THE EVALUATION OF DIFFERENT SAMPLING METHODS FOR THE MEASUREMENT OF MEAN AND DISTRIBUTION OF FIBRE DIAMETER

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SUMMARY

Guillotine and minicore methods of snippet preparation were compared using wool from the New England Sire Evaluation Scheme. The minicore method was the most suitable for both fibre diameter mean and distribution measurements. For mean because it gave a more accurate indication of fibre diameter over the whole year (the basis on which wool is sold) and it had a high heritability. For distribution because it included variance between fibres within a staple and variance along fibres (susceptibility to environmental change), both of which were found to have some genetic origin.

INTRODUCTION

Mean fibre diameter is well established as the most important determinant of wool quality. There is widespread interest in the use of fibre diameter distribution, partly because testing instruments have become commercially available. Most papers presented at a conference on fibre diameter variability (FDV) at CSIRO, Belmont have been recently published in the journal 'Wool Technology and Sheep Breeding'. There is some evidence that high FDV is associated with increased fleece rot susceptibility, reduced staple strength, style grade, fabric comfort and spinning performance (Taylor et al. 1992).

There are two sources of FDV within a staple of wool: variation between and variation along fibres. Different methods of sample preparation for flock testing will give different results and may rank animals differently. Minicoring gives a random population of fibres similar to those measured by the airflow technique, while a guillotine sample is a single 2mm wide cut across a staple, which effectively removes along fibre variation. Hansford (1992) suggested a guillotine sample taken at skin level was most appropriate for estimating FDV as there is more chance the wool snippets were grown during the same period. This study was conducted to determine the relative merits of using a minicore versus guillotine subsample.

MATERIALS AND METHODS

Results for the mean and distribution of fibre diameter for the 160 progeny of 7 sires in the New England Sire Evaluation scheme were obtained using the CSIRO Fibre Fineness Distribution Analyser (Lynch and Michie 1976). Snippets were cut for the FFDA using a twin blade guillotine (Lunney 1978) at both one-third (base) and two-thirds (tip) of the distance from base to tip of the staples to estimate variance at two single points along the staple (between fibre). They were also prepared by using a minicore (Buckenham et al. 1979) to estimate both single point variance and along fibre variance.

Along fibre variance was estimated by difference, assuming between fibre variance was the same in guillotine and minicore samples.

The variances, heritabilities and correlations of along and between fibre variance were calculated using Harvey's least squares analysis. These estimates were used to construct selection indices to reduce total FDV by using either both along and between fibre variance as selection criteria or only single point variance. Standard matrix algebra was used to construct the indices (Hazel 1943) using a program written in Basic (Cottle and Supple, unpublished).

RESULTS AND DISCUSSION

Mean fibre diameter

There were significant differences ($P<0.005$) in along fibre variance both between and within sires' progeny (Table 1).

Table 1. Along fibre variance for each of the seven sires.

	1	2	3	4	5	6	7
Var (u^2)	3.5	2.8	2.8	1.8	2.7	2.7	1.7

Therefore it would be expected that the guillotine samples would result in lower between and within sire variation of mean fibre diameter (MFD) due to the elimination of along fibre variation. Lower within:between sire variance results in higher heritability estimates. This is the basis of the argument that guillotine samples should be used when comparing sheep with similar environmental histories.

However the within sire variance of MFD for minicore samples was lower than that for base or tip samples (Table 2). The guillotine samples included some along fibre variation due to the difficulty experienced in sectioning at exactly the same position in every staple. This problem would be reduced by taking samples at skin (base) level. The minicore method was the best method for estimating MFD of those tested as it gives the MFD over the whole year and had a high heritability.

Table 2 - Variance between and within sires and heritabilities for MFD obtained using different sampling techniques.

	Variance		Heritability (S.E.)
	Between	Within	
Base	0.50	2.12	0.76 (0.430)
Tip	0.48	1.78	0.85 (0.456)
Minicore	0.42	1.41	0.91 (0.476)

Fibre diameter distribution

The total variability obtained from the minicore method is higher due to the inclusion of both between and along fibre variation (Table 3).

Table 3. Least squares means for standard deviation and coefficient of variation of fibre diameter for all 160 progeny

	Standard Deviation	C of V
Base Guillotine	3.22	17.61
Tip Guillotine	3.31	18.93
Minicore	3.60	20.00

The choice of sampling method depends on which components of variation it is desirable to measure. Guillotine samples can measure single point (between fibre) variance, minicore samples a combination of single point and along fibre variance and both samples are needed to calculate along fibre variance.

The choice of method was studied by calculating selection indices using the genetic and phenotypic parameters found in this study with various ratios of relative economic values (REVs) for between and along fibre variance. Both sources of variation have production and processing significance, which have not been quantified in economic terms. The ratio of REVs is probably in the range 1:2 to 2:1 (Postle and Johnson, pers. comm.). The indices calculated (Table 4) using a ratio of REVs (point:along) within the range 1:1 to 2:1 gave index weightings for the two traits that were similar to the physical weightings obtained from minicore samples, since the ratio of phenotypic variances (point:along) was found to be 3:1.

Table 4. Index weighting ratios for single point and along fibre variance for differing ratios of REVs in a selection index

REVs (*Point* : *Along*)	*Weights* (*Point* : *Along*)
5:1	50:1
2:1	5:1
1.35:1	**3:1**
1:1	2:1
1:5	1:5

Minicore samples therefore appear to be the best method of sample preparation for FDV, as selection for reduced minicore FDV will reduce both along and between FDV with the appropriate relative

emphasis on each source of variation. This would not be the case if it was shown that the ratios of REVs were not as suggested above.

The minicore sample has the advantage of providing the best MFD measurement and also fortuitously a balanced estimate of FDV.

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