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Processing results of Western Australian wool

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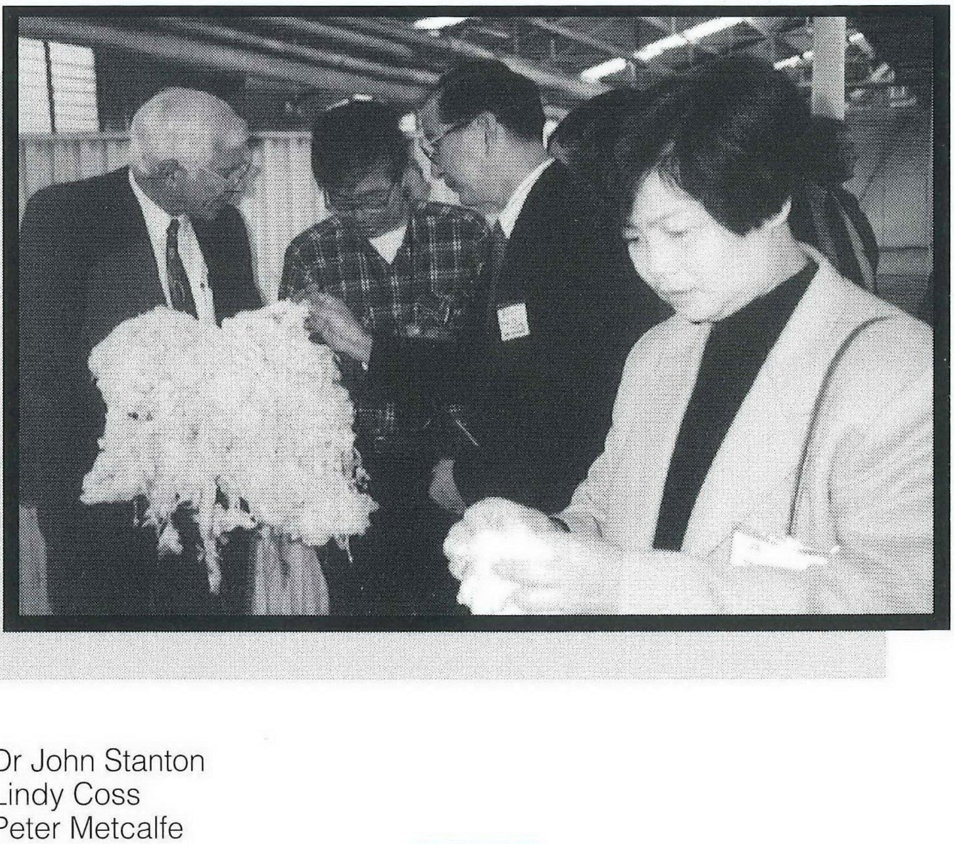

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Wool Program

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WESTERN AUSTRALIA

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Definition

To define the processing performance, and the characteristics that impact on processing performance, of consignments of solely Western Australia wool:

1. to compile all processing results containing WA wool that were made available to the project and analyse their performance relative to predictive equations; and
2. examine the ASMAP dataset and establish comparative results between the WA consignments and ASMAP consignments.

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COVER PHOTOGRAPH

Wool processors from the People's Republic of China examine Western Australian scoured wool with Syd Lodge, Managing Director of Jandakot Wool Scouring Co Pty Ltd

Contents

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Synopsis

Despite a perception by some that Western Australian wool 'processes poorly', this study found that consignments processed:

1. into long tops suited for worsted weaving
2. into longer than predicted tops
3. with the same consistency as other Australian consignments

Major findings

Western Australian wool is perceived by the trade and early stage processors to 'process poorly'.

The objective of this study was to test the validity of this perception. The study therefore had to separate differences due to the raw wool specifications of the consignments and differences from an expected processing outcome. This was achieved by using results from a range of commercial consignments, relating the raw wool characteristics to the processing results, and using prediction equations to derive the expected processing outcome.

The actual fibre length results after combing commercial consignments of WA wool were analysed to see if these WA raw wool consignments:

- processed into tops with short Hauteur (Option A)
- processed into tops with shorter than expected Hauteur (Option B)
- processed erratically, with some consignments below expected Hauteur (Option C).

