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Milk production in Romney ewes lambing out of season

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ABSTRACT

Milk yield (MY) of groups of Romney ewes lambing at 3 times of the year: January (n=9), March (n=14) and June (n=13)) was measured on alternate days in the first week postpartum and at weekly intervals for nine weeks. Twin-bearing ewes produced significantly more milk than single-bearing ewes during the first week and during the whole of lactation (63 days) (P<0.05), except in the January-lambing group, in which ewes with single lambs produced more milk then those with twins during the first week. The shape of the lactation curve for ewes with singles or twins differed significantly (P<0.01) between lambing groups, reflecting that single- and twin-bearing ewes responded differently in January, but the number of twin-bearing ewes was small (n=4) in that month. MY differed significantly (P<0.01) among groups lambing in January (single MY±SEM: twins MY±SEM) (1605±57: 1402±71 g/d), March (1425±38; 1802±46) and June (1520±43: 1951±54). Despite having the lowest (P<0.05) mean pre-lambing live weight (62±3 kg), ewes lambing in June produced the highest overall mean MY (1735±48 g/d), whilst ewes lambing in March and January had mean pre-weaning live weights of 70±2 kg (in both groups) and produced 1613±42 g/d and 1504±64 g/d respectively. The June–lambing ewes gained weight (1.38±1.19 kg) and condition score (0.39±0.16 /d) whilst weight loss was significant (P<0.05) in the March (-9.82±1.15 kg) and January (-7.78±1.44 kg) groups between pre-lambing and weaning, as was change in condition score (March: -0.49±0.16; January: -0.63±0.19). Lamb birth weights did not differ between seasons but ADG (g/d ±SEM) was highest (P<0.01) in June (0.262±0.008), followed by March (0.238±0.008) and January (0.202±0.009).

Keywords: milk yields, sheep, out-of-season lambing, lamb growth

INTRODUCTION

There is limited information on milk yields of traditional breeds of ewes grazing pasture in New Zealand. Peterson *et al.* (2005) reported data for a nine-week lactation for East Friesian-cross ewes lambing at five equal intervals throughout the year, but there are no similarly detailed reports for Romneys lambing out of season. This paper reports milk yields of Romney ewes with lambs at foot in New Zealand at three different times of the year (January, March and June) grazed and managed contemporaneously with the East Friesian-cross ewes (Peterson *et al.*, 2005) so data are directly comparable.

Autumn-lambing Romney-cross ewes demonstrated delayed lactogenesis and produced 30-40% less milk than spring-lambing ewes fed the same diet (Peterson *et al.*, 1990; Peterson 1992). In those trials, sheep were housed indoors. In this trial, lactogenesis and total milk yields were measured in grazing ewes during the period of declining photoperiod from January to June when any effect of photoperiod or season on lactation might be most easily detected.

Hence, the objective of this trial was to measure milk yields in groups of Romney ewes lambing in January, March and June. Ewes with single or twin lambs were included to determine if they responded differently to lambing season. Live weight and body condition score were also recorded. An additional objective was to identify management practices that might influence milk yields.

MATERIALS AND METHODS

Animals

The ewes were Romneys aged 3-5 years and all had had at least one previous lactation. Ewes were drenched for internal parasites on the first day of milking and subsequently at two-week intervals with a standard dose of abamectin given separately to a standard dose of a combination of albendazole plus levamisole. Ewes were monitored for other problems such as foot rot, fly strike, and mastitis. When infections were detected, animals were treated with Pharmacillin®, or in the case of severe mastitis, with 250,000 units of benzyl penicillin (Mamyzin®). Animals that did not respond quickly were removed from the trial.

Ewes were grazed at pasture, or on a crop, and given supplementary baleage, as required throughout the trial, depending upon seasonal pasture availability. Pasture DM intake of the experimental ewes was not estimated.

Farm shearing policies meant that groups of ewes were not all shorn at the same time with reference to lambing. The January-lambing group was shorn at day 100 of pregnancy, but the other groups were not shorn during pregnancy or lactation.

