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The effect of calving season on milk production. A system study.

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ABSTRACT

A 3-year trial is being conducted at No1 Dairy Farm, Massey University, to compare the effect of calving season on the whole system of production, and the results of the first year are presented here. Three different systems were implemented by stocking each farmlet (40 ha) with Friesian cows which calved either in Autumn (A), in Spring (S) or 50% in A and 50% in S (A/S). Average stocking rate (SR) was 2, 2.25 and 1.95 cows per ha, respectively. A larger area was conserved as silage in A than in A/S and S, which also affected pasture growth rate in Spring. More supplements (t DM/cow) were fed in A (1.2) than in A/S (0.8) or in S (0.4). The higher yield of milk solids (MS) per cow for cows which calved in Autumn compensated the lower stocking rates of those herds and resulted in similar levels of production per ha (705-725 kg MS) for all three systems. These first year results suggest that similar levels of production per ha can be achieved with different calving systems and they emphasise the importance of farm systems studies as a research tool.

Keywords: calving date; milk production; farm comparison; dairy system.

INTRODUCTION

Systems based on high stocking rates and a concentrated calving period in early Spring have been adopted by the majority of dairy farmers in New Zealand, to ensure that all the cows are at peak of lactation when the growth of quality pasture is maximum (Holmes *et al.*, 1987; Sheath and Clark 1996). Consequently, the dairy industry must process large quantities of milk during a relatively short period of time, with little activity during Winter. Calving during Autumn is an alternative to the traditional, Spring-calving system. However, the effects of calving season on the whole production system have not been investigated in New Zealand. Calving date interacts with almost all the variables in the system (e.g. stocking rate, pasture production) so that its effects must be investigated within the context of the whole system. A 3-year trial is being conducted at Massey University's No 1 Dairy Farm in order to compare the effects of calving season on the whole system and preliminary results are presented in this paper.

MATERIALS AND METHODS

Massey University's No1 Dairy Farm (123.5 ha) was divided into three 40-ha farmlets, each with 21 paddocks, with all the soil types (river soils, Rangitikei and Manawatu Series) evenly represented in each farmlet. The trial started in July 1996 when the following systems (farmlets) were implemented: 1) 100% Autumn = all the cows calving in Autumn (Planned start of calving [PSC]=10/3); 2) 100% Spring = all the cows calving in Spring (PSC=20/7); 3) 50:50=half the cows calving in Autumn and half in Spring (PSC= 20/3 and 1/8, respectively). Planned stocking rates were 2, 2.5 and 2.25 cows/ha for each system, respectively. All cows were of similar Breeding Worth at the beginning of the trial (herd average \pm SD = 26 \pm 0.8). Pastures on the

whole farm are based on perennial rye grass and white clover, although cocksfoot, prairie grass and tall fescue are also present in some paddocks. Pasture measurements included whole farm herbage mass (cover) weekly (HM), pre- and post-grazing HM daily and pasture quality monthly. Herbage mass estimations were made with a Rising Plate Meter (RPM), which was calibrated 3 times during the spring season by cutting 54 quadrants of pasture to the ground level. Pasture growth rate (PGR) was estimated either by the difference in HM of all the paddocks not grazed during a week (method 1) or by the difference (for every paddock) between the HM left as residual yield and the HM available before the next grazing (method 2). Daily milk yield by each herd was recorded from the load cells of the milk vat. Once per week the milk from each herd was collected separately and a sample was taken for analysis of milk composition. Milk production and composition of individual cows were measured by herd tests, monthly during the first twelve months of the trial, and fortnightly during the second year. All the forage mass harvested, purchased and fed to the cows were recorded on a wet basis. Samples were taken periodically to calculate % of DM and for chemical analysis. Apparent pasture dry matter intake (DMI) was estimated daily for each herd from the difference between the pre- and post-grazing covers. Live weight and body condition score were recorded monthly for each cow. All health related treatments and/or reproductive events were recorded for every cow.

As the replication of whole 40-ha commercial farms was not possible, the variation between farmlets cannot be estimated and consequently, a direct t-test for comparing treatments is not possible (Maindonald, 1992). Therefore, paddocks and cows were used as experimental units for variables concerned with pasture and milk production, with standard errors (SE) based on the major sources of variation (paddocks and cows) within farmlets (Dillon *et al.*,

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1995). Paddocks were blocked accounting for variation in location and soil type over the whole farm. Pasture growth rate was analyzed as a split-plot design (or repeated measurements), with farmlet ("treatment") and block as major effects and time (month of the year) as subplot. The interaction between farmlet x block was utilized to test the main effects. Lactation curves of individual cows were analyzed in a similar way as PGR but without blocking. Month of lactation (0-1, 1-2, etc.) was used as the repeated variable.