These options were tested against a large number of Australian processing results (the ASMAP[1] dataset), as it was assumed that the 'poor perception' was based on the trade's comparison with Australian consignments that had comparable raw wool specifications.

The average raw wool specifications for the WA consignments were similar to the long term average for the State clip, and were comparable to the average raw wool specifications for the Australian consignments. All wool in both the WA consignments and the Australian consignments was tested for staple characteristics. Both sets of consignments were composed of merino fleece wool and a variable component of skirting wool. Some of the WA consignments were composed of fleece wool only.

The WA consignments were processed in different mills in Europe, Japan and S.E. Asia.

The major findings from the analyses of these consignments were:

1. Long Hauteur
The average Hauteur of WA consignments was 74 mm, with an average top diameter of 21.9 µm. This length is in excess of the generally accepted average fibre length (Hauteur) requirements for worsted spinning. The WA result is also longer than the average of 69.4 mm from the Australian dataset used. This refutes Option A.

2. Longer than expected
The average difference[2] between actual Hauteur and expected (as measured by the TEAM equations[3]) was +3.7 mm. The equivalent Australian result was +2.0 mm. Therefore, the processing results of the WA consignments were better than expected, and were better than the Australian results. This is independent of differences in the raw wool characteristics as these have been removed by the use of the predictive equation. These results refute the perception that WA wool processes shorter (that is, poorer) than expectation (Option B). These results also show that the result in (1) is due in part to better than expected processing outcomes.

3. Normal range of processing results
The standard deviations of the Hauteur differences (that is, difference between predicted and actual results) in the WA and ASMAP datasets were 5.0 mm and 4.5 mm respectively. The equivalent standard deviations of the CV(H) differences were 4.8% and 4.0%. These WA and ASMAP results were not significantly different. This refutes Option C, that WA consignments process erratically compared to other Australian consignments.

4. Australian consignments containing WA wool
Results were obtained from 38 Australian consignments that contained a proportion of WA wool. These consignments showed no depression of Hauteur as the proportion of WA wool increased to 100%. This refutes Option A. Also the differences between the predicted and actual Hauteur were independent of the proportion of WA wool, suggesting that the processing outcomes of WA wool in blends are also no different to other Australian wool, and so refuting Option B.

5. Prediction of WA consignment results
Deviations between actual and predicted processing results of WA consignments differ significantly to the Australian results. This suggests that on the basis of these consignments the prediction equations need to be revised to accommodate consignments made wholly of WA wool.

6. Subset of long Hauteur WA consignments
Eight (out of 44) WA consignments had very large positive deviations between predicted and actual Hauteur, which were not evident in the same percentage in the Australian dataset.

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[1] Australian Staple Measurement Adoption Project (ASMAP).

[2] The use of difference between actual and predicted Hauteur allows comparisons to be made between consignments without confusion caused by comparing short or long consignments.

[3] Developed in Trials Evaluating Additional Measurement (TEAM).

This study concludes that, when the raw wool was staple measured, WA consignments have a very low risk of producing short or shorter than expected Hauteur. These WA consignments also show no evidence of erratic processing performance.

Clearly the Hauteur results of these WA consignments do not support the perception that WA wool 'processes poorly'. In fact 79% of the WA consignment results were in excess of expected Hauteur (based on TEAM).

We believe that the definition of a good processing result would mean that in the top:

- diameter is within 0.2 µm of the consignment raw wool average
- Hauteur is in the range 68 mm – 75 mm
- CV(H) is in the range 40% – 48%
- short fibre content is less than 15%.

The results of the WA consignments fit this definition of having a good processing performance:

- diameter of 21.9 µm which was 0.1 µm over the raw wool average
- Hauteur of 74 mm
- CV(H) of 45.5%
- short fibre content of 9.1%

1. Background

The performance of WA raw wool in processing has been questioned in the past by the commercial trade and early stage processors. Attention has been mainly focused on the raw wool characteristics, in particular on the staple characteristics of strength, length and position of break. Poor results in these characteristics are thought to indicate poor processing performance.