Treatments

The experiment was carried out at Massey University's Haurongo farm, seven kilometres south of Palmerston North (latitude 40.23° S and longitude 175.37° E). Ewes were part of a larger trial (Morris *et al.*, 2004) investigating the practical implementation of the STAR system of sheep production (Hogue *et al.*, 1987). Oestrus was synchronised in all ewes using progesterone CIDRs. PMSG (Knight *et al.*, 1989) was used for mating in January. Ewes were included in the trial if they lambed during the first cycle and if they gave birth to the same number of live lambs as seen in an earlier ultrasound scan. Ewes were dropped from the trial if their lamb died or if they had mastitis that did not respond rapidly to treatment. Condition scores and live weights were recorded before lambing and at weaning (70 days). Numbers of ewes finally included in the analyses in each seasonal group were: January (n=9), March (n=14) and June (n=13). The Massey University Animal Ethics Committee approved this work (AEC 02/127).

Ewes from each seasonal group were milked on days 1, 3, 5, 7, 14, 21, 28, 35, 42, 56 and 63 of lactation. Milk yield of the ewes was estimated by the "oxytocin method" first described by McCance & Alexander (1959). The technique involves i.v. injection of 1 i.u. oxytocin V (Vetpharm LTD) then emptying the udder by machine and hand milking, and repeating the milking procedure a measured time (about 6 h) later, at which time the milk yield is measured. The lambs were separated from the ewes (and bottle fed as required) during the intervening period. Lambs were weighed at birth and weekly thereafter.

Statistical analyses

Data were analysed using a mixed linear model for repeated measures. All means presented are least-squares means (LSM). Both the shape of the curve and the overall production were considered. For analysis of lactogenesis, LSM and the slope of the regression for only the first 7 days were considered. Since live weight of ewes was significantly ($P<0.001$) related to their milk yields, milk yield data presented were adjusted for number of lambs born and for both linear and quadratic effects of pre-lambing live weight.

RESULTS

Lactogenesis

Mean milk yields during the first week (average of days 1, 3, 5 & 7) were significantly ($P<0.05$) different among lambing groups (Table 1). The slopes of the regression differed significantly among groups, the regression line for March being flatter than that for June, and January intermediate between the other two. Figure 1 shows milk yields for ewes with single and twins in each season. There was a significant season by rank interaction ($P<0.05$). In January, milk yield in the first week did not differ significantly between ewes with singles and twins, but the difference was significant for the other lambing groups and greatest in March (Figure 1).

FIGURE 1: Least-squares mean ± SEM daily milk yields during the first seven days of lactation for groups of Romney ewes with single and twin lambs, lambing in January, March and June (n is given within each column and asterisks denote significance differences within a lambing group).

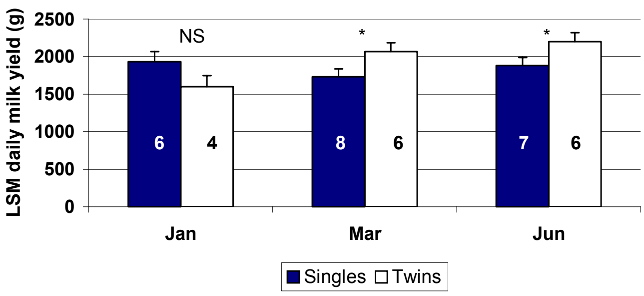


TABLE 1: Least-squares means of pre-lambing live weight, and milk yields during the first seven days of lactation (MY7), and the slope of the regression of milk yield on time during the first week, for groups of Romney ewes lambing in January, March and June.

Lambing group	Pre-lambing live weight (kg ± SEM)	MY7 ± SEM (g/d ± SEM)	Slope of regression of milk yield on time (g/d/d ± SEM)	Significance of regression
Jan (n=9)	69.9±2.31^{b}	1765 ±100^{a}	134±44^{ab}	<0.01
Mar (n=14)	69.7 ±1.86^{b}	1899 ± 75^{ab}	74±34^{a}	<0.05
Jun (n=13)	61.8 ±2.92^{a}	2039 ± 82^{b}	186±36^{b}	<0.001

Means in columns with differing superscripts differ significantly (LSD, $P<0.05$)

Whole-Lactation Milk Yields

Over the whole lactation period (63 days), the mean daily milk yields (Figure 2) differed significantly amongst lambing groups (P<0.01). Milk yields (LSM ± SEM) were highest in June (1735 ± 48 g/d), followed by March (1613 ± 42 g/d) and January (1504 ± 64 g/d). Ewes with twins produced significantly more than those with singles (P<0.001) in March and June but not in January. The season-by-day interaction was not significant, indicating that the shapes of the lactation curves did not differ between lambing groups, however, the significant season-by-rank interaction (P<0.001), indicated that the lactation yields of ewes with twins responded differently from those of ewes with singles at the three different lambing times (Figure 3).

