The repeatability of reproduction rate in the Tygerhoek Merino flock

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Received 27 February 1986

The repeatability of reproduction rate at 2 years or up to 3 years of age was investigated by regression methods considering subsequent reproduction averaged over a number of lambing opportunities or within subsequent age groups. Results from the study suggested multiple birth rate at 2 years of age to be more repeatable than conception rate. Subsequent differences in lambs born/ewe mated (Lb/Em), derived from an initial difference of one lamb at 2 years of age, were approximately twice as large between one and two lambs born (0,20) than between no and one lamb born (0,11). The culling of all the barren ewes at 2 years of age would not improve Lb/Em in the current flock substantially, whereas the proportion of ewes bearing multiples at 2 years was too low to supply replacement requirements. Differences in the subsequent rearing performance of ewes rearing no or one lamb or one or two lambs at 2 years of age were approximately of the same magnitude (0,15 and 0,17). The culling of all the ewes rearing no lambs at 2 years was associated with moderate gains in rearing performance in the current flock. The subsequent reproduction of ewes barren up to 3 years was considerably lower than in ewes conceiving at least once. Expected gains in the current flock by culling the former ewes are limited by the small proportion of ewes in this category (0,03). Comparable results were obtained for ewes rearing no lambs up to 3 years of age. Ewes bearing or rearing at least one set of twins were more productive in subsequent years than their contemporaries. The utilization of modern techniques to accelerate gains in reproduction rate in the current flock and in future generations by techniques such as superovulation, embryo transfer and the manipulation of the fecundity threshold are discussed.

Die herhaalbaarheid van reproduksietempo op 2-jaar-, of tot op 3-jaar-ouderdom, is met regressiemetodes ondersoek met gemiddelde latere reproduksie oor 'n aantal lamgeleenthede of binne ouderdomsgroepe as afhanklike veranderlikes. Verkreë resultate dui op 'n hoër herhaalbaarheid vir meerlinggeboortes as vir besetting. Latere verskille in lammers gebore/ooi gepaar (Lb/Em) wat ooreenstem met 'n aanvanklike verskil van een lam op 2 jaar, was ongeveer dubbel so groot vir die verskil tussen een en twee lammers (0,20) as vir die verskil tussen geen en een lam (0,11). Die uitskot van alle droë ooie op 2-jaar-ouderdom sou nie Lb/Em in die huidige kudde noemenswaardig verhoog nie, terwyl die proporsie ooie met tweelinge op 2 jaar te laag is om vervangingsbehoeftes te bevredig. Verskille in die latere speenpersentasie van ooie wat op 2 jaar geen of een lam of een of twee lammers gespeen het, was naastenby ewe groot (0,15 en 0,17). Die uitskot van ooie wat op 2 jaar geen lammers gespeen het nie, sou speenpersentasie in die huidige kudde tot 'n mate verhoog. Die daaropvolgende reproduksietempo van ooie wat tot op 3 jaar nie beset geraak het nie, was laer as by ooie wat minstens een keer beset geraak het. Vordering in die huidige kudde word egter beperk deur die lae proporsie ooie in hierdie kategorie (0,03). Vergelykbare resultate is verkry vir ooie wat tot op 3 jaar geen lammers gespeen het nie. Ooie wat minstens een tweeling gehad of gespeen het, was meer produktief in latere jare as hulle tydgenote. Die gebruik van moderne tegnieke soos superovulasie, embrio-oorplasing en die manipulasie van die drumpel vir meerlinggeboortes om vordering in die huidige kudde te versnel, word bespreek.

Keywords: Repeatability, reproduction rate, Merino sheep

Part of an M.Sc.(Agric.) thesis submitted to the University of Stellenbosch

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Introduction

In previous papers on reproduction rate in the Tygerhoek Merino flock, attention was given to the heritability of components of reproduction rate and genetic correlations of these components with wool and livemass traits (Cloete & Heydenrych, 1987). A proper knowledge of the repeatability of reproduction rate is, however, a further prerequisite for gains through selection in the current flock (Turner, 1969) and therefore also for the formulation of a breeding strategy for increased reproduction rate.