However, predictions from individual sale lots may not be reflected in the average predictions of the consignment as it can be assembled from up to 50 individual sale lots.

Equally important is the need to use results from commercial consignments rather than estimated performance from predictive equations, since this is the basis on which industry experience is founded.

We therefore undertook a study, with the support of WA industry and a number of mills, to examine the actual processing performance of raw wool consignments originating from WA.

To quantify the assessment of the processing performance, it was necessary to use a processing prediction system against which the processing result could be assessed. We used the TEAM and the SiroHauteur equations for this study.

We also compared processing results from WA consignments against other Australian or eastern Australian processing results, through comparisons done within single mills, and comparisons with results from the ASMAP dataset that contains 340 consignment results from a wide range of commercial consignments drawn from across Australia.

2. Objectives

a) To collate the processing results of commercial consignments of WA wool that were supplied to this project.
b) To analyse these processing results.
c) To compare these processing results with other processing results of Australian wool.

3. Methodology

3.1 Sources of data

Results from the processing of WA raw wool through to combed tops were collected from a variety of commercial sources. These results included consignments where all sale lots were either pre or post-sale tested for the staple measurements, in addition to the core test results for diameter, yield and vegetable matter content and composition. Not all consignments had a complete set of results. These consignments were assembled in the period August 1991–February 1995.

The results were drawn from the commercial consignments in the Pilot Projects initiated by the Wool Strategy Group (Section 4.1), quality assured commercial consignments (Section 4.2), pastoral consignments (Section 4.3), and broker and/or buyer assembled consignments (Section 4.4).

The majority of the WA consignments were made of merino combing fleece wool with a few consignments containing a proportion of merino skirting wool.

Results were collected from six different combing mills. However, no mill adjustments were applied to the TEAM equations for these individual mill results.

Actual top characteristics were derived from information originally supplied by the comber. Usually this was the physical top characteristics of diameter, Hauteur and CV(H). In some instances, this was supplemented by estimates of the processing efficiency of that consignment such as top yield[4], noil[5] and/or romaine[6] figures. No consignments were supplied with Almeter diagrams. All information supplied is recorded in Section 4.

A large dataset of the processing performance of Australian consignments, the ASMAP dataset, was also used to provide a comparison with the WA results. This is a randomised dataset containing a set of commercial consignments assembled from across Australia (from 1989 to 1991) without mill identity. The ASMAP data has been essentially used as supplied by the International Wool Secretariat (IWS). WA sale lots were identified in the ASMAP dataset by combining it with information from the AWC catalogue history database using the SAS statistical package and the raw wool measurements of the individual sale lots. Mill test results of diameter, Hauteur and CV(H) were used in both WA and ASMAP results.

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4 Top yield is the weight of top resulting divided by the weight of clean fibre going onto the cards.

5 Noil percentage is the weight of noil expressed as a percentage of the weight of top produced.

6 Romaine is the weight of noil removed during the combing operation, and is expressed as the percentage by weight of noil compared to the top plus noil weight. As this measures the weight loss from the combed top, the romaine should be as low as possible.

3.2 Analysis of data

The individual raw wool sale lot results were used to calculate a weighted raw wool consignment result. The prediction of processing performance was done on the weighted consignment results. All results and estimations were rounded to one decimal place. A total of 44 WA consignments were used, however Figures 2 to 18 only include those consignments with the appropriate results.

The TEAM equations were used to predict Hauteur[7], coefficient of variation of Hauteur[8] (CV(H)) and romaine. The SiroHauteur equations were used to predict the short fibre content[9]. It should also be noted that the TEAM equations were developed from consignment information, while the SiroHauteur equations were developed on single sale lot processing information derived from AWC and CSIRO trials. We also used the SiroHauteur equations and the TEAM equations on the WA consignments to compare their predictions of Hauteur and CV(H).

Differences between predicted and actual diameter, Hauteur and CV(H) were calculated on an consignment basis. Differences were not calculated for romaine as too few actual romaine results were available. When necessary, these differences were averaged. This average difference does not equal the difference between the averages when the distributions are skewed.

