Short Communication / Kort Mededeling

The repeatability of greasy wool mass of Merino breeding ewes in the south-western Cape

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Received 26 June 1990; revised 8 April 1991; accepted 17 January 1991

Data of 224 Merino breeding ewes, kept on artificial pasture in a favourable environment in the South Western Districts, were analysed. Means of greasy wool mass at 16, 28 and 40 months of age were respectively 8,41, 9,14 and 8,79 kg. The mean shorn body mass at 16 months of age was 50,8 kg and the number of lambs born per ewe mated was 1,05 at both 24 and 36 months of age. The mean repeatability of greasy wool production was 0,76 ± 0,024.

Data van 224 Merino-teelooie, wat op aangeplante weiding in 'n gunstige omgewing in die Suid-westelike Distrikte aangehou is, is ontleed. Die gemiddelde rouwolmassa op 16-, 18- en 40-maande-ouderdom was onderskeidelik 8,41, 9,14 en 8,79 kg. Die gemiddelde kaalgeskeerde liggaamsmassa op 16-maande-ouderdom was 50,8 kg en die aantal lammers gebore per ooi gepaar was 1,05 op beide 24- en 36-maande-ouderdom. Die gemiddelde herhaalbaarheid van rouwolmassa was 0,76 ± 0,024.

Keywords: Merino, greasy wool, repeatability.

For characteristics such as greasy wool mass that can be measured several times on the same individual, the intra-class correlation or repeatability is a useful parameter. Since the repeatability of a character includes all genetic plus permanent environmental differences between individuals, its value is an upper limit for the heritability of that characteristic. In more practical terms, the repeatability indicates the extent to which observed differences in performance between animals will be repeated in future (Pirchner, 1983). When a group of animals is selected on measurements of a certain characteristic, the gain in lifetime production in the current flock can be predicted from the product of the repeatability and the selection differential (Turner & Young, 1969).

It appears that only two estimates of repeatability of greasy wool production of South African Merinos have been published, both on data of some 30 years ago from measurements in sub-populations of the Grootfontein Merino Stud in the Central Karoo Region. Nel (1964) used data of 281 breeding ewes born from 1956 to 1960 having 2—6 records. Nel *et al.* (1972) analysed data of 7108 ewes from six different breeding groups of about 100 breeding ewes each, born between 1941 and 1954. The age of most of the ewes in these groups varied from 1,5 to 5,5 years, with small proportions of up to 8,5 years. The repeatability in both these investigations was estimated at 0,58 with 95% confidence limits of 0,498 and 0,655 in the first. Nel (1964) pointed out that his data were from a selected group of ewes, but that the selection differential for greasy wool mass was unknown as culled ewes were not measured. He could therefore, not adjust his estimate for selection as was done by Young *et al* (1960). His data were also not corrected for fecundity of the ewes. Nel *et al.* (1972) do not mention these aspects in their paper.

The data of the present study were obtained from five groups of approximately 50 ewes each from five different breeders. The farms of these breeders are all situated in the more favourable south-western Cape Province in the district of Bredasdorp, where the climate is more favourable and the grazing consists mainly of artificial pastures. On each farm, 50 ewes were selected at random at weaning and each group was raised by its breeder on his farm to take part in the Young Ewe Competition of the National Wool Growers Association when they were 16-months old. The ewes were then shorn and wool and body masses were recorded. After shearing, ewes of all groups were assembled on one of the farms for about three months and mated to Merino rams. After mating each group was returned to its original farm. The different groups remained on their respective home farms and were managed as part of the breeding ewe flock on each farm. For the following two years, 12 months' greasy wool masses were measured at 28 and 40 months of age. Lambs born per ewe mated were also recorded during this period at 24 and 36 months of age. Results of the measurements are given in Table 1.

Table 1 Means of different characteristics and the repeatability of greasy wool mass

	Body mass (kg)		Lambs born per ewe mated		Greasy wool mass (kg)			Repeatability	No. of
Group	16 months	18 months	24 months	36 months	16 months	28 months	40 months	of greasy wool	ewes
A	47,7	62,0	1,24	1,06	7,62	8,97	9,01	0,65 ± 0,070	45
B	38,6	59,1	1,02	1,20	7,29	8,89	8,39	0,81 ± 0,042	48
C	56,2	62,6	1,02	0,88	9,26	9,27	8,88	0,84 ± 0,039	41
D	51,4	63,2	0,96	1,12	8,16	9,24	8,46	0,78 ± 0,048	48
E	60,1	65,3	1,00	1,00	9,70	9,35	9,31	0,73 ± 0,060	42
Mean	50,8	62,5	1,05	1,05	8,38	9,14	8,79	0,76 ± 0,024	224
SD[a]	8,31	4,63			1,31	1,12	1,12		
n	250	249	248	243	250	243	224	224	

[a] Standard deviation.

Repeatabilities were estimated according to the method of Young *et al.* (1960) as shown in Table 2. In this analysis of variance, variation due to year was removed. According to definition, repeatability is estimated from such a table as $\sigma^2_s / (\sigma^2_s + \sigma^2_e)$. With more than one set of data available, the pooled estimate of repeatability is obtained from pooling the degrees of freedom and sums of squares of the separate analyses. Standard errors were estimated according to the method given by Becker (1967). Pooled linear correlation coefficients were estimated by combining group values by means of the *z* transformation. A total of 224 ewes with three records each were available. The data were not adjusted for fecundity as only a negligible number of ewes did not produce lambs. Differences between the wool masses of ewes with one or two lambs were not statistically significant. The mean wool masses of ewes with one or two lambs at 28 months of age were respectively 8,95 and 8,84 kg and at 40 months 8,63 and 8,74 kg. The upper part of Table 2 shows the analysis of data for group A as an example and the lower part shows the pooled analyses of all five groups.

