

THE EFFECT OF DAYLENGTH ON THE REPRODUCTIVE TRACT OF THE MERINO RAM

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OPSOMMING: DIE INVLOED VAN DAGLENGTE OP DIE GESLAGSORGANE VAN DIE MERINO RAM

Agt-en-veertig 2¹/₂-jaar-oud Merino ramme is in 'n spesiaal geïnsuleerde en geventileerde skuur aangehou op konstante liggaamsgewig teen 'n konstante voedingspeil. Vier is elke maand geslag en veranderinge in die geslagsorgane bestudeer. Die gewig van die epididymides, sperm motiliteit en morfologie het nie verander nie, maar die gewig van die testes, saadbuisiedeursnee en getal sperme in die epididymides het afgeneem met toename in daglengte. Die gewig en fruktose konsentrasie van die vesiculae seminales het geen duidelike neiging in een of ander rigting getoon nie.

SUMMARY

Forty-eight 2¹/₂-year-old Merino rams were maintained in a specially insulated and ventilated enclosure at constant body weight on a constant nutritional level. Four were slaughtered each month and changes studied in the reproductive tract. Weight of epididymides, sperm motility and morphology did not vary but the weight of testes, seminiferous tubule diameter and number of epididymal sperm decreased as daylength increased. Seminal vesicle weight and fructose content were more unpredictable.

The libido and seminal characteristics of most rams of many European breeds of sheep vary markedly throughout the year (Chang, 1941; Yeates, 1949; Ortavant, 1961; Lees, 1965). It is not possible to comment on the fertility of the semen since the ewes of these breeds, almost without exception, have a prolonged period of anoestrus during the year. The Merino breed is less affected than the European breeds by the factors which cause anoestrus in the ewes (Terrill, 1962) although fertility does vary throughout the year. Three of the factors which are responsible for the variations in the performance of the ram are temperature, nutrition and daylength. These three probably work in different ways, an exposure to high temperature can interrupt spermatogenesis "directly" and in experimental situations the effect can be quickly reversed. There is some controversy over the rôle of nutrition in reproduction but it seems likely that it governs general body condition rather than acting directly on the reproductive tract. Daylength or, more specifically, change in daylength appears to act on the hormone status of the animal producing long term effects which are reversible. Moule (1970) has recently focussed attention on the problem of declining fertility of rams when moved to different latitudes and he emphasised the need for more information to elucidate the separate effects of environmental influences on the fertility of Merino rams. This paper is concerned with the effect of daylength on Merino rams with particular reference to the reproductive tract.

Procedure

The study was carried out at the Irene Research Institute (latitude 25° 45'S). Four animals selected at random from a group of 48 2,5-year-old rams were slaughtered every month for one year. The rams were fed a balanced ration, pellets containing adequate roughage and 14% protein and 60% digestible energy) throughout the year related to weight. They were shorn before the experiment commenced and again in October. They were

weighed regularly and liveweight was also recorded just before slaughter. For the duration of the experiment the rams were kept in a climatic enclosure which had been specially insulated and ventilated to ensure that they were not subjected to extremes of temperature.

At autopsy, the reproductive tract was dissected out and the different parts weighed, paired values (left + right) being recorded in all instances. After weighing, pieces of testis were fixed in Bouin's solution and, following routine paraffin embedding and sectioning at 6 μ , stained with Delafield's haematoxylin and chromotrope 2R, for routine histological study. The diameter of the seminiferous tubules was measured using a Zeiss screw-micro-meter eyepiece.

Immediately following dissection, a droplet of epididymal semen was observed under the microscope at 37°C and the percentage of motile spermatozoa estimated subjectively as is standard practice at A.I. stations. A droplet of sperm was also stained with nigrosin:eosin (10% : 1,67%) at 37°C and the percentage eosinophilic spermatozoa estimated by counting 100 spermatozoa on each of three smears. The percentage of abnormal sperm was also determined from the same slide using Blom's (1950) classification.

The number of spermatozoa in the epididymides was estimated following the method of Dott & Skinner (1967). Fructose and citric acid concentrations in the seminal vesicles were assayed using the method of Lindner & Mann (1960). The statistical significance of differences between different months was determined using student's *t* test.

