GENETIC VARIATION IN OVULATION RATE IN MERINO EWES AGED 18 MONTHS

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SUMMARY

Ovulation rate in Merino ewes aged 18 months has been studied over a three year period in a flock consisting of 15 different random-bred lines of Merino sheep. There were no significant differences between lines in mean ovulation rate, and, for the 14 lines drawn from current industry sources, the pooled half sib heritability estimate was 0.05 ± 0.07. The implication is that there may be little advantage in using ovulation rate instead of litter size as a selection criterion for increasing numbers of lambs born in Merino sheep.

INTRODUCTION

A number of studies has demonstrated that selection can improve the generally low level of reproductive performance in the Australian Merino (Turner 1978; Atkins, these proceedings). However, unless selection is based on life-time reproduction records it is likely to be relatively inefficient because, with fewexceptions, the heritability estimates for individual lambing records are low (Young *et al.* 1963; McGuirk 1973). This is especially true for first lambing records where the heritability is effectively zero (McGuirk 1973).

Ovulation rate is a major determinant of litter size and on a number of different grounds has been suggested as a possible alternative to litter size as a selection criterion for increasing reproduction rate in sheep (Hanrahan 1974, 1979; Bindon and Piper 1976). However, there are no published estimates of genetic variation and covariation for ovulation rate in Merinos and in this paper we report heritability estimates for 18 mo. Merino ewes grazed at Trangie, N.S.W.

MATERIALS AND METHODS

Sheep and Environment

The flock at Trangie consists of fifteen separate random-bred lines, each of 100 breeding ewes. The lines were chosen to represent the major strains of Merino in Australia and the number of lines selected for each strain reflects the relative importance of the various strains in N.S.W. The flocks are maintained as separate genetic entities by mating each year with three to seven new rams from the appropriate parent flock.

With the exception of line 15 (Table 1), which has been developed at the Agricultural Research Station, Trangie, by selection for increased numbers of lambs weaned (Atkins and Robards 1976), all lines were sampled from current industry sources. A more detailed description of the origins and structure of the lines has been given by McGuirk *et al.* (1978) and the environment and sheep management at Trangie have been described by Dun (1964).

Experimental

Ewes born in spring in the three years 1975 to 1977 had their ovulation rates assessed by mid-ventral laparoscopy at 15-16 months of age in February 1977

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to 1979 respectively. Each year the ewes grazed with vasectomised rams for 3-4 months prior to laparoscopy. During the actual observation period (l-2 days each year) oestrous ewes were drafted off each day and laparoscopied 36-48 hours later to avoid examination of animals before ovulation was complete.

Statistical

The data were examined by least squares methods after first excluding ewes in which no ovulations were observed. The total number excluded was 160 and the proportions did not differ significantly between times (Heterogeneity χ^2_{14} = 21.502, $0.10<P<0.05$). The initial model included effects due to year, age of dam, litter size at birth, strain, line within strain, sire within line x year subclass and the interaction of line x year. Line, sire and the line x year interaction were treated as random effects while the remaining effects were regarded as fixed. Strain and litter size at birth did not significantly influence ovulation rate and in the analyses presented, these effects were excluded from the model.

RESULTS

The least squares mean ovulation rate for each line in each year is given in Table 1 and the analyses of variance in Table 2.

TABLE 1 Least squares mean (±S.E.) ovulation rate for each line in each year. Ewes not ovulating excluded.

Line	Total ewes ovulating	Total sires represented	Year 1977	1978	1979	Mean
1	116	9	1.10±.10	1.51±.08	1.09±.09	1.23±.05
2	86	9	0.95±.14	1.75±.10	1.07±.17	1.26±.08
3	93	9	1.22±.12	1.49±.09	1.13±.09	1.28±.06
4	100	9	0.98±.11	1.52±.09	1.09±.09	1.20±.05
5	94	9	1.06±.12	1.54±.10	1.03±.08	1.21±.06
6	63	8	1.00±.12	1.35±.11	1.13±.12	1.16±.07
7	96	9	1.00±.10	1.59±.09	1.25±.10	1.28±.05
8	34	5*	1.16±.16	1.91±.24	1.17±.14	1.41±.10
9	61	8	0.87±.13	1.36±.11	1.05±.24	1.09±.10
10	43	8	1.29±.13	1.54±.17	0.98±.19	1.27±.09
11	66	9	1.08±.13	1.60±.13	1.05±.10	1.24±.07
12	90	9	1.10±.11	1.41±.11	1.22±.09	1.24±.06
13	70	9	1.12±.18	1.42±.16	1.11±.09	1.21±.08
14	71	8	1.01±.14	1.46±.11	1.12±.10	1.20±.06
15	242	19	1.17±.06	1.90±.06	1.15±.06	1.41±.03
Total/Mean	1325	137	1.07±.07	1.56±.06	1.11±.05	μ= 1.25±.08

* one sire (four daughters) only represented in 1978.

When all lines were included in the analysis (Table 2(a)) the effects of age of dam, year and sire were all significant ($P<0.01$, $P<0.001$, $P<0.05$ respectively) but not the line or line x year effects. In Table 2(b) where, because of its history of selection for increased reproduction rate (Atkins and Robards 1976) line 15 has been excluded, only the year effects remain significant ($P<0.05$).

The estimates of heritability of ovulation rate derived from the sire component of variance were 0.16+0.07 (93 d.f. for sires; 9.2 daughters/sire) and 0.05±0.07; (77 d.f. for sires; 8.6 daughters/sire) for the Table 2(a) and

2(b) analyses respectively. The corresponding estimates of the between sire component of variance, and of the phenotypic variance were 0.0091 and 0.0023, and 0.2255 and 0.1824 respectively. The apparent reduction in heritability therefore occurred because the exclusion of line 15 reduced the between sire component by 75 percent but only reduced the phenotypic variance by 19 percent. Closer inspection of the contributions to the between sire sum of squares shows that the effect of excluding flock 15 largely arises because the sires used in 1976 contributed 36 percent of the between sire sum of squares but only 6 percent of the degrees of freedom.

TABLE 2 Analyses of variance

Source of variance†	(a) All 15 lines included d.f.	Mean square	(b) Line 15 excluded d.f.	Mean square
Age dam	4	0.8954**	3	0.0678
Year	2	3.9454***	2	0.6369*
Line	14	0.4765	13	0.1678
Year x line	28	0.2825	26	0.1825
Sires within year x line sublcasses	93	0.3004*	77	0.1996
Remainder	1183	0.2164	961	0.1801

† (a) Year, line and year x line tested against sires; sires and age of dam against remainder. (b) All tested against remainder since sires not significant. *** P<.001, ** P<.01, * P<0.05.

DISCUSSION

In a recent review Hanrahan (1979), concluded that the genetic variation in litter size in sheep arises almost exclusively from genetic variation in ovulation rate and recommended that selection programmes to increase litter size should be based directly on measurements of ovulation rate.

The data in this paper shows that in lines of Merinos representative of the industry (lines 1-14) the heritability of ovulation rate in young ewes is low and probably not different from estimates of the heritability of litter size for Merino ewes of the same age (Young, Turner and Dolling 1963; McGuirk 1973). If this is substantiated by further data, then a measure of ovulation rate in young ewes is of very limited value in predicting her breeding value for reproductive performance either at first lambing or throughout life. Estimates of the comparative heritabilities of ovulation rate and litter size at later ages and of the genetic correlations between them are therefore required before firm conclusions can be drawn about the relative merits of either measure as a selection criterion for increasing litter size in Merinos.

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