Repeatability estimates derived from the traditional intra-class correlation method tend to be low for reproduction traits (Turner, 1969). For the purpose of the present investigation, repeatability was estimated according to the regression method proposed by Lush (1956), which may yield more accurate estimates in some cases. Repeatability estimates obtained from the regression method can also be used to estimate gains in reproductive performance of the current flock. With this method it is often found that the regression of subsequent means on an initial difference of one lamb, e.g. between no and one or between one and two lambs born, is not the same. Young, Turner & Dolling (1963) found the difference in subsequent reproduction of ewes giving birth to one or two lambs to be twice as high as between barren ewes and those producing one lamb. This finding led Turner (1969) to conclude that selection for multiple births in the current flock is likely to be more profitable than selection against failure to lamb. In some flocks, however, the magnitude of these differences is reversed, the subsequent difference between barren ewes

and those producing singles being larger than between ewes bearing singles and multiples (van der Merwe, 1976; Fogarty, McGuirk & Nicholls, 1976; Kritzinger, Stindt & van der Westhuysen, 1984). The repeatability of fertility and multiple births thus appears to differ between flocks and/or environments.

Data of the Tygerhoek Merino flock were therefore used to estimate the repeatability of the components of reproduction rate for Merino sheep in the south-western Cape. Estimates obtained from the investigation were used to predict current flock gains under different selection regimes for an increased reproduction rate.

Materials and Methods

Repeatability was estimated by the regression method as proposed by Lush (1956) and described by Turner & Young (1969). This method involves the classification of ewes according to their reproductive performance in a reference year. The average subsequent reproduction of ewes belonging to different reproduction classes in the reference year is then calculated. Repeatability is calculated as the difference between these classes. In the present study, subsequent reproduction within age groups from 3 to 6 years, and averaged over two to four lambing opportunities corresponding to ages of 4 - 6 years, was regressed on reproduction at 2 years of age. Only the results of the within-age group analyses are presented and discussed, as the conclusions were similar to those obtained from the analyses where average subsequent reproduction over a number of lambing opportunities was considered. Subsequent reproduction averaged over two and three lambing opportunities was also regressed on reproduction up to an age of 3 years. Reproduction traits considered were ewes conceived/ewe mated (Ec/Em), lambs born/ewe conceived (Lb/Ec), lambs born/ewe mated (Lb/Em), and lambs weaned/ewe mated (Lw/Em). Pre-weaning mortalities (Ld/Lb) were also investigated in the analyses where average reproduction over two and three lambing opportunities (at ages of 5 - 6 years) was regressed on reproduction up to an age of 3 years.

The number of observations in the respective reproduction classes at 2 years of age, or up to an age of 3 years, is presented in Table 1. Ewes available for the respective analyses ranged from 1 046 ewes available for four subsequent lambing opportunities at ages from 3 to 6 years inclusive, to 2 074 ewes being available for one subsequent lambing opportunity at an age of 3 years. The mean subsequent reproduction of ewes belonging to different reproduction classes was derived from least squares analyses by the LSML76 computer program (Harvey, 1977). The general fixed linear model applied to the data included the effects of birth year, selection group (see Heydenrych, du Plessis & Cloete,1984), birth type and reproduction class, as well as the two-factor interactions of selection group and birth type with reproduction class. Birth years ranged from 1968 to respectively 1978 - 1982 for ewes available for four to one lambing opportunities. Birth type classes were single and multiple born ewes. Reproduction classes represented the reproduction of ewes in a specific reference year, e.g. no, one or two lambs born at 2 years of age. Least square means corresponding to the respective reproduction classes were tabulated, and repeatability estimates were calculated as the difference between adjacent classes. Repeatability values were pooled by the calculation of weighted means and appropriate standard errors, using the formulas given by Turner & Young (1969).

