLE 1: The breed, numbers, stocking rate and metabolic weight of the four herds.

Herd	Abbreviated herd name	n	SR† (cows/ha)	Metabolic Weight (kg $^{0.75}$) *
Low Stocked Jersey	JL	26	3.5	1858^a
High Stocked Jersey	JH	33	4.5	2305^b
Low Stocked Friesian	FL	22	3.0	1879^a
High Stocked Friesian	FH	29	4.0	2308^b

* Total mass of the herd (mean of 6 weighings from 17/8/91 to 26/10/91)
† Stocking rate

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RESULTS

Jerseys had shorter C-ovn1 and C-h1 intervals than F as did the low stocking herds compared to the high stocking rate herds (Table 2). The interaction between stocking rate and breed approached significance for both intervals as the effect of stocking rate was more pronounced in F than in J (Table 2). The 2 year old (yo) cows had longer C-ovn1 (40.2, 33.5 and 27.2 ± 6.2 days for 2 yo, 3 yo and older cows, respectively) and C-h1 (47.1, 38.4 and 32.5 ± 4.6 days for 2 yo, 3 yo and older cows, respectively) intervals than older cows. Because the calving date by breed interaction was significant for the C-h1 interval, separate models were fitted for each breed. The C-h1 interval was significantly related to calving date in the J (-0.41 ± 0.13, $P<0.01$) but not the F cows (-0.03 ± 0.18). The proportion of cows that had not ovulated (No ovn) or had not been detected in oestrus (No oestrus) by 50 days postpartum differed among herds ($P<0.01$; Table 2).

The average CS was higher for J than F (4.7 ± 0.1 vs. 4.4 ± 0.1) and for cows at the low stocking rates compared to animals at the higher stocking rates (4.8 ± 0.1 vs. 4.4 ± 0.1 cows, respectively). However, the stocking rate by breed interaction approached significance since the J herds did not differ in CS as much as the F herds (Table 3). The high stocked herds lost more CS over the first month of lactation than the low stocked herds (0.7 vs. 0.4 ± 0.1, $P<0.01$) and contained lighter animals (363 ± 5 vs. 385 ± 6 kg, $P<0.05$). For liveweight, the stocking rate by breed interaction approached significance since the J herds differed than the F herds (Table 3). Jerseys had lower production than F (1.6 ± 0.1 vs. 2.2 ± 0.1, kg milksolids/cow/day) and cows at the higher stocking rates produced less than animals at the lower stocking rates (1.6 ± 0.1 vs. 2.3 ± 0.1 kg; Table 3).

Average dry matter disappearance (DMD) from June to October was lower in the high stocked herds (9.3 vs. 10.8 and 9.7 vs. 12.1 ± 0.2, kg DM/cow/day, for JH vs. JL and FH vs. FL, $P<0.05$, respectively) than the low stocked herds (Figure 1). The high stocked F had lower DMD/cow than the low stocked F in each month except July and the high stocked J had lower DMD/cow than the low stocked J in July, September and October.

The mean CS (weeks -4 to + 8 relative to calving) was not significantly related to the C-ovn1 interval in the full model, but when this relationship was examined within each breed, the mean CS in F was negatively related to the C-ovn1 interval (-15.9, $P<0.1$), but not related in J (1.7).

Mean CS (slope = -7.9, $P<0.05$) and the milksolids production at week 4 (slope = -14.2, $P<0.001$) postpartum were significantly related to the C-h1 interval. A breed by mean CS interaction occurred with the mean CS being negatively related to the C-h1 interval in F (-14.7; $P<0.1$), but not in J (-3.9).

FIGURE 1: Dry matter disappearance/cow (DMD) for the 4 herds.

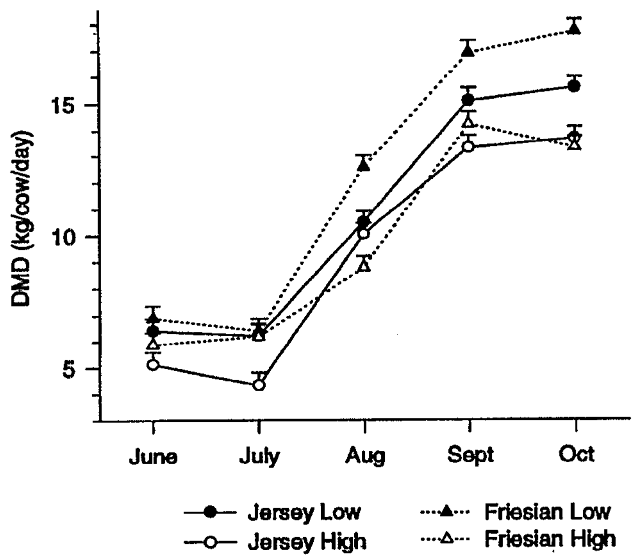

TABLE 2. The intervals from calving to first ovulation (C-ovn1) and from calving to first oestrus (C-h1) and the percentage of cows not ovulating (No ovn) or not detected in oestrus (No oestrus) by 50 days postpartum for each of the four herds.