Results

The results of the study are graphically illustrated in Figure 1. The maximum and minimum temperatures were

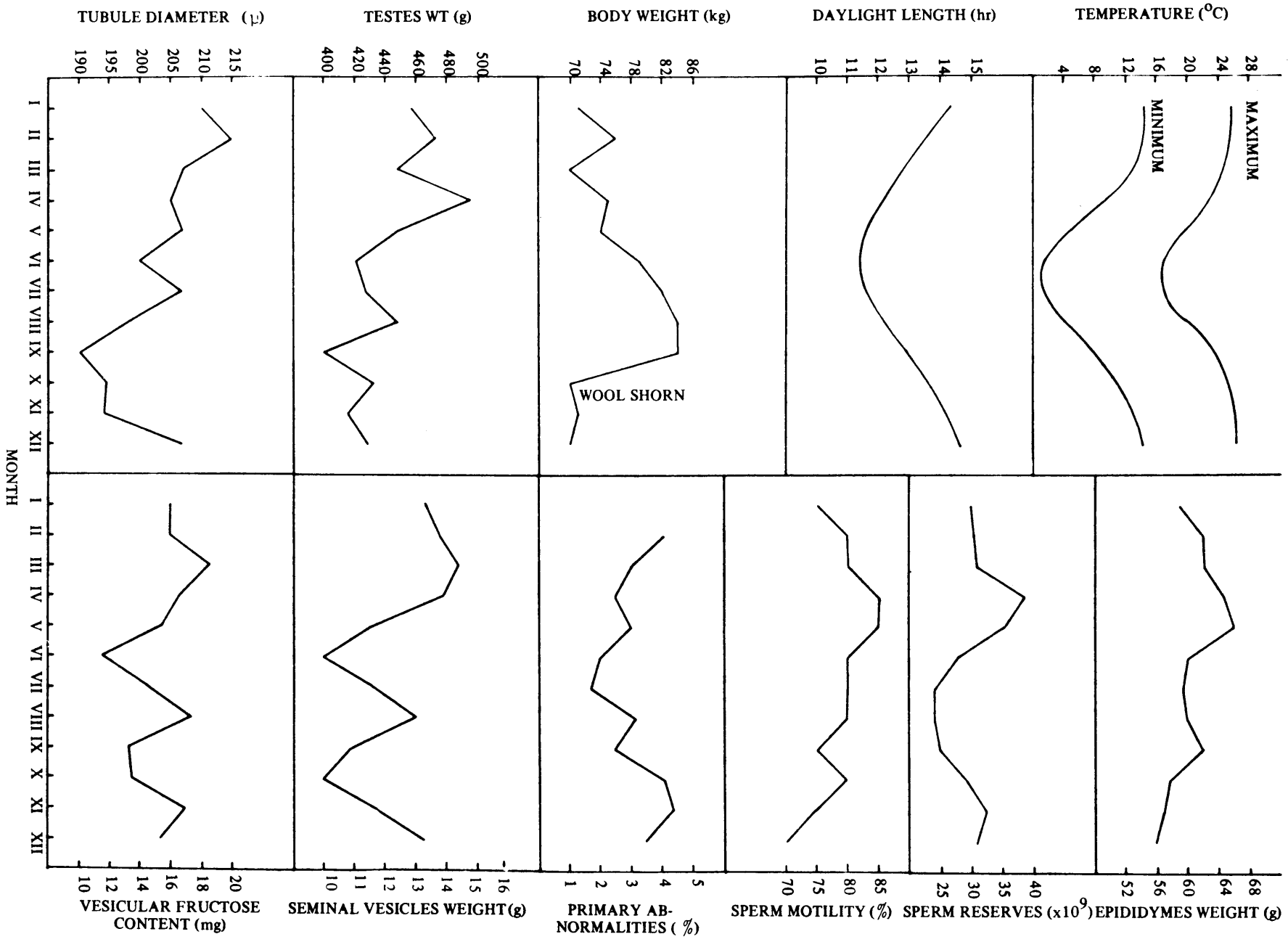


Fig. 1.— Changes in daylight, ambient temperature, body weight and the reproductive tract of Merino rams at the Irene Research Institute over a period of one year.

recorded at Irene and the daylength was recorded at Rietvlei Experimental Station on the same latitude as Irene but five miles further east. Temperatures were not recorded constantly in the area where the rams were held but from observations made conformed with those illustrated. Due to the structure of the building, temperature extremes were successfully eliminated.