FIGURE 2: Least-squares mean daily milk yields of groups of Romney ewes lambing in January (n=9), March (n=14) and June (n=13).

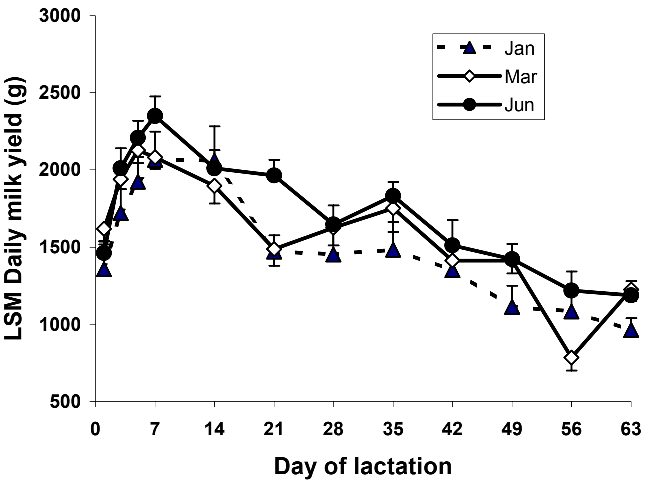
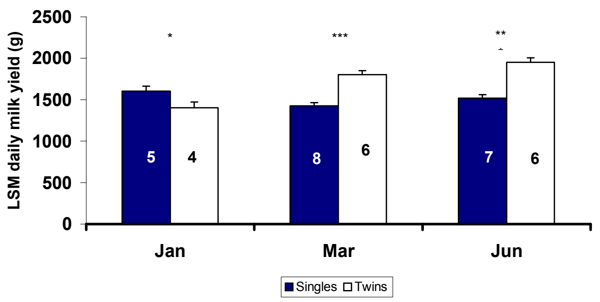


FIGURE 3: Least-squares mean ± SEM daily milk yields during the whole of lactation for groups of Romney ewes with single and twin lambs, lambing in January, March and June (n is given within each column and asterisks denote significance differences within a lambing group).



Live Weights and Condition Scores

Mean live weight differed significantly (P<0.001) among seasons (Table 1) ewes being about 8 kg lighter before June lambing than for the January or March lambing. There was a trend for ewes with twins (69.0±1.8 kg) to be heavier than those with singles (65.3±1.6 kg) but the difference was not significant (P=0.13). There was no interaction between lambing group and number of lambs. The change in ewe live weight (Table 2) between the pre-lambing measurement and weaning differed significantly (P<0.001) between June and the other seasons and between rearing ranks, but there was no significant season by rearing rank interaction. The change in CS was significantly different between June and the other seasons (P<0.001), but not between rearing ranks (Table 2).

The regressions of change in live weight (ΔLWT) of each ewe on average daily measured milk yield (MYA), for each season were: January: $\Delta LWT = 0.0003MY - 7.9736$ ($R^2 = 0.0006$). March: $\Delta LWT = -0.0091MY + 5.2465$ ($R^2 = 0.366$) June $\Delta LWT = -0.007x + 13.48$ ($R^2 = 0.1454$). The slope of the regression of ΔLWT on ΔCS was identical for all season and rank combinations and 1 unit increase in ΔCS was equal to 4.09 kg ΔLWT (± 1.3), however, the intercepts were different between season and rank.

TABLE 2: Least-squares means (±SEM**)** of change in live weight and condition score (CS) from pre-lambing until weaning, of Romney ewes lambing in January, March and June, and in ewes rearing single and twin lambs over all three periods.