	JL	JH	FL	FH	SED	Age	Breed	Cd†	SR	SR|Breed††
C-ovn1 (days)	24.7^{b}	31.1^{b}	29.4^{b}	49.2^{a}	5.0	*	*	*	**	0.11
C-h1 (days)	30.9^{c}	38.9^{b}	35.3^{bc}	52.2^{a}	3.6	0.08	**	**	**	0.12
No ovn (%)	0	10.6	12.5	50.0						
No oestrus (%)	0	15.1	9.1	62.1						

^{abc} Means with different superscripts within a row differ significantly ($P<0.05$)
† Calving date as a covariate (slope = -0.05 and = -0.25 for C-ovn1 and C-h1, respectively)
†† Stocking rate (SR) by breed interaction

TABLE 3. The average¶ CS, liveweight (WT) and milksolids (MS) production in the peri-partum period for the 4 herds.

	JL	JH	FL	FH	SED	Age	Breed	SR	SR|Breed††
CS	4.9^{a}	4.6^{a}	4.7^{a}	4.1^{b}	0.1	ns	**	***	†
WT (kg)	342^{c}	333^{b}	428^{a}	393^{b}	11	***	***	***	†
MS (kg/day)	1.6^{c}	1.4^{c}	2.7^{a}	1.8^{b}	0.3	***	***	***	***

¶ Weeks -4 to 8 relative to calving for CS and weight and weeks 1 to 10 postpartum for milksolids production
† $P<0.1$
†† Stocking rate (SR) by breed interaction
^{abc} Means with different superscripts within a row differ significantly ($P<0.05$)

DISCUSSION

The PPA interval was longer in F than J cows as has been previously reported (Fonseca *et al.*, 1983), especially at higher stocking rates. Younger cows (2 yo) had a longer period of PPA than older (>3 yo) cows with 3 yo animals being intermediate.

The significant stocking rate by breed interactions for the PPA intervals, CS, weight and milk solids production suggest that F may be more sensitive to the effects of nutritional restriction on the resumption of cyclic activity than J and that partitioning of nutrients may differ between the breeds. The breeds also differed in the relationship between mean CS and the C-ovn1 and C-h1 intervals. Jerseys appear to be less dependent on body fat reserves (as determined by CS) than F for resumption of ovulation and oestrus as the C-ovn1 interval in J was not related to CS.

Increasing stocking rates extended the PPA period and were associated with reduction in individual cow feed intake, CS, liveweight and milk production. The period of NEB may have been prolonged by the high stocking rate, resulting in prolonged PPA. Early postpartum milk production is driven by the homeorhetic mechanisms (Bauman and Currie, 1980) at the expense of body reserves. However, homeostatic mechanisms such as reduced milk production (Staples *et al.*, 1990) and increased feed intake (Garnsworthy and Topps, 1982) may eventually override the homeorhetic drives. The high stocked herds had lower milk production than the low stocked herds indicating that homeostatic mechanisms may have been invoked.

Mean CS was negatively related to the C-h1 interval. Condition score is related to energy balance and is influenced by pre- and postpartum nutrition and milk production. Restriction of both pre- and postpartum nutrition extends PPA (Grainger *et al.*, 1982). Whether low CS causes, or is merely associated with extended PPA has not been established.

Milksolids production at 4 weeks postpartum was negatively related to the C-h1 interval. For each increase of 1 kg in daily milksolids production, the C-h1 interval was reduced by 14.2 days. Previous studies of both pasture based systems (Wilson *et al.*, 1985) and those with individual feeding of a total mixed rations have produced a similar relationship (Fonseca *et al.*, 1983; Staples *et al.*, 1990). In the group pasture grazing system used in the present trial, competition for limited pasture resources may have occurred, with the most successful cows having higher milk production as well as being in less severe NEB.

This data demonstrates that reproductive performance should be considered when increasing stocking rate and/or altering the breed of cattle on a farm. Short term gains in production per hectare may come at the cost of increased expenditure resulting from increased incidence of PPA.

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