Pooled repeatability estimates were obtained from adjacent groups (e.g. ewes bearing no and one lamb and ewes bearing one and two lambs at 2 years of age) to obtain a single repeatability estimate for number of lambs born in a particular data set. Repeatability estimates were also pooled in order to measure the average difference in the subsequent performance which is associated with an initial change from, for example, no to one lamb born or from one to two lambs born. Both these approaches were also followed by Young, *et al.* (1963). Expected gains in the current flock obtainable by culling ewes on their early reproduction were predicted according to the formula

$$G = pd,$$

with G the gain in the current flock, p the proportion culled and d the difference in subsequent performance between ewes culled and those retained (Turner, 1969).

Table 1 The distribution of ewes classified according to their production at 2 years of age or up to an age of 3 years

Number of lambs born or weaned at 2 years	Age groups[a]			
	3 years	4 years	5 years	6 years
Number born				
0 lambs	536	431	329	251
1 lamb	1 339	1 164	957	700
2 lambs	199	177	132	95
Number weaned				
0 lambs	774	633	471	344
1 lamb	1 214	1 062	885	653
2 lambs	86	77	62	49
Total	2 074	1 772	1 418	1 046

Number of lambs born or weaned up to 3 years	Lambing opportunities	
	2	3
Number born		
0 lambs	46	36
1 lamb	367	263
2 lambs	736	538
3 lambs	232	180
4 lambs	37	29
Number weaned		
0 lambs	127	86
1 lamb	480	340
2 lambs	664	503
3 lambs+	147	117
Total	1 418	1 046

[a] Age groups of 4 - 6 years corresponded to ewes available for two to four subsequent lambing opportunities

Results and Discussion

The repeatability of reproduction at two years of age

Ewes conceived/ewe mated

The mean subsequent conception rate within age groups over four subsequent lambing opportunities for ewes that were barren or conceived at 2 years of age are presented in Table 2. Repeatability estimates derived from these means ranged between 0,05 and 0,08 within age groups and gave a pooled estimate of 0,066. These estimates are rather low and in general agreement with estimates ranging between 0 and 0,07 for Clun Forest ewes (Forrest & Bichard, 1974), 0,03 - 0,12 for crossbred ewes (Fogarty, Dickerson & Young, 1985), and 0,02 - 0,09 for Merino and Corriedale flocks grazing oestrogenic pastures (Ponzoni & Walker, 1982). The present estimates are somewhat higher than the estimate reported for the Sonora Rambouillet flock (Shelton & Menzies, 1970), but lower than the corresponding estimate for the McGregor flock. The estimates are also considerably lower than other estimates reported by Ponzoni & Walker (1982), and those obtained for Karakul ewes by le Roux & van der Westhuizen (1972).

The estimate in Table 2 was used to predict the gain in Ec/Em in the current flock when a regime of culling ewes barren at 2 years of age is practised. With a proportion of 0,24 barren ewes at 2 years of age (calculated from Table 1) a selection gain of approximately 0,016 Ec/Em could be expected in the current flock. This gain is lower than the comparable estimate of 0,066 reported by le Roux & van der Westhuizen (1972), and not of practical value in the improvement of conception rate in the current flock.

Lambs born/ewe conceived

Repeatability estimates for lambs born/ewe conceived ranged between 0,13 and 0,25 within age groups, giving a pooled estimate of 0,21 (Table 2). Comparable estimates from the literature were 0,13 - 0,17 for Merino ewes (Mann, Taplin & Brady, 1978), 0,24 and 0,30 for Blackface and Welsh ewes (Purser, 1965), 0,12 and 0,15 for Rambouillet ewes (Shelton & Menzies, 1970) and 0,10 - 0,16 for crossbred ewes (Fogarty, *et al.*, 1985). The present estimates agreed with these results, but were amongst the higher values.

