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Objective Measurement of the South African Wool Clip

Part II: Sampling by Model T Coring Equipment in Durban, East London and Port Elizabeth Ports

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OBJECTIVE MEASUREMENT OF THE SOUTH AFRICAN WOOL CLIP: PART II
SAMPLING BY MODEL T CORING EQUIPMENT IN DURBAN, EAST LONDON AND PORT ELIZABETH PORTS

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ABSTRACT

Estimates for the South African merino wool clip of the within bale (σ_w) and between bale (σ_b) variations of yield and of diameter have been made from cores taken by Model T coring machines for wools sold through three ports. The yield values were each about 1,6 per cent while the diameter variations for Durban and East London were approximately 1 µm and 1,5 µm which are higher than the values of 0,5 µm obtained previously for Port Elizabeth wools.

INTRODUCTION

In Part I[1] of this study values for the within bale (σ_w) and between bale (σ_b) variations in respect of the IWTO clean yield and diameter for merino wool sold through Port Elizabeth port were published. These were obtained from samples taken by a mechanical (rotary) corer, and were respectively three and two for yield and 0,5 for diameter.

The values for yield variation were different to those published in ASTM, D1060[2] which gave 1,5 for within bale variation and 4,0 for between bale variation. If all bales within a lot are sampled then only the within bale variation will affect the precision of the determined yield. The two-fold difference between these reported values for σ_w requires that four times as many samples or cores must be taken to attain the same precision.

David and Deltoer[3] have reported a mean value for σ_w (yield) of 1,52 for many types of wool at five different centres in Australia. For diameter they reported a σ_w value of 0,29 µm.

Subsequent to Part I of this report, the Model T coring equipment which was developed at the CSIRO in Australia has been installed in the wool stores at Durban, East London and Port Elizabeth. In this report the work reported in Part I has been repeated and extended to include wools from the Durban and East London wool stores to give estimates of σ_w and σ_b for samples cored by the Model T equipment.

EXPERIMENTAL

The South African merino wool clip had the following approximate composition in 1974:

Spinners fleeces	23 *per cent*
Good Topmaking fleeces	35 *per cent*
Average and Inferior Topmaking fleeces	25 *per cent*
Bellies and Pieces, etc.	17 *per cent*

The composition of the wools selected for determining the within and between bales variation of IWTO clean wool content and airflow diameter is shown in Table I.

TABLE I

PERCENTAGE COMPOSITION BY TYPE OF THE EXPERIMENTAL MATERIAL

	Port Elizabeth	Durban	East London
Spinners	33	17	17
Good Topmaking	33	33	33
Average Topmaking, Inferior Topmaking		33	33
Bellies and Pieces, etc.	34	17	17

Details of type, description, number of lots and numbers of bales selected for coring by the Model T machine are given in Table II.

Two normal butt cores and two cap cores were taken from each bale and each immediately sealed and identified in standard individual plastic core bags. Detailed information on bale weights as received and at the time of coring, dates of reception and coring, source of bale and lot numbers was recorded.

To prevent excess moisture changes in the core samples groups of sample bags were wrapped in greasy wool and sealed in larger bags for transportation to SAWTRI and were maintained in this condition until tested.

The IWTO clean wool content of each core was determined in the same manner as described previously, as was the mean fibre diameter (via airflow method using two sub-samples and taking three readings on each). Only yield tests were made on the Port Elizabeth wool. The earlier report gave variations of yield and diameter for samples manually cored. The present investigation of Port Elizabeth wool considered only the yield variations associated with the Model T type cores since it was thought that the variations in measured diameter would not be affected by the type of core used.

TABLE II

DESCRIPTION OF WOOL SAMPLED

TYPE	DESCRIPTION	DURBAN		EAST LONDON		PORT ELIZABETH	
		Total Lots	Total Bales	Total Lots	Total Bales	Total Lots	Total Bales
8	Spinners style, practically free 21 μm (64's), 75–90 mm (12 months)	4	20			3	25
C9	Spinners Style, practically free 21,5 μm (62/64's), 75–90 mm (12 months)			4	20		
48	Good Topmaking, slight burr/seed 21 μm (64's), 75–90 mm (12 months)	4	20	4	20	2	25
49	Good Topmaking, slight burr/seed 22 μm (60/64's), 75–90 mm (12 months)			4	20		
54	Good Topmaking, slight burr/seed 22 μm (60/64's), 60–75 mm (10/12 months)	4	20				
A89	Average Topmaking Some burr/seed 21 μm (64's), 60–75 mm (10/12 months)	4	20	4	20		
90	Inferior Topmaking burr/seed 22 μm (60/64's), 60–75 mm (10/12 months)	4	20	4	20		
113	Merino bellies and pieces 21 μm and finer (+ 64's), 60–75 mm (10/12 months)			4	20		
A113	Merino bellies and pieces 21 μm and finer (+ 64's), 50–60 mm (9/11 months)	4	20			4	26

