

Assessment of different selection criteria for reproduction rate in Dormer and S.A. Mutton Merino sheep. 3. Prepubertal testis size of ram lambs

N.M. Kritzinger, H.W. Stindt and J.M. van der Westhuysen
Winter Rainfall Region, Elsenburg

Data of all the ram lambs born to the Elsenburg Dormer ($n = 144$) and S.A. Mutton Merino ($n = 166$) flocks during the 1977 and 1978 lambing seasons as well as that of their female relatives were used to study various aspects regarding the use of testis size as a possible selection criterion for reproduction rate in sheep.

The prepubertal testis diameter of ram lambs was found to be a highly repeatable character, positively correlated with either live mass or plasma LH levels. No significant differences between breeds could be found, while considerable within-breed variation was observed for both breeds. No positive association between testis diameter of ram lambs and the reproductive performance of their female relatives could, however, be demonstrated for any one of the two breeds.

S. Afr. J. Anim. Sci. 1984, 14: 88–90

Gegewens van alle Elsenburg Dormer ($n = 144$) en S.A. Vleismerino-ramlammers ($n = 166$) gebore gedurende die 1977 en 1978 lamseisoene asook die van hul vroulike verwantes is gebruik ten einde verskeie aspekte rakende die gebruik van testisgrootte van ramlammers as moontlike seleksiemaatstaf vir reproduksietempo by skape te ondersoek.

Prepubertale testisdeursnee van ramlammers blyk 'n hoogs herhaalbare eienskap wat positief met beide liggaamsmassa en serum-LH-vlakke gekorreleer is. Geen betekenisvolle verskille tussen rasse is waargeneem nie terwyl 'n relatief groot binne-ras-variësie vir albei rasse gevind is. Geen positiewe verwantskap tussen prepubertale testisdeursnit van ramlammers en die reproduksieprestasie van hul vroulike verwantes kon egter aangedui word vir enige van die twee rasse nie.

S.-Afr. Tydskr. Veek. 1984, 14: 88–90

Keywords: Testis size, selection criterion, reproduction rate, sheep

Extract from a M.Sc. (Agric.) thesis submitted by the senior author to the University of Stellenbosch

N.M. Kritzinger*

Winter Rainfall Region, Private Bag, Elsenburg, 7607
Republic of South Africa

H.W. Stindt

Department of Biochemistry, University of Stellenbosch,
Stellenbosch, 7600 Republic of South Africa

J.M. van der Westhuysen

Mohair Board, P.O. Box 2243, Port Elizabeth, 6000
Republic of South Africa

*To whom correspondence should be addressed

Received 19 December 1983

Introduction

In the past selection for reproduction rate in the male animal was based on information obtained from his female relatives. This indirect criterion not only requires laborious recordkeeping of female relatives but also disadvantageously increases the generation interval.

Following the finding by Land (1973) that the quantitative expression of sexual activities in male and female animals were genetically interrelated together with the possible advantages of direct selection in male animals to improve reproduction rate in female relatives, various physiological characters in the male animal were evaluated by researchers as possible selection criteria for reproduction rate.

Bindon & Piper (1976) considered testis growth in ram lambs as the most promising measure of the genetic merit for female reproduction rate. This criterion, both from a practical and genetic point of view, offers advantages over other selection criteria, in so far as that this character can be measured directly in the male animal at a very early age. Measurement is also relatively simple and, unlike most other reproductive traits, it is not a threshold character, thus showing continuous variation.

Evidence of genetic variation in testis growth of ram lambs and the positive relationship between this character and the reproduction rate of female relatives were demonstrated both between (Land, 1973; Land & Carr, 1975; Land & Sales, 1977; Islam & Land, 1977) and within breeds (Bindon & Piper, 1976; Hanrahan & Quirke, 1977). Land & Lee (1976) further reported a relatively high estimation of heritability for testis size (0,40), while selection for testis size in ram lambs resulted in a positive response on ovulation rate of the female progeny (Land & Lee, 1976; Land, 1977).

In view of these particularly promising results the suitability of testis size as a possible selection criterion for reproduction rate in sheep was evaluated for both the Elsenburg Dormer and S.A. Mutton Merino flocks.