RESULTS

The main results for the first year of the trial (1996/97) are summarized in Table 1. Actual stocking rates for the 100% Spring and 50:50 systems were lower than planned due to the removal of some cows for health reasons. Cows in the 100% Autumn and in the 50:50 system had more days in milk and produced more milksolids (MS) than cows in the 100% Spring farmlet. This compensated for the higher stocking rate of the latter, resulting in similar levels of total milk production per ha for the three systems (Table 1).

TABLE 1: Main results of the comparison. Values correspond to Jul96/Jun97 season unless stated.

Item	Calving System		
	100% Autumn	100% Spring	50:50
Stocking rate (cows/ha)	2.0	2.25	1.95
Milk solids production (kg)			
Per ha	705	705	722
Per cow	354	322	371
Lactation length (days)	281	258	276
Supplements harvested (kg DM/cow)			
Maize silage	290	0	405
Grass silage	1037	567	904
Supplements fed ¹ (kg DM/cow)			
Maize silage	690	140	440
Grass silage	300	97	250
Brewers grain (Spring 1996 only)	190	173	120
Dry cows grazed-off (cow-weeks)	162	425	379
Pasture DM intake ² (kg/cow/d ± SD)	13.9±4.2	14.2±2.9	15.4±3.2
Total farm net income (\$/ha)	3643	2657	3312
Total farm expenditure (\$/ha)	2184	1894	2093
Profit (\$/ha)	1459	763	1219

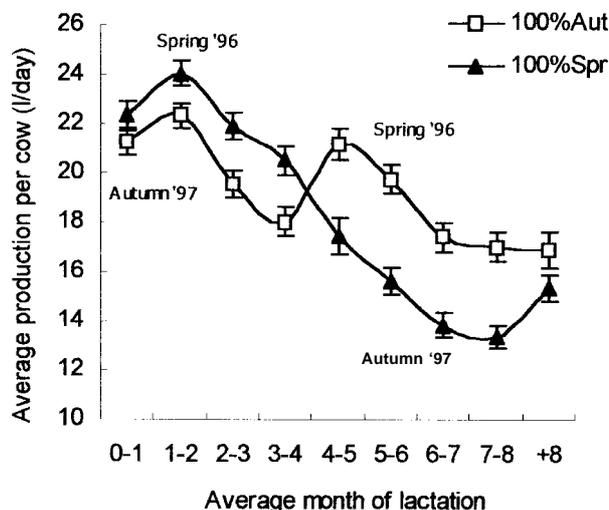
¹ Including maize silage purchased

² Average of months with and without supplements. Period: Jan97/Dec97.

Cows in the 100% Autumn system produced lower daily milk yields than Spring-calving cows at the peak of lactation (22 and 24 l/day, respectively) but higher yields in mid and late lactation ($P < 0.05$, Fig. 1). Total supplements fed (mainly maize and grass silage) were 1180, 410 and 810 kg DM/cow for the 100% Autumn, 100% Spring and 50:50 systems, respectively (Table 1). Larger quantities of total supplements were fed to the 100% Autumn-

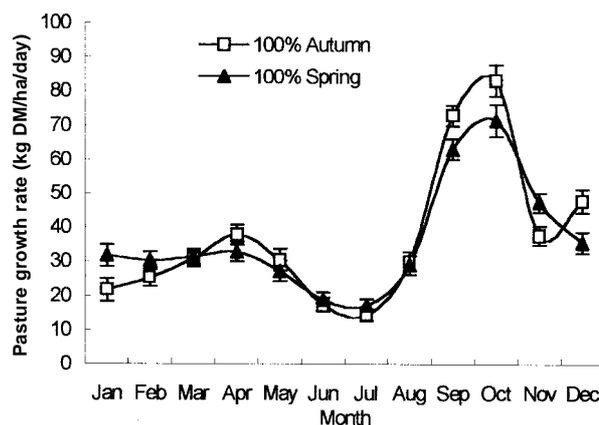
calved cows during Winter (6-9 kg DM/, which corresponded with the 3rd to 5th month of lactation and relatively lower yields of MS per cow.

FIGURE 1: Average lactation curves for the two 100% calving herds during the period Jul 96-Jun 97 (mean ± se).