From the results presented in Table 1 it is clear that there were substantial differences between group means for shorn body mass and greasy fleece mass at the age of 16 months. The lower body mass means of groups A and B increased sharply to the age of 18 months. These two groups also had the lowest means for greasy wool mass which increased much more than the other group means to the next measurement at 28 months. The within-group repeatabilities varied from 0,65 to 0,84. The mean pooled repeatability over all groups was 0,76 ± 0,024. The mean pooled correlation coefficients between different measurements and between the first measurement and the sum of the second and third (23) and between the sum of all three measurements (123) were as follows:

$r_{1.2} = 0{,}72$ $r_{1.3} = 0{,}73$ $r_{2.3} = 0{,}89$
$r_{1.23} = 0{,}74$ $r_{1.123} = 0{,}87$

These values show a higher relationship between second and third measurements than between the first and following measurements. The measurements over three production years of this study, do not measure lifetime production which will usually extend over five or more years. However, from the high correlation value of 0,74 between the first and the sum of the second and third measurements, it appears that the first measurement will be a reasonably good indication of lifetime production. The correlation between the first and the total of all three measurements (0,87) is expected to be higher, this being a part-whole correlation (Young *et al.*, 1960).

The effects of years and of sheep are statistically highly significant ($P < 0{,}01$) in the pooled analysis of variance. Both the variance components are given at the bottom of Table 2.

The repeatability estimate of 0,76 for greasy wool is in good agreement with estimates of greasy wool for Australian Merinos. Morley (1951) reported a value of 0,737; Young *et al.* (1960) a value of 0,637 for 159 ewes of an unselected flock and a value of 0,600 for 154 ewes of a selection flock (which increased to 0,639 when adjusted for selection), and Mullaney *et al.* (1970) found a correlation of 0,79 between two successive measurements. However, the estimate of this study (0,76) appears to be higher than the previous South African estimates (0,58) of Nel (1964) and Nel *et al.* (1972). Nel (1964) speculated that the harsher Karoo environment of his study could account for his lower estimate of 0,58 compared to earlier Australian measurements. The environment of the present study with greasy wool means of around 8—9 kg and lambs born per ewe mated of more than 100% (Table 1), was much more favourable than the Karoo Region for which Nel *et al.* (1972) gave greasy fleece means of 4,31—6,36 kg. From Table 1 it appears that groups with more uniform means over time, like groups B and C, tend to have a higher repeatability value. Nel (1964) further mentioned that the fact that he could not correct his estimate for selection, for reasons referred to earlier, could cause a lower value. This possible correction would probably not alter the estimate materially as the adjusted value of Young *et al.* (1960) increased only from 0,600 to 0,639. In a recent analysis of approximately 1500 Australian Merino ewes with measurements at ages of 1—6 years, Atkins & Mortimer (1987) reported phenotypic correlations between measurements in different years ranging from 0,50 to 0,63, suggesting repeatabilities of the same order.

Table 2 Analysis of variance for the estimation of repeatability of *n* animals with *k* records each, with the results of Group A, and the results of the pooled analysis of the five groups

Source of variation	Degrees of freedom	Mean squares	Expected mean squares
Group A			
Between years	$(k-1) = 3-1$	26,988	$\sigma^2_e + n\,\sigma^2_y$
Between sheep	$(n-1) = 45-1$	2,404	$\sigma^2_e + k\,\sigma^2_s$
Within sheep	$(k-1)\,(n-1) = (2)\,(44)$	0,366	σ^2_e
Pooled analysis			
Between sheep	u = 219	2,7060	$\sigma^2_e + \frac{u+v}{v}\,\sigma^2_s$
Within sheep	v = 438	0,2597	σ^2_e

Variance components of pooled analysis of variance: $\sigma^2_y = 0{,}337$ $\sigma^2_s = 0{,}8154$ $\sigma^2_e = 0{,}2597$.

Van der Merwe & Poggenpoel (1977) found that South African Merino farmers who measured the performance of their young sheep, selected about 50—70% of their maiden ewes as replacements. Poggenpoel & van der Merwe (1984) estimated the standard deviation of 12-month's greasy fleece mass of unselected maiden Merino ewes in 25 flocks, as 0,72 kg. It can thus be predicted that, with an assumed average repeatability of 0,76 for greasy fleece mass, the following annual increases in subsequent greasy wool production of the current flock of breeding Merino ewes can be expected. With 50% of the available maiden ewes selected on greasy fleece mass only 0,44 kg per ewe, with 60% selected, 0,35 kg and with 70% selected, 0,27 kg. With a repeatability value of greasy fleece mass of the order of the present estimate of 0,76, the lifetime production of the ewe flock can therefore be increased substantially with selection mainly on greasy fleece mass at the first measurement of about 12 months growth, at approximately 16—18 months of age. With selection applied also to other characteristics, the selection differential for greasy wool and consequently the predicted gains will be less.

As the present study is based on a relatively small sample of ewes in a favourable environment, the results must be interpreted with caution. It does appear, however, that the repeatability of greasy fleece mass of Merino breeding ewes in South Africa can in some instances be higher than the previous estimates of 0,58.

Acknowledgements

The authors are indebted to the following farmers who cooperated in collecting of the data: Messrs. J. Viljoen of Karsrivier, A.P. McDonald of Spes Bona, J. du Toit of Klipbankskloof, C.L. Neethling of Soutkloof and M.J. Kempen of Amerika Estate.

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