The rather large difference between ewes bearing singles and multiples at 2 years of age is of little practical importance, as the proportion of ewes bearing multiples at this age (0,096 in the Tygerhoek flock) is generally insufficient for replacement purposes. It could, however, be used to identify highly prolific ewes at an early age. Such ewes can then be used in the formation of high fertility flocks where genetic progress can be accelerated by techniques such as superovulation and embryo transfer (Hanrahan & Quirke, 1982; Kelly, Lewer, Allison, Paterson & Howarth, 1983). Another aspect that could possibly be considered is the manipulation of the fecundity threshold at 2 years of age (de Lange, 1984) to increase the proportion of ewes that can be selected at this age. According to the author cited, the ideal would be to alter the number of ewes giving birth to multiples at 2 years of age to meet the replacement requirements for that particular contemporary group. This purpose can possibly be achieved through the immunization of ewes against steroid hormones (Scaramuzzi, Geldard, Beels, Hoskinson & Cox, 1983), for which maiden ewes appear to be as responsive as adult ewes. This knowlegde may also be of value in group breeding schemes where intensive selection can be applied to replacement ewes for the nucleus flock (Parker, 1979; Erasmus & Delport, 1985). The identification of ewes bearing twins can be problematic in practical flock lambing situations where sheep are supervised once a day (Alexander, Stevens & Mottershead, 1983). Advances in ultrasound techniques (Wani, 1981; Fowler & Wilkens, 1982) may, however, enable producers to identify ewes with multiple foetuses for selection purposes, without the need of extra supervision.

Lambs born/ewes mated

The mean subsequent reproduction within age groups of ewes having no, one or two lambs at 2 years of age is presented in Table 3. Pooled repeatability estimates within age groups ranged from 0,09 to 0,19. These values were in general agreement with corresponding within-age group values ranging from 0,02 to 0,15 for Merino ewes (Young, *et al.*, 1963; Mann, *et al.*, 1978), 0,01 - 0,18 for Clun Forest ewes (Forrest & Bichard, 1974) and 0,10 - 0,18 for crossbred ewes (Fogarty, *et al.*, 1985). The present results

Table 2 Least square means for the subsequent conception and birth rate of ewes, classified according to their performance at 2 years of age within age groups with appropriate repeatability (t) estimates

Reproduction at 2 years	Age group				Pooled t ($t \pm SE$)
	3 years	4 years	5 years	6 years	
Conception rate					
barren (0)	0,82[a]	0,81[a]	0,81[a]	0,80[a]	0,066 ± 0,006
conceived (1)	0,87[b]	0,89[b]	0,88[b]	0,87[b]	
Number of lambs born					
single (1)	1,05[a]	1,16[a]	1,17[a]	1,24[a]	0,207 ± 0,030
multiple (2)	1,18[b]	1,41[b]	1,42[b]	1,47[b]	

[a,b] Denote significant ($P \leq 0,01$) differences within columns

Table 3 Least square means for the subsequent lambing and rearing rate of ewes, classified according to their number of lambs born at 2 years of age, within age groups, with appropriate repeatability estimates

Number of lambs born or weaned at 2 years	Age group				Pooled t ($t \pm SE$)
	3 years	4 years	5 years	6 years	
Number of lambs born					
0 lambs	$0,98^{1}$	$1,01^{1}$	$1,06^{a1}$	$1,08^{1}$	
1 lamb	$1,04^{1}$	$1,16^{2}$	$1,16^{b1}$	$1,23^{2}$	$0,113 \pm 0,023$
2 lambs	$1,17^{2}$	$1,41^{3}$	$1,41^{c2}$	$1,46^{3}$	$0,203 \pm 0,031$
Pooled t ($t \pm SE$)	$0,085 \pm 0,029$	$0,185 \pm 0,042$	$0,145 \pm 0,069$	$0,178 \pm 0,032$	
Number of lambs weaned					
0 lambs	$0,73^{1}$	$0,84^{1}$	$0,84^{a1}$	$0,93^{1}$	
1 lamb	$0,93^{2}$	$1,00^{2}$	$0,97^{b2}$	$0,97^{1}$	$0,146 \pm 0,032$
2 lambs	$1,07^{2}$	$1,07^{2}$	$1,20^{c2}$	$1,27^{2}$	$0,170 \pm 0,050$
Pooled t ($t \pm SE$)	$0,193 \pm 0,023$	$0,141 \pm 0,031$	$0,145 \pm 0,037$	$0,084 \pm 0,101$	