The statistical analysis of the results was done using the SAS statistical package.

Mill adjustments that can be included in the TEAM equations were unavailable, so the predictions for the individual consignments ignored mill adjustment factors. Consequently part of the variation that is evident in the results is due to differences between the consignments and part of the variation is due to the differences between the mills.

Some of the consignments were assembled from adjacent wool selling areas[10]. Other consignments were assembled from the auctions in Fremantle which generally resulted in sale lots from across the State being used in the consignments. The 20 wool selling areas in the State are shown in Figure 1.

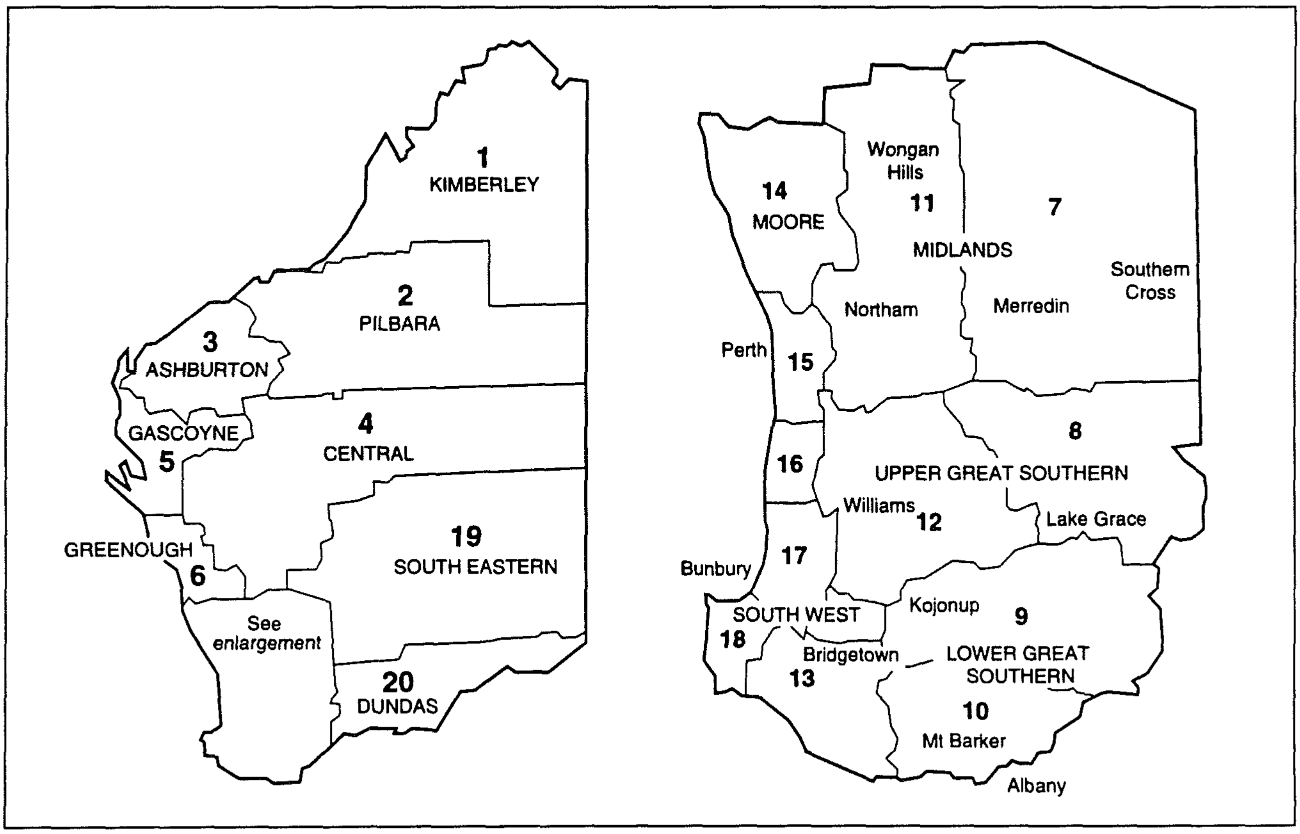

Figure 1. Wool selling areas (WSA) within WA shown by WSA number

7 Hauteur is the average fibre length in the combed top, measured in millimetres. For worsted spinning, common commercial expectation is for Hauteur to be in excess of 65 mm and less than about 80 mm.

