EFFECT OF SEASON ON LAMBING PERFORMANCE OF SELECTION AND CONTROL FLOCK EWES TESTED IN AN 8-MONTHLY LAMBING SYSTEM

N.M. Fogarty and A. R. Gilmour

NSW Agriculture, Agricultural Institute, Orange, NSW, Australia 2800

SUMMARY

Lambing performance for 878 Hyfer ewes joined three times in February, October and June in an 8-monthly lambing system is reported. The ewes were unselected progeny from a Control flock and a flock selected for weight of lamb weaned per ewe joined. The Select flock ewes were 9% higher than the Control flock ewes for weight of lamb weaned ($P<0.05$), with the component traits lamb survival and lamb growth contributing most of the difference. There were significant effects of season on fertility, litter size ($P<0.05$) and lamb survival ($P<0.01$). Joinings in June resulted in the lowest fertility and litter size, whereas lamb survival was lowest from the February joining. Estimates of heritability for litter size and lambs born were 0.15 ± 0.06 and 0.08 ± 0.04 respectively with little additive variation for the other traits. Between season repeatability ranged from 0.12 to 0.17 for all traits except lamb survival which was zero.

Keywords: reproduction, breeding season, heritability, repeatability, Hyfer

INTRODUCTION

The success of accelerated lambing systems depends on the ewes being capable of mating outside the normal breeding season. Under an 8-monthly system or three joinings in two years, at least one of the joinings will be in the non-breeding season. Accelerated lambing systems that rely on natural matings require ewes that have an extended breeding season with a short anestrous period. There are numerous reports of very low fertility from ewes mated naturally in spring or summer under accelerated lambing systems (eg. Notter and Copenhaver 1980, Lewis *et al.* 1996), although there are considerable differences between breeds (Fogarty *et al.* 1984). The length of the breeding season varies between breeds (Quirke *et al.* 1986). Fahmy (1990) reported a heritability of about 0.3 and repeatability of 0.2 for date of lambing which reflected onset of the breeding season. Response to selection has also been demonstrated for total weight of lamb weaned in an 8-monthly lambing system (Fogarty 1994).

This paper examines the effect of season of joining on lambing performance and its components for unselected Hyfer ewe progeny of selection and control flocks tested under an 8-monthly lambing system. Estimates of heritabilities and repeatabilities for a range of reproduction traits are presented and the implications for improvement are discussed.

MATERIALS AND METHODS

The composite Hyfer breed was developed from Dorset(1/2), Booroola Merino(1/4) and Trangie Fertility Merino(1/4) genotypes (Fogarty *et al.* 1994) and selected for total weight of lamb weaned from three lambings in two years (Fogarty 1994). These data comprise lambing records from 878 Hyfer ewes, the progeny of 78 sires, joined on three occasions in two years. The ewes were first joined at 18 months of age in mid-February (5 weeks) and again in late October (6 weeks) and early June (5 weeks) to syndicates of Hyfer rams. The ewes comprised five cohorts born in spring from 1987 to 1991. Lambs were weaned two weeks before ewes were exposed to the rams for the next joining. The ewes in each cohort were all the surviving unselected ewe progeny from the Selection and Control flocks. The proportion of Control flock ewes in the data ranged from 15 to 27% for each of the five cohorts.

Statistical analysis. Traits analysed were the overall measures of lambing performance per ewe joined; lambs born, lambs weaned and weight weaned (adjusted to a constant age and standardised across years and seasons, Fogarty 1994) and the components; fertility (ewes lambing), litter size (of ewes lambing) and lamb survival. These were analysed using REG (Gilmour 1988) and fitting the fixed effects; year of birth (cohort, 1987-91), flock (select, control), season of joining (February, October, June) and the interactions. An animal model with full pedigree information was also fitted using ASREML (Gilmour *et al.* 1995, Gilmour *et al.* 1997) to estimate heritability and other genetic and environmental effects. The model fitted error variance at each season with the correlation between seasons, direct additive genetic variance at each season with covariance between occasions and average (non genetic) maternal effect.

RESULTS AND DISCUSSION

Unselected ewe progeny of the Select flock were 9% higher than contemporary Control flock progeny for weight of lamb weaned ($P<0.05$, Table 1), the trait under selection. These cohorts represent about two generations of selection. Weight of lamb weaned is a composite trait comprising fertility (at three seasons), litter size, lamb survival and lamb growth. Lamb survival and lamb growth each contributed about 4% to the difference between the flocks with the difference in fertility about 2.5%. Litter size was 2% lower for the Select flock, although there was a significant season x flock interaction ($P<0.05$, Table 1). The base population had a gene frequency of about 10% for Fec^B (Piper *et al.* 1985) and sampling could explain the higher litter size in the Control than Select flocks among some cohorts. However it is not clear why litter size declines with season in the Control relative to Select flock causing the interaction. Year of birth or cohort was significant for fertility, litter size, lambs born and lambs weaned ($P<0.01$), but not lamb survival.

Season of joining was significant for fertility, litter size and lamb survival as well as the composite traits lambs born and lambs weaned (Table 1). Weight of lamb weaned, the trait under selection, was standardised for season and year prior to analysis. Fertility and litter size were lower from the June joining than the other seasons. Lamb survival was low from the February joining, mainly due to harsher weather conditions usually experienced during the winter lambings and higher losses from the effects of dystocia as the young ewes were lambing for the first time during this season.

