Effect of selection for early lambing on the expression of hogget oestrus activity

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ABSTRACT

Selection for out-of-season breeding ability could be enhanced if an early indication of the trait was available. The onset of hogget oestrus has been proposed as such a trait and has been examined for 362 ewe progeny coming from early and late-lambing selection lines over 3 years.

In each year the early lambing (BV-) hoggets had an earlier (P<0.05) mean date of onset of oestrus than the hoggets from the late-lambing (BV+) line. In 1992 and 1993 this effect was confounded by the season of birth such that nearly all the BV- animals were autumn born (AB) and the BV+ animals born in the spring (SB). In 1993 animals from both lines were produced in both seasons. Their mean day of first oestrus in 1994 (expressed as day of year ± standard error) were AB BV- 81 ± 3; AB BV+ 100 ± 7; SB BV- 122 ± 5 and SB BV+ 148 ± 5. This indicates significant effects of both season (P<0.05) and selection line (P<0.05). A greater proportion of the BV+ animals did not cycle in 1993 (18% v 2%; P<0.05) and 1994 (40% v 18%; P<0.01).

These data confirm that selection for date of lambing has a significant effect on the date of first hogget oestrus, which could be used as a screening aid in the selection process. The effect of season of birth independent of genotype is of considerable interest to the evaluation of underlying mechanisms.

Keywords: Hogget oestrus; out-of-season lambing; selection lines.

INTRODUCTION

It has been demonstrated that selection for earlier lambing can result in flocks with advanced lambing patterns and that date of lambing has a relatively high heritability (0.31) and repeatability (0.43) (Smith *et al.*, 1992). Selection of replacement ewe and ram lambs in that flock is currently based on breeding values for date of lambing based on historical pedigree and performance records (Smith *et al.*, 1993). This paper examines data on the possible use of ewe lamb oestrus (puberty) as a selection indicator for early lambing ability.

MATERIALS AND METHODS

Animals. Ewe lambs (362) born in the Ruakura "Kamo" out of season breeding flock (Smith *et al.*, 1992) in 1991, 1992, and 1993 were used. They were run with harnessed vasectomised rams from weaning, and were inspected weekly for tup marks to indicate the onset of puberty and subsequent cycling activity in the year following their birth. Liveweights were recorded monthly from weaning onwards.

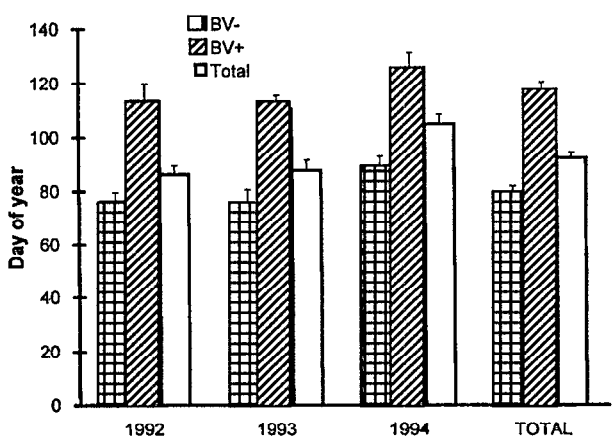
Breeding Values. Breeding values (BV) for date of lambing (DL) used in this report are those derived simply as the average of the estimated parental BVs for DL calculated from the flock database using BLUP procedures (Smith *et al.*, 1992).

Data analysis. The effects of lamb birth date (Bday), season of birth (autumn or spring), date of puberty (Tupday), age at puberty (Tupage), and weight at puberty (interpolated from weights pre and post that date - Tupwt) on BV (DL) were examined using an additive regression model. Residual maximum likelihood (REML) analysis of the hogget oestrous parameters was used to derive a prediction equation to be used for the selection of animals for early lambing ability.