8 Coefficient of variation of Hauteur (CV(H)) is the measure of the range of fibre lengths in the combed top. For worsted spinning, the tops should have results less than about 48% and over 40%.

9 Short fibre content is defined as the percentage of fibres in the combed top with lengths less than 30 millimetres. This percentage is usually kept to less than 15% in order to reduce processing problems and poor product quality in worsted spinning.

10 Wool Selling Areas are used to define regions in the State that have similar wool production characteristics such as temperature and rainfall.

4. Results of WA consignments

The consignments were assembled under normal commercial conditions, and processed in a variety of scours and combing mills. Inferences from these results must be tempered by the fact that the comparisons are not drawn from a controlled set of consignments.

In one instance, results were obtained from a single mill where the consignments were designed to examine the processing effect of position of break and to compare WA versus eastern Australian wool, with the other important raw wool characteristics being controlled. These results are shown in Section 5.

4.1 Pilot Project results

Three commercial consignments of WA wool were assembled by members of the Australian Council of Wool Exporters (ACWE) in Fremantle as part of a project designed to have the processing information returned to the wool producers (Pilot Projects). The sale lots were drawn from a wide distribution of wool selling areas and the consignments were compiled over the following periods:

- pp1 and pp3 –March 1994
- pp2 – April 1994

The three consignments varied in diameter and position of break but were similar in most other characteristics and were close to the State average for these characteristics. In addition they had similar

Table 4.1. Results for the pilot project consignments

Raw wool results		pp1	pp2	pp3
Diameter	µm	22.4	22.9	21.8
Vegetable matter content	%	0.9	0.9	1.4
seed and shive	%	0.8	0.8	1.2
Staple strength	N/ktex	37.8	40.6	36.1
Staple length	mm	92.5	90.0	90.6
Position of break (MID)	%	56.6	47.5	38.0
Total greasy weight	kg	79647	59619	37902
Yield[11]	%	69.0	66.6	65.6
Total clean weight	kg	54875	39658	24755
Predicted top results				
Hauteur[12]	mm	72.5	72.5	72.1
CV(H)	%	48.4	44.7	46.7
% fibres<30 mm[13]	%	14.5	13.2	12.1
Romaine	%	5.3	5.0	6.3
Actual top results		pp1	pp2	pp3
Diameter of combed top	µm	22.5	22.9	21.8
Hauteur	mm	76.4	86.0	85.7
CV(H)	%	41.3	32.5	34.9
% fibres<30 mm	%	6.5	1.5	1.7
Top yield	%			94.3
Noil	%			
Romaine	%		6.7	
Differences: Actual-predicted				
Diameter	µm	0.1	0.0	0.0
Hauteur	mm	3.9	13.5	13.6
CV(H)	%	-7.1	-12.2	-11.8
% fibres<30 mm	%	-8.0	-11.7	-10.4

11 This is a weight adjusted yield from the sale lot information and not from the processing weights.
12 Prediction of Hauteur and CV(H) uses the TEAM equation.
13 Prediction of short fibre content uses the SiroHauteur equations.

predicted top results. However all three consignments processed in excess of 76 mm which was 4 to 14 mm longer than predicted (a positive Hauteur difference). In addition they had a low CV(H) (below 42%) and low short fibre content, both of which were much lower than predicted (negative CV(H) and % fibres <30 mm difference). The results for pp2 and pp3 are unusual in the excessive length achieved and so were outside the parameters normally associated with worsted spinning contracts.

4.2 QA consignments

Four consignments were prepared under various quality assurance schemes. These schemes were primarily designed to address control of non-measured raw wool characteristics such as dark fibre content and contamination. The consignments were compiled over the following periods:

- qa1 – September and October 1994
- qa2 – July and August 1994
- qa3 – some January and majority in February 1995
- qa4 – January 1995

Most of the wool for qa1 and qa4 came from wool selling areas of 9, 12 and 13. Consignment qa2 was supplied from WSA 9 and 13. Consignment qa3 was drawn from across the State.