For fertility and litter size there was little difference between the joinings in February (early),

Table 1. Lambing performance (± s.e.) for unselected ewe progeny of Hyfer Select and Control flocks, joined at different seasons in an 8-monthly system

Joining season	Flock	Fertility (%)	Litter size (n)	Lamb survival (%)	Lambs born /ewe joined (%)	Lambs weaned /ewe joined (%)	Weight weaned /ewe joined[A]
February		85.8 ± 1.6	1.55 ± 0.03	65.1 ± 1.7	133.2 ± 3.3	81.3 ± 3.0	1010 ± 33
	Select	85.6 ± 1.4	1.48 ± 0.02	67.6 ± 1.5	127.0 ± 3.0	80.5 ± 2.7	1017 ± 29
	Control	86.0 ± 2.8	1.62 ± 0.05	62.7 ± 3.1	139.3 ± 5.9	82.1 ± 5.3	1002 ± 58
October		84.8 ± 1.6	1.51 ± 0.03	80.5 ± 1.7	128.2 ± 3.3	100.2 ± 3.0	1013 ± 33
	Select	84.3 ± 1.4	1.51 ± 0.02	82.7 ± 1.6	127.6 ± 3.0	101.5 ± 2.7	1054 ± 29
	Control	85.3 ± 2.8	1.51 ± 0.05	78.3 ± 3.1	128.9 ± 5.9	98.9 ± 5.3	972 ± 58
June		79.7 ± 1.6	1.45 ± 0.03	75.5 ± 1.8	116.2 ± 3.3	84.6 ± 3.0	950 ± 33
	Select	83.5 ± 1.4	1.47 ± 0.02	76.1 ± 1.6	123.2 ± 3.0	90.2 ± 2.7	1032 ± 29
	Control	75.9 ± 2.8	1.43 ± 0.05	74.9 ± 3.3	109.2 ± 5.9	78.9 ± 5.3	869 ± 58
Significance							
Flock		ns	ns	ns	ns	ns	*
Season		*	*	**	**	**	ns
Flock x Season		ns	*	ns	*	ns	ns
Heritability		0	0.15 ± 0.06	0	0.08 ± 0.04	0	0.03 ± 0.02
Season r_g -		0.63 ± 0.22	-	0.46 ± 0.33	-	-0.37 ± 1.00	
Season r_e 0.16 ± 0.03		0.12 ± 0.05	0	0.17 ± 0.04	0.17 ± 0.03	0.17 ± 0.03	
Maternal environ. c^2		0	0.05 ± 0.02	0.05 ± 0.02	0	0	0.04 ± 0.02

[A] Standardised units; * P<0.05, ** P<0.01, ns not significant and October (out of season), with a small decline for June, at the end of the breeding season, especially among the Control flock ewes. Season is confounded with age of ewe, but any effect would be small over the age range. The results are similar to earlier data (Fogarty *et al.* 1994) and show the good spring joining performance of Hyfer ewes in an 8-monthly system.

The heritability estimates for litter size and lambs born (Table 1) were similar to those reported from earlier generations of this population, as well as literature estimates reviewed by Fogarty (1995). There was little if any direct genetic effect for the other traits. There was a moderate positive genetic correlation between seasons for litter size and lambs born. The error correlation between seasons, which equates to repeatability, was similar to the earlier values from this population (Fogarty *et al.* 1994) and literature values (Fogarty 1995) for most traits. There was a small maternal environment effect for litter size, lamb survival and weight of lamb.

Out of season fertility has contributed little to the selection response achieved in total weight of lamb weaned. This is not surprising given the lack of genetic variation found for fertility. The high level of fertility at the October joining (85%) would also preclude the expression of any underlying genetic variation. This contrasts with Al-Shorepy and Notter (1996) who suggested that selection to improve fertility may be more effective from spring joining than in the breeding season. However they reported a heritability of 0.09 in spring joined ewes that had a mean fertility of 40% which allows more expression of underlying variation providing the opportunity for greater selection response in fertility.

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REFERENCES

Al-Shorepy, S. A. and Notter, D. R. (1996). *J. Anim. Sci.* **74:** 1490-1498.
Fahmy, M. H. (1990). *Can. J. Anim. Sci.* **70:** 771-778.
Fogarty, N. M. (1994). *Proc. 5th Wrld. Congr. Genet. Appld. Livest. Prod.*, Guelph **18:**79-82.
Fogarty, N. M. (1995). *Anim. Breed. Abstr.* **63:** 101-143.
Fogarty, N. M., Dickerson, G. E. and Young, L.D. (1984) *J. Anim. Sci.* **58:** 285-300.
Fogarty, N. M., Brash, L. D. and Gilmour, A. R. (1994). *Aust. J. Agric. Res.* **45:** 443-457.
Gilmour, A. R. (1988). REG - A generalised linear models program. Dept. Agric. NSW.
Gilmour, A. R., Thompson, R. and Cullis, B. R. (1995). *Biometrics* **51:** 1440-1450.
Gilmour, A. R., Thompson, R., Cullis, B. R. and Welham, S. J. (1997). ASREML. Biometrics Bull. 3, NSW Agriculture, Orange, NSW.
Lewis, R. M., Notter, D. R., Hogue, D. E. and Magee, B. H. (1996). *J. Anim. Sci.* **74:** 1511-22.
Notter, D. R. and Copenhaver, J. S. (1980). *J. Anim. Sci.* **51:** 1033-1042.
Piper, L. R., Bindon, B. M. and Davis, G. H. (1985). In "Genetics of Reproduction in Sheep", pp. 115-125, editors R.B. Land and D. W. Robinson, Butterworths, London.
Quirke, J.F., Hanrahan, J.P., Loughnane, W. and Triggs, R.(1986). *Ir. J. Agric. Res.* **25:**167-72.