Onderstepoort Journal of Veterinary Science and Animal Industry, Volume 3, Number 1, July, 1934.

The Determination of Fleece Density in the Merino Sheep.

By V. BOSMAN, M.Sc., Sheep and Wool Research Officer, Grootfontein School of Agriculture, Middelburg, Cape.

INTRODUCTION.

THE term " density " is used by the practical sheep judge to denote compactness in a fleece. In discussing the " Interpretation of the Merino Score Card in South Africa ", Rose (1930) refers to density as meaning " the close proximity of fibre growth on a given surface of skin ".

Several research workers have attempted a more precise definition. Duerden and Botha (1930) suggest either " the volume of wool material of a certain length " or " the weight of wool material of a certain length, grown on a constant skin area ".

Burns and Miller (1931) in their work on " Sampling Instruments to Determine Fleece Density in Sheep ", refer to density as meaning " the total amount of wool fibre growing on a definite unit area of skin, usually on the living animal ".

Workers are agreed that the expression for fleece density is based on the number of fibres growing per unit area of skin. Some use this factor only. (Hultz and Paschal, 1930; Burns, 1933). Others suggest that number of fibres per unit area should be associated with fibre fineness. (Bosman and Maré, 1933; Bosman, 1934.)

Whichever system for expression is used, the number of fibres growing per unit area is the basis and its estimation is necessary in fleece analysis. The determination of fibre fineness has received the attention of many workers (Duerden, 1929; Roberts, 1927; Barker and Burgess, 1928, *et alia*).

The study outlines two methods for determining the number of fibres growing per unit area of skin and compares their relative merits for routine anlysis of merino fleeces in sheep breeding.

METHODS.

A. SAMPLING.

Burns and Miller (1931) review the sampling instruments used to delimit unit area of skin on the sheep. Some of these were tested by the author on the dense merino fleece, and of these the Wyedena Fleece Caliper (Burns and Miller, 1931) was found useful and was adopted. The caliper delimits four square centimetres of skin area and the wool is cut with a fine nail scissors from the area. Repeat tests on the same region of the animal have shown great consistency.

In our genetic studies sampling is made on different regions of the sheep in order to measure variability in density. A similar system of regional sampling was used by Burns (1933).

B. Estimating the Number of Fibres.

To estimate the number of fibres in the sample, most workers have adopted the method of counting a portion of the fibres, and then by comparing the weight of the portion with that of the large sample, form an estimate of the number. (Burns, 1931; Duerden and Botha, 1930; Bosman and Maré, 1933.)

In the present study an account of the weight-volume method is given and a comparison is made between results obtained by it and those by the counting method.

A series of samples obtained by means of the Wyedena Fleece Caliper on Merino Stud Ewes was analysed by both the counting method and the weight-volume method. Each sample was cleansed from wool grease and other impurities by the benzene-saponin method described by Miller and Bryant (1932). During scouring care was taken to keep the fibres undisturbed in the sample so as to avoid any matting. Each sample was handled by means of forceps and after drying, five hundred fibres were counted from the skin end of the staple. The bundle of counted fibres and the large sample were allowed to stand in the balance case before weighing so that both were weighed under similar conditions. By simple proportion the number of fibres was then calculated.

The Weight-Volume Method.

The alternate method by weight-volume was used on the same samples. This method was also suggested by Burns and Miller (1931) and takes into account dry weight of the sample, the volume of wool (from a knowledge of the length of the fibres and their fineness) and the specific gravity of wool. The number of fibres is calculated by the formula:—

$$N = \frac{W}{S \times A \times L}$$

where N is the number of fibres, S the specific gravity of wool adopted as a constant 1·30 (King, 1926), A the mean cross-sectional area of the fibres, and L, their mean straight length.

The dry weight of wool was obtained by the method of Barrit and King (1926). A current of dry air maintained at 105° C. was passed through the wool sample which was contained in a specially designed Regain Bottle. The cross-sectional area of the fibres was calculated from the mean fibre fineness measured by the Micro-Camera method described by Duerden (1929).

The straight length was obtained by measuring 50 fibres at random from each sample according to the method of Burns (1931).

Experimental Results.

The two methods were tested on twenty-six Merino stud ewes and the results summarised in table form. A close agreement between the two is shown. The number of fibres growing per square centimetre and per square inch are given in each case. In the last two columns of the table is given the mean fibre fineness and the fleece density in terms of per cent. skin area occupied by wool fibres.

TABLE 1.—COMPARISON OF RESULTS OBTAINED BY TWO METHODS.

Sample.	By the Method of Counting 500 Fibres.		By the Weight-volume Method.		Mean Fibre Thickness in μ.	Fleece Density as Per Cent Skin Area.
	No. of Fibres per Sq. Cm.	No. of Fibres per Sq. Inch.	No. of Fibres per Sq. Cm.	No. of Fibres per Sq. Inch.		
1	6,500	41,930	6,478	41,790	19·09	1·85
3	9,295	59,970	9,257	59,730	19·05	2·64
4	8,615	55,580	8,607	55,520	19·64	2·61
5	8,990	58,000	8,985	57,970	20·60	2·99
6	8,292	53,500	8,115	52,350	17·46	1·94
7	6,905	44,550	6,992	45,110	20·60	2·33
8	6,110	39,420	6,087	39,270	20·37	1·98
9	6,430	41,480	6,470	41,740	19·29	1·89
10	9,000	58,060	9,150	59,030	20·76	3·10
11	8,327	53,730	8,300	53,550	20·62	2·77
12	5,760	37,160	5,930	38,260	21·48	2·15
13	6,450	41,610	6,465	41,710	18·95	1·82
14	7,435	47,970	7,392	47,690	20·73	2·49
15	6,025	38,730	6,032	38,920	21·67	2·22
16	5,552	35,820	5,550	35,840	20·91	1·91
17	5,750	37,100	5,815	37,516	22·30	2·27
19	7,362	47,500	7,315	47,190	20·26	2·36
20	6,850	44,190	6,820	44,000	17·09	1·56
22	10,607	68,440	10,530	67,940	16·93	2·37
23	6,340	40,900	6,457	41,660	21·85	2·42
24	7,015	45,260	7,107	45,850	20·73	2·40
25	9,370	60,450	9,300	60,000	20·62	3·10
26	5,652	36,470	5,637	36,370	19·27	1·64
27	5,907	38,110	5,932	38,270	21·25	2·10
29	7,000	45,160	7,070	45,610	18·03	1·80
30	6,070	39,160	6,100	39,350	22·57	2·44