The consignments were processed at different combing mills. The results are summarised in Table 4.2.

One mill made the comment, "Preparation through the QA scheme obviously had a positive impact on the lots in general and an improvement has been achieved. The risk of obtaining poor results/ unpleasant surprises after processing seems to be lower than from lots handled the usual way" (qa2).

Consignment qa1 processed very close to expectation in all characteristics, although the small increase in CV(H) of 1.1% brought the consignment close to the acceptable upper limit for CV(H).

Table 4.2. Results for the QA consignments

			qa1	qa2	qa3	qa4
Raw wool results			qa1	qa2	qa3	qa4
	Diameter	µm	22.1	21.3	21.8	21.8
	Vegetable matter content	%	0.7	1.5	1.1	1.3
	seed and shive	%	0.6	1.3		1.2
	Staple strength	N/ktex	34.1	34.9	31.9	35.7
	Staple length	mm	93.9	90.0	83.7	90.6
	Position of break (MID)	%	47.0	32.6	26.8	21.7
	Total greasy weight	kg	73283	42299	35486	23619
	Yield	%	71.0	62.7	66.8	67.4
	Total clean weight	kg	52005	26487	23087	15905
Predicted top results						
	Hauteur	mm	73.1	70.7	66.6	72.0
	CV(H)	%	48.3	47.3	47.6	46.9
	% fibres<30 mm	%	13.9	12.4	12.2	11.2
	Romaine	%	5.5	6.9	7.5	6.3
Actual top results			qa1	qa2	qa3	qa4
	Diameter of combed top	µm	22.2	21.5	21.9	21.9
	Hauteur	mm	72.0	80.9	74.2	81.5
	CV(H)	%	49.4	36.7	42.7	36.9
	% fibres<30 mm	%	12.1	3.9	8.4	4.7
	Top yield	%			92.2	
	Noil	%			7.9	
	Romaine	%	6.7			
Differences: Actual-predicted						
	Diameter	µm	0.0	0.2	0.1	0.1
	Hauteur	mm	-1.1	10.2	7.6	9.5
	CV(H)	%	1.1	-10.6	-4.9	-10.0
	% fibres<30 mm	%	-1.8	-8.5	-3.8	-6.5

In qa2, qa3 and qa4, the actual results were significantly above the estimated Hauteur while the actual CV(H) and short fibre content were below the predicted result. Of these three, qa3 was a short (83.7 mm) and low strength (31.9 N/ktex) consignment with low mid break results (26.8%). Nevertheless, the actual Hauteur of 74.2 mm and CV(H) of 42.7% is more than adequate for worsted weaving. Whilst the predication of short fibre content was in excess of the actual results, the actual short fibre results are in the low to very low range.

4.3 Pastoral consignments

Several producers in the pastoral regions (wool selling areas 3, 4 and 5) had pastoral wool assembled into consignments by members of the wool trade and processed by a combing mill. The consignments have been assembled and processed during the following time frame:

- pc1 – assembled June 1993 and processed September 1993
- pc2 – assembled June 1994 and processed October 1994
- pc3 – assembled June 1993 and processed August 1993
- pc4 – assembled June 1994 and processed October 1994
- pc5 – processed October 1994
- pc6 – assembled September 1994 and processed January 1995

The wool result from these consignments is shown in Table 4.3.

Consignments pc1-4 were post-sale tested for the staple measurements. The raw wool measurements for pc1-5 were not complete but the actual processing results were made available.

These consignments were interesting as they were assembled from similar wool production areas that may allow for the control of variances in many measured and unmeasured raw wool characteristics.