Body weight fluctuated between 70 and 84 kg increasing as wool growth increased (a mature ram in full fleece is covered by about 15 kg after 12 months) and declining again when the wool was shorn. While there was a decline when daylength increased, in most testicular parameters, the motility of the spermatozoa remained relatively constant, the percentage live spermatozoa was always high ($92,0 \pm 0,6\%$) and the percentage primary abnormalities never exceeded four per cent. Detached sperm heads and other secondary abnormalities were so rarely observed as not to warrant analysis and were included in the counts of abnormal sperm. Testicular histology was proportionately unchanged throughout the year apart from a reduction in seminiferous tubule diameter coinciding with increasing daylengths.

Coinciding with the increase in testicular activity during the period of decreasing daylength, there was an increase in weight of the accessory glands. The ampullae weighed $5,7 \pm 0,2$ g in autumn compared to $4,1 \pm 0,2$ g in spring and the bulbo-urethral glands $6,4 \pm 0,3$ cf. $5,3 \pm 0,3$ g. Vesicular fructose content was also higher in the autumn although the variation was considerable.

Discussion

Although the number of rams slaughtered each month was small, nevertheless trends of practical importance were evident. The rams were both physically and sexually mature. Bodyweight, weight of epididymides, sperm motility and morphology did not vary but the weight of the testes, seminiferous tubule diameter and number of epididymal sperm decreased as daylength increased. Seminal vesicles and vesicular fructose were more unpredictable but there was a tendency for these parameters to decrease slightly with increasing daylength. The decline in testicular weight and sperm production must be seen in the context that both body weight and carcass weight remained virtually constant throughout the study. Symington (1961) actually found an increase in sperm numbers with increasing daylength. However, the decrease in sperm numbers as daylength increased was in agreement with the results of others who evaluated testicular histology and seminal characteristics in the mature Suffolk (Chang, 1951; Maqsood, 1951; Cupps, McGowan, Rahlmann, Reddon & Weir, 1960) and the mature Ile de France breed (Ortavant, 1961), of which the reproductive tract was also studied. Epididymal sperm numbers and testicular weight reached a much higher peak in autumn in the Ile de France where higher values were recorded throughout the year. Testicular weight in the Merino rams in the present study was of the same order as that recorded by Setchell,

Waites & Lindner (1965) in Australia for Merinos and by Dott & Skinner (1967) for Suffolks in Britain but only about two thirds that in the Ile de France. Epididymal sperm numbers were only half those recorded for the Ile de France.

Sperm quality (motility and proportion of live spermatozoa) remained constant throughout the year in this study, which does not agree with the results of other workers (MacKenzie & Berliner, 1937; Green, 1940; Dun, Ahmed & Marrant, 1960), who recorded highest values in autumn and lowest quality in spring and summer. Their observations were due to two main factors, a decrease in sperm density and a concomitant increase in the percentage abnormal sperm. In the present study, sperm density declined, but as the observations were on concentrated epididymal sperm, the effect was not noticeable. It has already been shown in the Ile de France breed (Ortavant & Thibault, 1956; Ortavant, 1961) that the peak in sperm production occurs when the light photoperiod reached eight hours, although the peak in spermatogenic activity was two hours earlier.

At this latitude it would appear that it is factors other than daylength which produce sperm abnormalities. Both nutrition and temperature were kept within physiological and temperate limits in this study. Malnutrition can disrupt spermatogenesis in the Merino (Setchell *et al.* 1965) but it is more likely that the high environmental temperatures in other studies caused the increase in abnormal sperm as this has been found in the Merino both in field studies (Gunn, Saunders & Granger, 1942) and in the climate chamber (Rathore & Yeates, 1967).

Malnutrition resulted in severe impairment of testicular endocrine function in the Merino ram (Setchell *et al.*, 1955) but where a constant level of nutrition was maintained (Ortavant & Thibault, 1956) fructose content of Ile de France rams was not influenced by different light regimes, and the present results for the Merino are in agreement with these findings.

It would appear from this study that daylength is of significance in the practical management of the breeding flock. Provided ambient temperature is not excessive and nutritional levels are adequate, Merino rams are fertile and capable of breeding throughout the year. However, the ratio of rams to ewes will have to be higher in spring than in autumn to ensure the same level of fertility, the more so the further south the farm, and adequate shade should be provided at all watering points to reduce the consequences of heat stress.

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