	N	Change in live weight (kg±SEM)	Change in condition score (CS±SEM)
Lambing Group			
January	9	-7.78±1.44^{a}	-0.63±0.19^{a}
March	14	-9.82±1.15^{a}	-0.49±0.16^{a}
June	13	1.38±1.19^{b}	0.39±0.16^{b}
Rearing Rank			
Single lamb	20	-2.14±0.97^{a}	-0.09±0.13
Twin lambs	16	-8.67±1.09^{b}	-0.39±0.15

Means within columns with differing superscripts differ significantly (LSD, P<0.05)

Lamb Growth

Lamb birth weights did not differ significantly among groups nor between sexes of lamb. Growth rate of lambs differed significantly (P<0.01) among lambing groups (Figure 4) when expressed as average daily gain from birth to weaning (ADG) and as the slope of the regression of live weight on age (Table 3). The highest ADG was observed in the June lambs (0.262 ± 0.008 g/d), followed by March (0.238 ± 0.008) and January (0.202 ± 0.009). Twin lambs grew faster (P<0.01) than singles and ram lambs tended (P = 0.06) to grow faster than ewe lambs (Table 3). The lamb growth rate was significantly (P<0.001) related to dam's MYA and there was a significant (P<0.05) interaction of season with MYA, i.e., the mean MYA was related to lamb growth but the lamb growth slopes were different between seasons.

FIGURE 4: Mean live weight (kg), from birth to weaning, of groups of Romney lambs, born in January (n=13), March (n=20) and June (19).

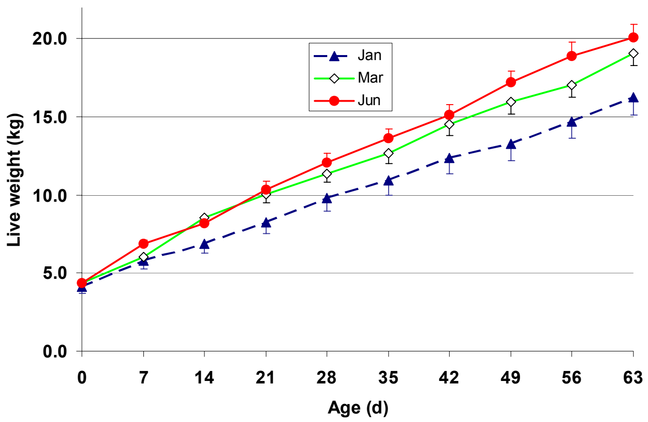


TABLE 3: Least-squares means (±SEM) for lamb birth weight, regression of weekly weight on time, and average daily gain (ADG) of Romney lambs born in January, March and June, and in ewe and ram lambs and in single and twin lambs during all three periods.

	N	Birth weight (kg±SEM)	Regression coefficient	ADG (kg/d±SEM)
Lambing				
January	13	4.2±0.3	0.1975±0.010[a]	0.2023±0.009[a]
March	20	4.5±0.2	0.2312±0.008[b]	0.2383±0.008[b]
June	19	4.5±0.2	0.2610±0.008[c]	0.2621±0.008[c]
Sex of lamsb				
Ewe	27	4.4±0.2	0.2188±0.007	0.2231±0.007
Ram	25	4.5±0.2	0.2410±0.007	0.2454±0.007
Rearing rank				
Singles	20	5.0±0.2[b]	0.2664±0.008[b]	0.2709±0.008[b]
Twins	32	3.9±0.2[a]	0.1933±0.006[a]	0.1976±0.006[a]

Means within columns with differing superscripts differ significantly (P<0.01)

Management

Farm management apparently affected milk yield on several occasions. No statistical analyses have been undertaken to test the significance of the effects of those actions, but the coincidence with changes in milk yields (see Figure 2) indicates that they were the likely causes. Moving January-lambing ewes onto a crop (forage brassica, cv Pasja) on day 22 of lactation was followed by a low milk yield at the next milking, whilst grazing new pasture from day 30 of lactation was followed by increased milk yields in June-lambing ewes. Fertiliser application prior to day 21 in March was followed by decreased milk yields in some ewes and death of two.