Table 4.3. Results for the pastoral consignments

Raw wool results		pc1	pc2	pc3	pc4	pc5	pc6
Diameter	µm						20.9
Vegetable matter content	%						1.2
seed and shive	%						1.0
Staple strength	N/ktex	36.0	32.0	38.0	37.0		37.2
Staple length	mm	78.0	83.0	90.0	93.0		85.4
Position of break (MID)	%	83.0	59.0	52.0	35.0		45.1
Total greasy weight	kg						20299
Yield	%						69.0
Total clean weight	kg						13995
Predicted top results							
Hauteur	mm						69.2
CV(H)	%						46.0
% fibres<30 mm	%						15.3
Romaine	%						6.9
Actual top results		pc1	pc2	pc3	pc4	pc5	pc6
Diameter of combed top	µm	23.0	22.0	24.5	23.3	23.2	20.9
Hauteur	mm	73.9	75.0	86.1	84.3	83.8	68.1
CV(H)	%	40.0	43.7	36.2	41.9	39.8	49.9
% fibres<30 mm	%	9.5	11.7	5.0	10.0	7.9	16.5
Top yield	%						
Noil	%						
Romaine	%						8.0
Differences: Actual-predicted							
Diameter	µm						0.1
Hauteur	mm						-1.1
CV(H)	%						3.9
% fibres<30 mm	%						1.2

Pc1 had short staple length and high mid breaks in the raw wool but still achieved good Hauteur (73.9 mm) and low CV(H) of 40.0%. In contrast, pc6 had a higher strength, lower mid breaks and longer staple, but processed shorter (68.1 mm) and with a higher CV(H) of 49.9%. Consignments pc3, pc4 and pc5 have achieved very high Hauteur and low CV(H).

These results are interesting as the wool in each consignment were selected from a small number of properties (even single properties). This is not a general practice, as processors believe that uncertainty exists in the processing performance of single property clips. However, in this set, the only deviations in the actual characteristics are in the desirable directions.

No further comment is possible on these consignments until the raw wool results become available.

4.4 Broker/buyer commercial consignments

Some brokers and buyers kindly made available a number of commercial results (totalling 21 consignments). These included both the raw and actual results. These are summarised in Tables 4.4.1, 2, 3, 4 and 5.

The reporting of the processing results has been divided on the basis of region of the topmaking mill:

- b1 was processed in SE Asia
- b2 was processed in Italy
- b3 was processed in Japan

Table 4.4.1. Results for the broker/buyer commercial consignments (b1)

Raw wool results		b1c1	b1c2	b1c3	b1c4	b1c5	b1c6
Diameter	µm	21.8	21.9	20.8	20.4	20.6	20.5
Vegetable matter content	%	0.9	1.2	1.3	0.8	1.3	0.8
seed and shive	%						
Staple strength	N/ktex	34.3	35.5	33.5	23.3	36.2	30.3
Staple length	mm	91.3	87.3	91.0	86.6	90.0	92.1
Position of break (MID)	%	60.0	39.0	32.6	37.2	54.9	48.7
Total greasy weight	kg	18658	20186	20112	17345	19762	19848
Yield	%						
Total clean weight	kg	12637					
Predicted top results							
Hauteur	mm	69.0	70.3	70.2	63.0	68.9	68.5
CV(H)	%	50.6	46.6	48.2	52.0	49.0	50.5
% fibres<30 mm	%	16.3	13.3	14.3	15.4	17.1	16.6
Romaine	%	6.1	6.6	6.9	8.5	6.7	6.9
Actual top results		b1c1	b1c2	b1c3	b1c4	b1c5	b1c6
Diameter of combed top	µm	21.8	21.9	20.8	20.6	20.7	20.6
Hauteur	mm	75.1	71.2	71.4	58.4	70.1	68.8
CV(H)	%	44.5	46.1	48.9	51.1	53.1	55.8
% fibres<30 mm	%	9.0	10.2	11.3	19.4	17.5	19.5
Top yield	%	91.6	88.7	91.2	87.9	90.7	91.8
Noil	%		9.5	9.1	11.7	4.6	5.1
Romaine	%						
Differences: Actual-predicted							
Diameter	µm	0.0	0.0	0.0	0.2	0.1	0.1
Hauteur	mm	6.1	0.9	1.2	-4.6	1.2	0.3
CV(H)	%	-6.1	-0.5	0.7	-0.9	4.1	5.3
% fibres<30 mm	%	-7.3	-3.1	-3.0	4.0	0.4	2.9