a, b, c — denote significant ($P \leq 0,05$) differences in columns

1, 2, 3 — denote significant ($P \leq 0,01$) differences in columns

also corresponded with pooled estimates of 0,10 - 0,20 for Merino ewes (Young, *et al.*, 1963; Kennedy, 1967; Lewer & Allison, 1980), 0,14 for Clun Forest ewes (Forrest & Bichard, 1974), 0,12 for crossbred ewes (Dzakuma, Whiteman & McNew, 1982), 0,11 and 0,18 for Dormer and S.A. Mutton Merino ewes respectively (Kritzinger, *et al.*, 1984), and 0,15 for crossbred ewes (Fogarty, *et al.*, 1985).

An initial difference of one lamb between no and one lamb born at 2 years resulted in a pooled difference of 0,113 lambs in subsequent years. The corresponding value for the difference between one and two lambs born were twice as large, namely 0,203. The trend is in agreement with results reported by Young, *et al.*, (1963), but the magnitude of both values was somewhat higher than those obtained by the authors cited. Corresponding results on Merino ewes (van der Westhuysen, 1973; Poggenpoel, Hart & Lund, 1984) and Galway ewes (More O'Ferrall, 1976) suggested small differences in the subsequent reproduction of ewes having no and one lamb at 2 years compared to those having one or two lambs. There is, however, ample evidence from the literature where the magnitude of these differences was reversed (Inskeep, Barr & Cunningham, 1967; van der Merwe, 1976; Fogarty, *et al.*, 1976; Kritzinger, *et al.*, 1984, for Dormer ewes). Other authors reported differences of approximately the same magnitude between initial differences of no and one lamb and one and two lambs (Dzakuma, *et al.*, 1982; Kritzinger, *et al.*, 1984, for S.A. Mutton Merino ewes).

The estimate in Table 3 was used to predict the gain in Lb/Em in the current flock under the assumption that all the barren ewes at 2 years of age are culled—which was 0,034 Lb/Em with a proportion of 0,24 barren 2-year-old ewes. This estimate is higher than the estimate of 0,01 reported by Poggenpoel, *et al.*, (1984), but still rather low for substantial progress to be made in the current flock.

From the results presented above, it is evident that reproduction rate shows a measure of repeatability. It is also of interest to note that similar relationships exist in highly prolific sheep breeds. Lewer & Allison (1980) reported a pooled repeatability estimate of 0,35 in ino ewes bearing no to three lambs at 2 years of age. Muratov (1982) similarly reported the average number of lambs born in subsequent years to be 2,07, 2,33, 2,65, 3,03 and 3,17 for Romanov ewes bearing one to five lambs at their first lambing.

Lambs weaned/ewe mated

Pooled repeatability estimates within age groups ranged from 0,084 to 0,193 for lambs weaned/ewe mated (Table 3). These estimates were in general agreement with the pooled estimate of 0,11 for Merino ewes (Kennedy, 1967), and estimates ranging from 0,11 to 0,14 in crossbred ewes (Fogarty, *et al.*, 1985), whereas they tended to be higher than pooled values of 0,05 - 0,10 presented by Young, *et al.*, (1963) for Merino ewes. An initial difference of one lamb between no and one lamb reared at 2 years was associated with a pooled difference of 0,146 in subsequent years. The corresponding estimate for the difference between one and two lambs reared was of approximately the same magnitude, namely 0,170. This estimate was in general agreement with estimates of 0,17 for Merino ewes (Young, *et al.*, 1963) and 0,13 for Perendale ewes (Lewer, Rae & Wickham, 1983). The corresponding difference between no and one lamb reared was somewhat higher than the corresponding estimate of 0,07 for Merino ewes (Young, *et al.*, 1963) and considerably higher than the estimate of 0,01 for Perendale ewes (Lewer, *et al.*, 1983). The present results for the regression of rearing performance at 3 years of age on number of lambs weaned at 2 years of age were rather similar to results of Inskeep, *et al.*, (1967).