Experimental procedure

Animals used in this experiment originated from the Elsenburg Dormer and S.A. Mutton Merino flocks described by Kritzinger, Stindt & Van der Westhuysen (1984a). Data included in this study differ from that described by Kritzinger, Stindt & Van der Westhuysen (1984b) in that only data of ram lambs born during the 1977 and 1978 autumn lambing seasons were used. The testis diameter of each lamb was measured by the method of Land (1973) and Islam & Land (1977) both at an age of 30 days and at weaning (at approximately 100 days),

while additional measurements at 60 and 90 days were performed on lambs born during the 1977 lambing season.

Statistical methods applied to investigate various aspects of testis size as a possible selection criterion for reproduction rate in sheep were similar to those described for plasma LH levels (Kritzinger *et al.*, 1984b) and included the repeatability of testis diameter and effects of breed, sire and birth type. Association between testis diameter, plasma LH levels and live mass for each animal as well as between testis diameter and dam's reproductive performance was calculated by correlation.

Results

Repeatability of testis diameter was calculated by correlation between measurement at 30 days and at weaning. Obtained correlation figures of 0,53 ($n = 166$) and 0,70 ($n = 144$) for the S.A. Mutton Merino and Dormer lambs respectively were highly significant ($P \leq 0,01$). These repeatabilities, however, might have been much higher if measurement of testis diameter was performed at exactly 100 days. Correlation values between measurements at 30 and 90 days, although based on less data, were as high as 0,92.

Analysis of variance could not demonstrate any significant effect of breed on the prepubertal testis diameter of ram lambs. The average 30-day testis diameter of $0,76 \pm 0,20$ and $0,78 \pm 0,23$ cm for S.A. Mutton Merino and Dormer lambs respectively, however, pointed towards a relatively high coefficient of variation for both breeds. Birth type in both breeds significantly ($P \leq 0,01$) affected testis diameter while the effect of sire was only significant in the case of S.A. Mutton Merino lambs (Tables 1 and 2).

Table 1 Analysis of variance for the effect of sire and birth type on the testis diameter of S.A. Mutton Merino lambs

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-value
Sire	11	0,54	0,05	3,550 ^a
Birth type	1	0,38	0,38	27,614 ^a
Sire \times birth type	11	0,16	0,01	1,047
Error	136	1,86	0,01	

^a $P < 0,01$

Table 2 Analysis of variance for the effect of sire and birth type on the testis diameter of Dormer lambs

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-value
Sire	12	0,29	0,02	0,858
Birth type	1	0,67	0,67	23,301 ^a
Sire \times birth type	12	0,20	0,02	0,579
Error	113	3,25	0,03	

^a $P < 0,01$

The testis diameter of lambs at all ages was positively correlated ($P \leq 0,01$) with live mass for both breeds. At 30 days the r -values were 0,21 ($n = 166$) and 0,25 ($n = 144$) for S.A. Mutton Merino and Dormer lambs, respectively. Partial correlation (to compensate for the effect of live mass) between serum LH levels and testis diameter at 30 days were signifi-

cant ($P \leq 0,01$) for both S.A. Mutton Merino ($r = 0,27$) and Dormer lambs ($r = 0,32$).

Neither 30-day testis diameter nor testis diameter at weaning age was significantly correlated with the dam's reproductive performance expressed as the number of lambs born per mating (Table 3).

Table 3 Correlation coefficients between testis diameter and dam's reproductive performance (Partial correlation coefficients are given in brackets)

Breed	Age	Correlation coefficient
S.A. Mutton Merino	30 days ($n = 166$)	-0,1839 (0,0267)
	100 days ($n = 37$)	0,0269 (-0,0164)
Dormer	30 days ($n = 144$)	0,0747 (-0,0516)
	100 days ($n = 71$)	0,0414 (0,0627)

Discussion

The relatively high repeatability of prepubertal testis diameter suggests that measurement of this parameter can be carried out at any age between four and sixteen weeks. From a practical point of view, this holds definitive advantages as a possible selection criterion. Bindon & Piper (1976), however, demonstrated that differences in testis size between different prolificacy classes, both between and within breeds, tend to decrease with increasing age.