Average pasture DMI (Table 1) was similar for the three systems (average = 14.5 kg/cow/day). Pasture production (tonne DM/ha) ranged between 12.9 and 13.6 when estimated by the differences in weekly HM (method 1) and between 13.2 and 13.6 when calculated from the PPC (method 2). However, an interaction ($P < 0.05$) between month and PGR was observed for the 1997 spring. Pasture growth rate (method 2) was higher in the 100% Autumn than in the 100% Spring system during September and October, lower in November and higher again in December (Fig. 2). More grass silage was harvested for the 100% Autumn system than for the 100% Spring system one during the first two cycles of the trial (data shown for the 1996/97 season only) with intermediate values for the 50:50 system (Table 1). Silage paddocks across all farms grew at the same rate before being closed (30 kg DM/ha/day in August). However, PGR (kg DM/ha/day) was higher ($P < 0.05$) than the average of non-silage paddocks in September (78 vs 61: silage vs non-silage), October (82 vs 71)

FIGURE 2: Average pasture growth rate (method 2) for the two 100% calving herds during the calendar year 1997 (mean ± se).



and December (48 vs 37) but lower in November, immediately after the silage was harvested (40 vs 47).

The 100% Autumn and the 50:50 systems received a 32 cents per liter premium on respectively, 30 and 20 l/ha/day for the period May-July. Total income (\$/ha) was 37% and 25% greater for the 100% Autumn and 50:50 systems compared to the 100% Spring farm, due to the winter premium payment for milk (Table 1). Consequently, profit was 91% and 60% greater for the 100% Autumn and 50:50 systems despite the higher total farm expenditure for these two systems.

DISCUSSION

The lower stocking rates in both Autumn calving systems were compensated by higher yields of MS per cow, resulting in similar yields of MS produced per ha for the three systems. This is in contrast to the study by Fulkerson *et al.* (1987) in which the Autumn-calved cows produced less MS per cow even though they were stocked at 1.45 cows/ha compared to 1.60 cows/ha for the Spring calving system, resulting in a 15% decrease in MS production per ha. However, no supplements were fed in Fulkerson's study, which probably resulted in relatively lower levels of feeding for the Autumn-calved cows. When supplements were fed during Winter to the Autumn calving cows (as in the present work), higher MS yields by Autumn-calved cows were also reported in a similar comparison of calving-date-systems in Ireland (Crosse and Ryan, unpublished results).

The Spring-calved cows achieved higher daily peak yields than the Autumn-calved cows (Fig. 1), probably because the 100% Autumn calving herd was being fed some silage (3 to 4 kg DM/cow/day) at this stage (early winter) whereas the Spring-calved cows were being grazed generously on pasture only. However, from the 4th month of lactation onwards, the Autumn-calved cows achieved higher daily yields than the Spring-calved cows. These differences developed because this stage of lactation (> 4th month) corresponded to Spring and early Summer for the Autumn-calved cows when the pasture supply was still relatively generous, whereas it corresponded to Summer and Autumn for the Spring-calved cows, when the supply of pasture was more restricted. Similar results have been reported for Autumn- and Spring-calved cows in Winter milk herds near Palmerston North, New Zealand (Changiendo, 1996) and by Auldish *et al.* (1997) who reported a second peak (Spring) in the lactation curve of cows that had calved in April.

The higher PGR for the 100% Autumn system during Spring (Fig. 2) was the result of the higher rates of growth for the (ungrazed) paddocks closed for silage and the larger silage area for that farm. A higher leaf area index can be achieved by undisturbed pasture when grasses are changing from the vegetative to the reproductive stage, due to the associated physiological and morphological changes that occur in the plants in early Spring (Robson *et al.*, 1988; Lemaire and Chapman, 1996). At the whole system level, it is therefore possible that the normally

greater losses associated with a larger area to be harvested as silage (winter milk production systems) might be partially compensated by a higher pasture production during early Spring. However, more system-research would be needed to test this hypothesis.

In conclusion, similar yields of MS per ha were obtained with three different systems of milk production. Autumn-calved cows compensated for a lower milk yield in early lactation with relatively higher milk yields during late lactation and more days in milk. Although more supplements were harvested and fed for the 100% Autumn system, grazed pasture supplied approximately 80% of the total DM eaten for that herd, suggesting that high levels of pasture utilisation can also be achieved with Autumn-calving systems. The premium received for the milk produced in Winter had a major effect in the farms income, and resulted in higher farm profits for the 100% Autumn and 50:50 systems than for the 100% Spring system.

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