It is interesting to note that within-age group differences in subsequent reproduction between ewes rearing no and one lamb at 2 years of age tended to decrease with age. Differences between ewes rearing one and two lambs tended to follow the opposite trend and to increase with age. Results regarding this aspect are scarce in the literature and no corresponding estimates were found. It does, however, appear that the culling of ewes not rearing

does, however, appear that the culling of ewes not rearing any lambs at an age of 2 years may contribute to progress in Lw/Em in the Tygerhoek flock. Estimated selection gains under this regime amount to approximately 0,05 Lw/Em, with a proportion of 0,348 ewes rearing no lambs at 2 years of age. Ewes rearing multiple lambs at 2 years of age maintained a better rearing performance in subsequent years when compared to ewes rearing a single lamb. The proportion of such ewes in the Tygerhoek flock is, however, much too small to be of practical importance. This knowledge can, however, be used in strict breeding programmes where modern techniques are used to manipulate the fecundity threshold, or to maximize the number of progeny of ewes with a known record for rearing performance. The latter procedures were in fact followed by Haughey (1983) in the establishment of his high and low efficiency flocks, where selection for and against rearing ability was successfully applied.

Table 4 Least square means for the subsequent conception and birth rate of ewes, classified according to their performance up to 3 years of age, averaged over two or three lambing opportunities, with appropriate repeatability (t) estimates

Reproduction up to 3 years	Lambing opportunities: Two	Lambing opportunities: Three	Pooled t ($t \pm SE$)
Conception rate			
Twice barren (0)	$0,56^{1}$	$0,55^{1}$	$0,300 \pm 0,004$
Once barren (1)	$0,85^{2}$	$0,85^{2}$	$0,048 \pm 0,002$
Conceived twice (2)	$0,90^{3}$	$0,90^{3}$	
Pooled t ($t \pm SE$)	$0,077 \pm 0,082$	$0,083 \pm 0,086$	
Number of lambs born			
1 lamb	$1,21^{a1}$	$1,23^{a1}$	$0,069 \pm 0,015$
2 lambs	$1,26^{a1}$	$1,31^{b1}$	$0,192 \pm 0,014$
3 lambs	$1,47^{b2}$	$1,49^{c2}$	$0,179 \pm 0,018$
4 lambs	$1,67^{c2}$	$1,66^{c2}$	
Pooled t ($t \pm SE$)	$0,123 \pm 0,055$	$0,127 \pm 0,034$	

a, b, c — denote significant ($P \leq 0,05$) differences in columns
1, 2, 3 — denote significant ($P \leq 0,01$) differences in columns

The repeatability of reproduction up to an age of 3 years

Ewes conceived/ewe mated

The mean subsequent conception rate of ewes classified according to their conception up to an age of 3 years is presented in Table 4. The average subsequent conception rate of ewes barren twice was considerably lower than in ewes conceiving at least once. The culling of these ewes will, however, result in gains of only about 0,01 Ec/Em in the current flock, as the proportion of such ewes is extremely low (0,034). It is clear that, even though culling of such ewes is advisable in a flock mating situation, this practice will result in only small gains under practical sheep farming conditions.

Lambs born/ewe conceived

The average subsequent Lb/Ec of ewes bearing one to four lambs up to an age of 3 years is presented in Table 4. It is evident that ewes bearing at least one set of twins up to an age of 3 years were more prolific in subsequent years than ewes with no twins. Ewes producing two sets of twins were, in turn, more prolific in subsequent years than ewes with only one set of twins. The proportion of ewes twinning at least once was only about 0,20 in the Tygerhoek flock, making it practically impossible to select all the required replacement ewes from these ewes. This knowledge may, however, be of considerable value in breeding programmes where strict selection can be applied to ewe

Table 5 Least square means for the subsequent lambing and rearing rate of ewes, classified according to their number of lambs born or weaned up to 3 years, averaged over two or three lambing opportunities, with appropriate repeatability (t) estimates