RESULTS AND DISCUSSION

Mass Changes of the Greasy Bales

It is standard practice to core bales when they are first weighed at the time of reception into the wool store. On the assumption that they contain no moisture gradients, the core yields will be a true reflection of bale yield. Whenever the bales are cored some time later, moisture gradients may have developed. To investigate this general possibility the bale masses at the time when the cores for this work were taken were noted.

For Durban and East London material the time period between reception of the wool into the store and coring varied, from lot to lot, between three weeks and twelve weeks. The change in mass for each lot showed no correlation with the duration of storage. The Durban wools showed an average decrease in mass of about 0,5 *per cent* while the wool at East London showed a gain of about 0,25 *per cent.* Thus the Durban wools tended to become more dry while in store and those at East London to increase their regain.

The nine lots of Port Elizabeth wool showed an average gain of 2,5 *per cent* for storage periods between seven and eighteen weeks. The gains in mass ranged between 0,5 *per cent* and 5,4 *per cent* and showed some correlation with time of storage in the warehouse.

There would appear to be some correlation between the wool growing district and the mass change while in the wool store. Wool from the Karoo region which was dry at that period in time and which passed through Port Elizabeth showed a much larger gain in mass than wools from districts of higher humidity which were stored at East London and Durban ports.

Analysis of the Objective Measurements of Yield and Diameter

Separate hierarchical analyses of variance were made for each property (yield and micron), for each type of wool, and for samples from each port. Twenty-seven such analyses were made.

From a yield analysis it was possible to estimate the variations associated with lots, bales, ends of bale and between duplicate cores. The fineness analysis gave additional information relating to sub-samples and repeat measurements.

For the purpose of this report estimates were made of the variation between lots, σ_ℓ, between bales within a lot, σ_b, between cores within a bale, σ_w. Values for these estimates are given in Tables III and IV.

Variation in Yield

The *within bale variation* of yield for the Durban wools had a weighted mean value of 1,64 *per cent.* Two types gave significantly different values, differences being judged by use of the F-test. Type 54 gave 1,04 *per cent* and type 90 gave 2,65 *per cent*.

The East London wools gave a mean value of 1,69 *per cent* for the within bale variation, no type being significantly different. Similarly the Port Elizabeth

TABLE III

MEAN IWTO CLEAN WOOL CONTENT AND ITS VARIATION

TYPE	DURBAN				EAST LONDON				PORT ELIZABETH			
	σ_w	σ_b	σ_ℓ	mean yield %	σ_w	σ_b	σ_ℓ	mean yield %	σ_w	σ_b	σ_ℓ	mean yield %
8	1,67	1,94	2,03	68,7					1,13	0,53	0	68,7
C9					2,13	0	2,37	69,3				
48	1,32	1,44	5,68	65,25	1,75	1,04	2,88	63,3	1,97	1,35	1,25	57,3
49					1,33	1,61	1,62	64,4				
54	1,04	1,19	4,76	66,0								
A89	1,32	0,22	0,66	61,0	1,86	3,56	4,13	66,0				
90	2,65	1,09	4,42	53,4	1,62	1,38	6,90	60,8				
113					1,33	2,58	2,76	65,9				
A113	1,29	1,31	6,91	57,2					1,37	1,67	3,31	56,4

TABLE IV

MEAN DIAMETER (AIRFLOW) AND VARIATION (μm)