DISCUSSION.

The weight-volume method for estimating number of fibres per unit area gives results that agree closely with those obtained by the counting-weighing method. The author found the former preferable to the latter and has adopted it for routine analysis of density determinations in merino genetic studies. The weight-volume method has its advantages in the fact that it eliminates the laborious counting of 500 fibres from each sample. The factors necessary in its calculation are dry weight of the sample, straight fibre length and mean fibre thickness. The latter two are determined in the ordinary course of fleece analysis in genetic studies and the only determination necessary is the dry weight.

Separate complete tests have shown that the weight-volume method is quicker than the 500 counting method when a large number of routine samples is analysed. With a convenient heating apparatus that holds a number of Regain Bottles, the determination is greatly facilitated.

The number of fibres per square centimetre as well as per square inch is given, as both systems have been employed by research workers.

The fibre fineness and the fleece density expressed as per cent. skin area occupied by wool fibres are given. As was shown by the author (1934), the number of fibres alone does not express fleece density. For example in the table, Sample No. 22 with 10,530 fibres per square centimetre and a mean fibre thickness of 16·93μ is less dense with 2·37 per cent. fleece density than Sample No. 25 which has 9,300 fibres per square centimetre, a fibre thickness of 20·62μ and a fleece density of 3·10 per cent.

Density determinations are becoming increasingly important in fleece analysis since density plays a very significant rôle in wool production. In a study of Rambouillet Show Sheep, Hultz and Paschal (1930) attached primary importance to fleece density when sheep judges' awards were analysed.

In an analysis of fleece characteristics as they affect wool production the author (1933; 1934) shows that density is of considerable importance. On a merino stud ram that has twelve square feet skin area, a four-inch staple length, and a 64's quality wool, every ten thousand fibres per square inch add 2·36 pounds to the scoured fleece weight. Such a ram with fifty thousand fibres per square inch would produce 11·8 pounds of scoured fleece.

SUMMARY.

An analysis is given of fleece density by two methods, the counting-weighing method and the weight-volume method and a close agreement between the results is shown.

Preference is given to the weight-volume method when in the course of genetic studies on merino sheep a number of routine samples have to be analysed.

REFERENCES.

BARKER, S. G., AND BURGESS, R. (1928). Some Characteristics of Wool as Affecting Worsted Spinning. *Bull. No.* 87, *Brit. Res. Ass. for the Woollen and Worsted Ind.*

BARRIT, J., AND KING, A. T. (1926). The Sulphur Content of Wool. *J. Text. Inst.*, Vol. 17, pp. T.386-395.

BOSMAN, V., AND MARÉ, G. S. (1933). Merino Stud Ram Wool. *The Farmers' Weekly*, 12th April, Bloemfontein.

BOSMAN, V. (1933). Wool Production and the Merino Slide Rule. *S.A. Journ. Sci.*, Vol. 30, pp. 360-365.

BOSMAN, V. (1934). Fleece Density in the Merino Sheep. *Farming in South Africa* (in print).

BURNS, R. H. (1931). Monthly Wool Growth of Rambouillet Ewes. *J. Text. Inst.*, Vol. 22, No. 2, pp. T.98-109.

BURNS, R. H. (1933). Wool Inheritance in Hampshire-Rambouillet Cross Breds. *Bull. No.* 196, *Apl. Univ. of Wyoming, U.S.A.*

BURNS, R. H., AND MILLER, W. C. (1931). Sampling Instruments to Determine Fleece Density in Sheep. *J. Text. Inst.*, Vol. 22, No. 12, pp. T.547-564.

DUERDEN, J. E. (1929). Wool Research in South Africa. *Paper No.* 64, *Pan-African Agricultural Conf.*, Dept. of Agric., Pretoria.

DUERDEN, J. E., AND BOTHA, P. S. (1930). Density Variation in the Fleece of the Merino. *S.A. Journ. Sci.*, Vol. 27.

HULTZ, F. S., AND PASCHAL, L. J. (1930). Wool Studies with Rambouillet Sheep, No. 11. *Bull.* 174, *Univ. of Wyoming, U.S.A.*

KING, A. T. (1926). The Specific Gravity of Wool and its Relation to Swelling and Sorption in Water and Other Liquids. *J. Text. Inst.*, Vol. 17, pp. T.53-67.

MILLER, W. C., AND BRYANT, D. M. (1932). An Apparatus for Scouring Small Samples of Wool and a Modified Apparatus for Determining Dry Weight. *J. Text. Inst.*, Vol. 26, pp. T.267-273.

ROBERTS, J. A. FRASER (1927). A New Method for the Determination of Fineness of Wool and of the Fleece. *J. Text. Inst.*, Vol. 18, pp. T.48-54.

ROSE, P. D. (1930). Interpretation of the Merino Score Card. *Farming in South Africa*, Dept. of Agric., Pretoria.