DISCUSSION

Although the slope of the lactation curve during the first week differed between seasons it is possible that this was an artefact due to particularly poor MY in two of the four twin-lambing ewes, one of which was lame during that week. However, it is interesting to note that January data for East Friesian-cross ewes grazed concurrently (Peterson *et al*., 2005) showed that the regression of MY on time was not significant due to large variation in MY in that group. The limited data for the Romneys suggest that the rate of onset of lactation increases concurrently with decreasing photoperiod. This is in contrast to the East Friesian-cross results (Peterson *et al*., 2005) in which there was no apparent association with photoperiod, but supports the earlier reports of Peterson *et al.* (1990) and Peterson (1992). Nevertheless, it is possible that the observed differences in rate of onset of milk production are due to many other seasonal factors.

Whole-lactation curves indicated that milk yields were highest in the group lambing in June followed by March, (although the poor March yields may have been influenced by fertiliser application). January lambing produced the lowest average milk yields, despite the fact that it was a wet summer with good feed supply. The marked decline in yields evident at 21 days (Figure 2) coincided with introduction to a brassica crop. In comparison, the East Friesian-cross ewes produced most in June (2223 ± 35 g/d), but their January MY (1826 ± 31 g/d) exceeded that of March (1742 ± 30 g/d) (Peterson *et al*., 2005).

The differential response of ewes with single and twin lambs in the three lambing groups is probably due to the poor performance of some of the small number of twin-lambing ewes in January. Nevertheless, it does agree with the East Friesian-cross results and suggests that because they were better able to take advantage of the conditions, ewes with twins exhibited significantly greater advantage in milk yields than those with single lambs in the groups lambing in June and March (Figure 3). This greater potential may be due to the higher degrees of mammogenesis in the twin-pregnant ewe or to the greater demand by the twin lambs. In general, if these data are indicative of lactation curves that may typically be achieved in commercial Romney flocks, lambing in January, March and June will achieve satisfactory milk yields.

In all lambing groups, peak milk yield was reached by the end of the first week of lactation. This is consistent with the lactation curves of the East Friesian-cross ewes (Peterson *et al*., 2005) but conflicts with those of Cardellino & Benson (2002) who reported a much later peak of lactation. The contribution to this difference by environmental conditions and diet was discussed by Peterson *et al*. (2005), as was the lactogenic or galactopoietic effects (Geenty, 1980) of very high doses of oxytocin such as the 10 i.u. used by Cardellino & Benson (2002).

Ewe LWT and CS are to be expected to alter throughout the year, and it is unsurprising that the ewes lambing in winter (June) were considerably lighter and poorer in condition, especially since most of those ewes had lambed during the previous spring or summer. That disadvantage did not, however, prevent them from attaining their highest MY following June lambing. Furthermore, they achieved that milk yield whilst simultaneously gaining weight. In January and March, ewes lost weight and CS, but in January there was no response in MY. In March there was a small (NS) response in terms of MY, but in June, ewes gained weight and CS, although the more weight each gained the less milk each produced. Absolute MY differed from season to season but the extra MY attained by mobilising or foregoing a kilogram of LWT is about the same in all seasons. In June, one extra kilogram of milk per day on average was equivalent to 9 kg change in LWT between pre-lambing and weaning. Over all three periods, a change of one CS was equivalent to 5 kg LWT change, which is similar to that reported by Kenyon *et al*. (2004) in non-lactating ewes.

Changes in lactational performance suggested that Romney milk yields are very susceptible to changes in diet, especially introduction to feeding on a crop, fresh new pasture, and ingestion of superphosphate fertiliser.

Several studies have shown that autumn-born lambs are 0.4-1.0 kg (i.e., up to 25%) lighter at birth than spring-born lambs (Reid *et al*., 1988; Peterson *et al*., 1990; Morris *et al*., 1993, Peterson *et al*., 2000). In the current trial, lamb birth weight did not differ between the groups despite the markedly different photoperiod experienced by the pregnant ewes in each of the lambing groups. Lamb growth rates were highest in June followed by March and January, corresponding exactly to the ranking of lambing groups for MY.

In conclusion, this trial has demonstrated lactation curves for Romney type ewes grazing pasture in the Manawatu district and has shown no detrimental effect on milk yield as a result of lambing in January, March and June (that might have been expected if photoperiod had a major effect on lactation). June is potentially the best month for lambing to achieve high milk yields, especially in ewes with twins. The milk yield advantage for June was translated to lamb growth rates. There was no evidence of photoperiod effects on milk yields, although any such effects may have been masked by the many other environmental factors involved, including management practices apparently detrimental to milk yields.

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