TYPE	DURBAN				EAST LONDON			
	σ_w	σ_b	σ_ℓ	Mean diameter (μm)	σ_w	σ_b	σ_ℓ	Mean diameter (μm)
8	0,29	0,72	0	20,5				
C9					0,02	0,32	0	21,7
48	1,43	1,86	0	21,3	0,30	0,50	0,28	21,6
49					1,84	1,53	0,52	22,0
54	1,13	2,32	0	21,1				
A89	1,35	1,64	0	21,6	0,02	0,37	0,39	21,2
90	1,27	0,44	1,02	21,7	1,48	3,03	0	21,1
113					0,23	0,81	0,28	21,5
A113	0,96	1,38	1,21	20,0				

wools gave a mean within bale variation of 1,57 *per cent.* A *grand mean* of 1,64 *per cent* for the *within bale variation* (σ_w) can be taken as typical for the South African merino wool clip, when cored by a Model T coring machine. In Part I a value of 3 *per cent* was reported for the within bale variation. This was unexpectedly higher than the value of about 1,5 *per cent* given in ASTM[2] and probably reflected the method of coring.

The *between bale variation* (within a lot) for the Durban wool gave a mean value of 1,38 *per cent.* One type (A89) gave a significantly low value of 0,22 *per cent.* The East London wools averaged 2,04 *per cent.* Only three of the six types gave consistent values. Type C9 gave a very low σ_b while types A89 and 113 gave significantly high values. The Port Elizabeth wools gave a *between bale variation* of 1,22 *per cent,* type 8 giving a significantly lower value. The best estimate of the *between bale variation* for the South African merino wool clip was 1,59 *per cent.*

The *lot to lot variation* (within one type) was much higher as was to be expected. For Durban wools the value was 4,60 *per cent,* for East London 3,85 *per cent* and for Port Elizabeth 2,04 *per cent.* These values were not statistically different. The average value of the *between lot variation* was 3,90 *per cent.*

Variation in Diameter

The mean value of the *within bale variation* of diameter for the Durban wool was 1,14 μm. Only type 8 gave a significantly different value. The mean value for the East London wool was 0,98 μm, four of the six types having significantly better than average values. The other two were significantly worse. The *average* value for the *within bale variation* was 1,06 μm for Durban and East London wools.

Two of the Durban wool types showed better than average *between bale variation,* the mean value being 1,54 μm. The East London wools showed large differences among the types around an average of 1,45 μm. The *average* for the *between bale variation* for wools at Durban and East London was 1,50 μm.

The *variation between lots* for these wools was 0,51 μm.

An interpretation of these statistical quantities can be made by considering the total mean squares from the analyses of variance. These gave an average standard deviation of 0,70 μm which implies that for a type having a mean diameter of 20 μm, test values in the range of 18,6 μm to 21,4 μm (plus/minus two standard deviations) may be found. Although this interpretation has been simplified it serves to illustrate the range over which values for identically classed wools will be obtained.

The values for the variations within a bale, between bales within a lot and between lots within one type give a concise description of the different values which were found for the measured diameters. The largest difference found in mean diameter between any two bales in one lot was 2,8 μm (Durban, type 8, and East London, type 113) and between lot mean values the largest difference was 1,3 μm which reflects these variations in terms of the actual measurements.

The values for each of the within and between bale variation of diameter for Port Elizabeth wool was given as 0,5 μm which is significantly smaller than the values found for Durban and East London wools. A factor which may have a bearing on this difference is that the Port Elizabeth results were obtained from wool which was cored in 1972 while the Durban and East London values were for the 1975 season. The high variations might well reflect malpractices that have arisen recently on the part of the wool producer.

The precision of diameter will be determined by the IWTO core test regulations which specify the number of samples to ensure a precision of yield of one unit. To obtain sufficient material for test, about twenty cores from a lot will have to be taken. If every bale is cored the precision obtained will be about 0,47 μm for the Durban and East London wools and about 0,22 μm for the Port Elizabeth wools. About four times as many cores would be needed from these Durban and East London wools to achieve the same precision of micron that the 1972 Port Elizabeth wools gave.

CONCLUSIONS

The average within bale (σ_w) and between bale (σ_b) variations of IWTO clean yield for merino wool sold through the Durban, East London and Port Elizabeth ports were found to be 1,64 *per cent* and 1,59 *per cent* respectively.

Corresponding values for diameter were 1,06 μm and 1,50 μm for the Durban and East London wools. In a previous report both values for Port Elizabeth wool were 0,5 μm.

During a storage period of up to twelve weeks the Durban wools lost 0,5 *per cent* in mass while the East London wools gained 0,25 *per cent*. Port Elizabeth wools gained 2,5 *per cent* over an equivalent period of time.

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