RESULTS

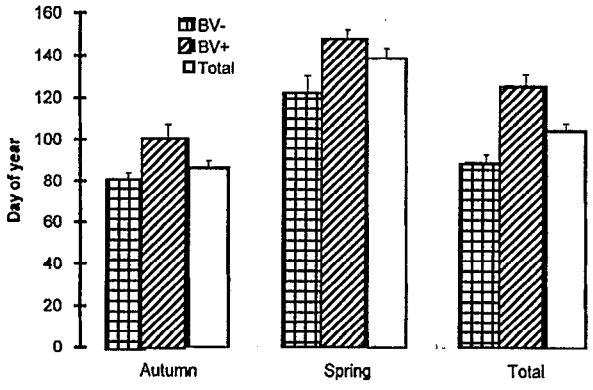
In each year hoggets from the early lambing line (BV-) had an earlier (P<0.05) mean date of onset of oestrus (expressed as day of year ± standard error) than the later lambing (BV+) animals (Table 1 and Fig 1). In 1992 and 1993 this effect was confounded by the season of birth: most BV- animals were autumn born (AB) and most BV+ animals spring born (SB). In 1993 animals from both lines were produced in both seasons. Their mean date of first oestrus in 1994 (Table 1 and Fig 2) showed significant effects of season (AB = 86.5 ± 3.4 v SB = 138.9 ± 4.6; P<0.05) as well as selection line (BV- 89.1 ± 3.8 v BV+ 125.6 ± 5.6; P<0.05). A greater proportion of the BV+ animals did not cycle in 1993 (17.9% v 1.7%; P<0.05) and 1994 (39.7% v 18.1%.; P<0.01).

FIGURE 1: Effect of selection line on the date of first oestrus over three years. Values are means (± SEM) expressed as day of the year.



Multiple regression analysis confirmed that Tupday, Bday, Tupwt and season of birth had significant (P<0.001) effects on BV (LD). However while the overall trends were similar, the actual contribution of each factor varied from season to season and year to year.

FIGURE 2: Effect of selection line and season of birth (autumn vs spring) on the date of first oestrus for ewe hoggets born in 1993. Values are means (± SEM) expressed as day of the year.



The pooled regression of BV (LD) over the 3 years gave an R^2 value of 0.60. However half of this variation was due to the year x season of birth effects and half R^2 = 0.3 was associated with the average effects of birthdate, day of first tup and tup weight.

Separate equations were derived to predict the BV (LD) for autumn and spring born hoggets exhibiting oestrous and thus assist the selection of replacement ewes for each of the lines.

Index = 6.584 * Bday + 1.112 * tupday + [5.029 (for spring born) or 11.611 (for autumn born) * tupwt] / 1000.

DISCUSSION

Breeding value for date of lambing is an indication of the genetic ability to lamb out of season. Examination of the factors associated with hogget oestrus (puberty) as potential indicators of this ability has shown that date of puberty

TABLE 1. Means (± SEM) by year, selection line and season of birth: for breeding value for lambing day (BV (LD)), birthday (Bday), date of first tup (Tupday) and weight at first tup (Tupwt).