Number of lambs born or weaned up to 3 years	Lambing opportunities: Two	Lambing opportunities: Three	Pooled t ($t \pm SE$)
Number of lambs born			
0 lambs	$0,74^{a1}$	$0,73^{1}$	$0,332 \pm 0,016$
1 lamb	$1,06^{b2}$	$1,08^{2}$	$0,098 \pm 0,004$
2 lambs	$1,15^{c2,3}$	$1,18^{3}$	$0,235 \pm 0,001$
3 lambs	$1,39^{d3}$	$1,41^{4}$	$0,108 \pm 0,046$
4 lambs	$1,55^{d3}$	$1,49^{4}$	
Pooled t ($t \pm SE$)	$0,168 \pm 0,046$	$0,170 \pm 0,049$	
Number of lambs weaned			
0 lambs	$0,71^{1}$	$0,80^{a1}$	$0,153 \pm 0,030$
1 lamb	$0,90^{2}$	$0,93^{a1,2}$	$0,087 \pm 0,005$
2 lambs	$0,99^{3}$	$1,01^{b2}$	$0,197 \pm 0,007$
3+ lambs	$1,18^{4}$	$1,21^{c3}$	
Pooled t ($t \pm SE$)	$0,135 \pm 0,033$	$0,122 \pm 0,036$	

a, b, c, d — denote significant ($P \leq 0,05$) differences in columns
1, 2, 3, 4 — denote significant ($P \leq 0,01$) differences in columns

replacements, or where modern techniques to accelerate genetic progress are implemented.

Lambs born/ewe mated

The average subsequent lambing performance of ewes classified according to their number of lambs born up to 3 years, is presented in Table 5. The average subsequent Lb/Em of ewes barren in both lambing seasons was considerably lower than in those conceiving at least once. The estimated gain in the current flock associated with the culling of the former ewes was approximately 0,015 which was somewhat higher than a comparable value of 0,01 reported by Turner (1966), but still too low for substantial gains in the current flock. The means reported in Table 5 are in close agreement with comparable results for Merino ewes reported by van der Westhuysen (1973), and preliminary findings (Cloete, Heydenrych & du Plessis, 1984) in the Tygerhoek control flock. Differences between the respective reproduction classes were larger in the present investigation than in results reported by Poggenpoel, *et al.* (1984).

Repeatability estimates were also obtained for Ld/Lb. Ewes losing at least one lamb up to 3 years of age lost significantly ($P < 0,05$) more lambs in subsequent years than ewes not losing any lambs. The repeatability estimate for this trait was 0,05. This estimate agrees with similar results reported by Fogarty, *et al.* (1985) for crossbred ewes, and Shelton & Menzies (1970) for the Sonora Rambouillet flock. It is lower than the estimate for the McGregor flock reported by the latter authors. Results furthermore indicated that the subsequent pre-weaning mortality rate of ewes bearing one, two or three+ lambs up to 3 years, of which one or more lambs died prior to weaning, was respectively 0,04, 0,08 and 0,02 Ld/Lb higher than contemporaries not losing any lambs. These estimates evidently do not suggest higher repeatability values for Ld/Lb in ewes bearing multiples.

Lambs weaned/ewe mated

The average subsequent rearing performance of ewes classified according to their number of lambs weaned up to 3 years of age is presented in Table 5. The average subsequent rearing performance of ewes rearing no lambs up to 3 years was lower than in ewes rearing at least one lamb, especially when two lambing opportunities were considered. The proportion of ewes included in the former class (0,08 - 0,09) was rather low. The culling of these ewes would result in current flock gains amounting to approximately 0,020 Lw/Em. The subsequent rearing performance of ewes weaning at least one set of twins was higher than in ewes with no twin-rearing record. Ewes belonging to the former class contributed only 10 - 11% of all ewes available, and can therefore not be considered sufficient for replacement needs in a normal breeding flock.

Acknowledgement

The authors wish to thank Mr J.J. du Plessis, the late Mr D.J.B. Meissenheimer and Miss E.du Toit for the maintenance of the breeding flock and the collection of the data. Mr A.van Rooyen and Mrs C.Thiart are also thanked for assistance regarding analyses and interpretation of the data.

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