The positive correlation between testis size and live mass found in this study is in agreement with results reported by Carr & Land (1975) and to a certain extent explains the significant effect of birth type on testis diameter. Single born lambs were heavier and had a significantly larger testis diameter than twin born lambs.

The significant positive correlation between serum LH level and testis diameter demonstrated for both breeds is not only in accordance with results of Carr & Land (1975) and Hanrahan & Quirke (1977), but also suggests that testis diameter in male animals can be used as criterion for circulating levels of gonadotrophic hormones.

Despite the fact that breed had no significant effect on testis diameter of lambs, within-breed variation was relatively high. Although this variation can advantageously be exploited by selection, contrary to results of Bindon & Piper (1976) and Hanrahan & Quirke (1977), no positive association between testis diameter and dam's reproductive performance could be demonstrated within breeds. However, it must be stressed that the results of these research workers were obtained from animals in different prolificacy classes with relatively large genetic differences between the various classes. Findings in the present study may possibly be explained by a too small genetic variation within the two breeds under investigation.

The association between testis diameter of ram lambs and their female progeny's reproductive performance was unfortunately not investigated. Such an investigation would have thrown more light on the possible use of testis diameter as a selection criterion for reproduction rate in sheep.

Conclusions

Prepubertal testis diameter of ram lambs was found to be a highly repeatable character showing considerable within-breed variation and was positively correlated with live mass and plasma LH levels. Although the latter finding suggests that

testis diameter of male lambs could at least be used as some indication of circulating gonadotrophic hormone levels, no positive association between testis diameter of ram lambs and the reproduction performance of their female relatives could be demonstrated. From this finding it may be concluded that testis diameter, at least in flocks where a small genetic variation in reproduction rate exists, offers no advantage as a selection criterion to improve the reproductive performance of sheep.

Acknowledgements

The authors wish to express their appreciation to Messrs. H.E. Theron and B. Harmse for technical assistance and to Mr. A. van Rooyen for his assistance in the statistical analysis.

References

- BINDON, B.M. & PIPER, L.R., 1976. Assessment of new and traditional techniques of selection for reproduction rate. In: Sheep Breeding. Ed. G. Jones, D.E. Robertson and R.J. Lightfoot. Western Australian Institute of Technology, Perth.
- CARR, W.R. & LAND, R.B., 1975. Plasma luteinizing hormone levels and testis diameters of ram lambs of different breeds. *J. Reprod. Fert.* 42, 325.
- HANRAHAN, J.P. & QUIRKE, F.F., 1977. Testis size and plasma luteinizing hormone as aids to selection for fecundity in sheep. *Anim. Prod.* 24, 148.
- ISLAM, A.B.M.M. & LAND, R.B., 1977. Seasonal variation in testis diameter and sperm output of rams of breeds of different prolificacy. *Anim. Prod.* 25, 311.
- KRITZINGER, N.M., STINDT, H.W. & VAN DER WESTHUYSEN, J.M., 1984a. Assessment of different selection criteria for reproduction rate in Dormer and S.A. Mutton Merino sheep. 1. Birth type and early reproductive performance of the ewe. *S. Afr. J. Anim. Sci.* 14, 79.
- KRITZINGER, N.M., STINDT, H.W. & VAN DER WESTHUYSEN, J.M., 1984b. Assessment of different selection criteria for reproduction rate in Dormer and S.A. Mutton Merino sheep. 2. Luteinizing hormone concentrations in the plasma of prepubertal lambs. *S. Afr. Anim. Sci.* 14, 84.
- LAND, R.B., 1973. The expression of female sex-limited characters in the male. *Nature, Lond.* 141, 208.
- LAND, R.B., 1977. Testis measurement as an aid to genetic selection for female reproduction. In: A.B.R.O. Report A.R.C. Edinburgh, U.K.
- LAND, R.B. & CARR, W.R., 1975. Testis growth and plasma LH concentration following hemicastration and its relation with female prolificacy in sheep. *J. Reprod. Fert.* 45, 495.
- LAND, R.B. & LEE, G.J., 1976. Testis growth, a possible genetic predictor of female productivity. *Anim. Prod.* 22, 137.
- LAND, R.B. & SALES, D.I., 1977. Mating behaviour and testis growth of Finnish Landrace, Tasmanian Merino and crossbred rams. *Anim. Prod.* 24, 83.