Year	Line	Season	n[1]	BV (LD)	Bday[2] (DOY)	Tupday[2] (DOY)	Tupwt (kg)
1992	BV-	autumn	93	-0.101 (0.007)	147.5 (1.8)	76.3 (3.3)	40.5 (0.5)
		spring	0	-	-	-	-
			93	-0.101 (0.007)	147.5 (1.8)	76.3 (3.3)	40.5 (0.5)
	BV+	autumn	13	+0.032 (0.005)	158.0 (6.1)	78.5 (7.7)	39.8 (0.5)
		spring	21	+0.079 (0.012)	228.5 (1.1)	135.0 (5.3)	35.6 (0.5)
			34	+0.061 (0.008)	201.6 (6.4)	113.4 (6.4)	37.2 (0.7)
		autumn	106	-0.085 (0.007)	148.7 (1.8)	76.6 (3.0)	40.4 (0.5)
		spring	21	+0.079 (0.002)	228.5 (1.1)	135.0 (5.3)	35.6 (0.5)
		TOTAL	127	-0.058 (0.008)	161.9 (3.0)	86.2 (3.3)	39.6 (0.5)
1993	BV-	autumn	36	-0.390 (0.026)	123.4 (2.9)	49.0 (4.2)	42.4 (0.7)
		spring	32	-0.098 (0.012)	233.6 (0.7)	105.6 (5.9)	34.6 (0.8)
			68	-0.253 (0.023)	175.2 (6.9)	75.7 (4.9)	38.7 (0.7)
	BV+	autumn	0	-	-	-	-
		spring	34	+0.140 (0.015)	238.3 (1.0)	110.5 (4.9)	35.2 (0.7)
			34	+0.140 (0.015)	238.3 (1.0)	110.5 (4.9)	35.2 (0.7)
		autumn	36	-0.390 (0.026)	123.4 (2.9)	49.0 (4.2)	42.4 (0.7)
		spring	66	+0.025 (0.018)	236.0 (0.7)	108.1 (3.8)	34.9 (0.5)
		TOTAL	102	-0.122 (0.025)	196.3 (5.5)	87.3 (4.0)	37.5 (0.6)
1994	BV-	autumn	46	-0.430 (0.020)	157.0 (1.5)	80.6 (3.3)	40.8 (0.5)
		spring	12	-0.303 (0.017)	231.8 (1.6)	121.8 (8.4)	32.9 (1.1)
			58	-0.404 (0.018)	172.4 (4.2)	89.1 (3.8)	39.2 (0.6)
	BV+	autumn	20	+0.141 (0.012)	166.1 (0.7)	100.1 (7.4)	37.5 (0.8)
		spring	23	+0.170 (0.017)	233.6 (1.2)	147.8 (4.6)	33.7 (0.7)
			43	+0.156 (0.011)	202.2 (5.2)	125.6 (5.6)	35.5 (0.6)
		autumn	66	-0.257 (0.036)	159.8 (1.1)	86.5 (3.4)	39.8 (0.5)
		spring	35	+0.008 (0.041)	232.9 (1.0)	138.9 (4.6)	33.5 (0.6)
		TOTAL	101	-0.165 (0.030)	185.1 (3.6)	104.7 (3.7)	37.6 (0.5)
Overall	BV-	autumn	175	-0.247 (0.014)	145.0 (1.5)	71.8 (2.3)	41.0 (0.4)
		spring	44	-0.154 (0.017)	233.1 (0.7)	110.0 (4.9)	34.1 (0.7)
			219	-0.228 (0.012)	162.7 (2.7)	79.5 (2.3)	39.6 (0.4)
	BV+	autumn	33	+0.098 (0.012)	162.9 (2.5)	91.6 (5.7)	38.4 (0.7)
		spring	78	+0.132 (0.010)	234.3 (0.8)	128.1(3.4)	34.9 (0.4)
			111	+0.122 (0.008)	213.1 (3.2)	117.2 (3.3)	35.9 (0.4)
		autumn	208	-0.192 (0.015)	147.8 (1.4)	75.0 (2.2)	40.6 (0.3)
		spring	122	+0.029 (0.015)	233.8 (0.6)	121.6 (2.9)	34.6 (0.4)
		TOTAL	330	-0.110 (0.013)	179.6 (2.5)	92.2 (2.1)	38.4 (0.3)

[1] number of hoggets on which a tup day value was recorded, animals failing to exhibit an oestrus were not included in the analysis.
[2] values are day of year.

(Tupday), birthday and thus age at puberty and weight at time of puberty (Tupwt) have significant effects on BV (LD). However there were significant effects of year and season of birth on prediction equations involving these puberty factors. While the general trend was the same for all season of birth x year groups there were significant differences between these subgroups in the slope of the regression. Thus calculation of a single overall equation was not valid and separate equations were derived for autumn and spring born hoggets from the data pooled over the 3 years which contains a factor for weight at first tup (tupwt) that differs depending on season of birth. Because of the significant effect of the year x season of birth interaction the equation should strictly be used only within a single cohort of animals (i.e. those born in the same season in a particular year).

There are a number of possible reasons for an earlier onset of hogget oestrus in the autumn born lambs. Firstly, the environmental window (determined by changes in day length) during which they can express their oestrus abilities is wider due to genetic changes in sensitivity to seasonal patterns of day length. Secondly, because of an earlier date of birth they may reach the age and liveweight thresholds needed for expression of puberty at the opening of this environmental window. Thus, although the spring born ewes had a later date of first tup, they were on average younger and lighter than the autumn born lambs were when they were first tupped. This is supported by the data of Dufour (1975) for Dorset cross ewes in Canada. Thirdly, the earlier puberty of the autumn born lambs could be due to the photoperiodic signals (long days) they received whilst *in utero* via maternal melatonin levels (Helliwell and Williams 1990).

Helliwell *et al.* (1992) have shown that the photoperiod the ewe was exposed to during pregnancy influenced the interval of puberty in the lambs, with lambs from ewes experiencing long days in pregnancy having an earlier puberty. The data from this trial support this latter finding and suggest that at least two, possibly independent effects (genetic sensitivity to and exposure to changes in day length) influence the date of puberty. The mechanisms involved are largely unknown and of considerable biological interest.

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