These raw wool consignments were assembled from auction in Fremantle, and so the wool was drawn from wool selling areas across the State. The dates of assembly of the raw wool for these consignments were:

- b1c1 – August 1992
- b1c2 to b1c6 – September to October 1994
- b2c1 – mainly September 1993 to January 1994
- b2c2 – between August 1991 and February 1994
- b2c3 – mainly September 1993 to February 1994
- b2c4 – August 1993 to February 1994
- b2c5 – March 1994
- b2c6 – mainly March and April 1994
- b2c7 – mainly October 1993 to May 1994
- b2c8 – July and August 1994
- b2c9 – mainly August 1994
- b2c10 – mainly July and August 1994
- b2c11 – mainly September and October 1994
- b2c12 – mainly August and September 1994

There is no information about the dates of assembly for b3c1 to b3c13.

This section contains a wide range of consignments, in terms of diameter, and in terms of predicted top performance. Consignments of interest include those consignments which process close to prediction (b1c2, b1c3, b2c2, b2c7, b2c8, b3c3). These can be compared with only two consignments that achieved significantly shorter Hauteur than expected (b1c4 and 3c12) and the remaining 10 consignments that were superior to prediction in one or more top characteristics.

Table 4.4.2. Results for the broker/buyer commercial consignments (b2)

Raw wool results		b2c1	b2c2	b2c3	b2c4	b2c5	b2c6
Diameter	μm	21.2	20.0	23.0	23.1	22.2	21.0
Vegetable matter content	%	1.1	1.1	0.8	0.9	1.4	1.6
seed and shive	%	0.9	0.8	0.6	0.7	0.8	1.3
Staple strength	N/ktex	35.2	33.8	35.7	39.7	47.2	40.0
Staple length	mm	91.7	90.7	90.8	95.1	96.9	89.1
Position of break (MID)	%	58.0	59.2	65.7	51.6	38.4	57.8
Total greasy weight	kg	23756	22357	43653	41400	20705	20872
Yield	%	67.6	68.5	67.7	66.1	70.1	65.5
Total clean weight	kg	16009	15282	29308	27249	14519	13643
Predicted top results							
Hauteur	mm	69.3	66.8	69.5	76.4	81.0	69.9
CV(H)	%	50.1	51.2	50.7	46.7	42.8	47.8
% fibres<30 mm	%	15.9	18.0	14.9	12.6	11.7	15.4
Romaine	%	6.3	7.0	5.4	4.4	4.0	6.4
Actual top results		b2c1	b2c2	b2c3	b2c4	b2c5	b2c6
Diameter of combed top	μm	21.9	20.0	23.1	23.2	22.2	21.4
Hauteur	mm	68.5	66.5	75.5	86.2	82.7	84.6
CV(H)	%	46.7	49.8	43.7	37.1	36.4	35.0
% fibres<30 mm	%	9.3	14.0	7.0	3.4	3.1	2.6
Top yield	%						
Noil	%						
Romaine	%						
Differences: Actual-predicted							
Diameter	μm	0.7	0.0	0.1	0.1	0.0	0.5
Hauteur	mm	-0.9	-0.3	6.0	9.8	1.7	14.7
CV(H)	%	-3.4	-1.4	-7.0	-9.6	-6.4	-12.8
% fibres<30 mm	%	-6.6	-4.0	-8.0	-9.2	-8.6	-12.9

Table 4.4.3. Results for the broker/buyer commercial consignments (b2 cont.)

Raw wool results		b2c7	b2c8	b2c9	b2c10	b2c11	b2c12
Diameter	µm	21.4	20.7	21.9	23.0	21.9	20.6
Vegetable matter content	%	2.4	3.3	1.3	0.9	1.3	2.9
seed and shive	%	1.8	2.3	1.3	0.9	1.2	1.9
Staple strength	N/ktex	34.2	34.9	35.6	36.1	39.0	33.7
Staple length	mm	78.0	76.1	89.9	90.7	91.3	75.2
Position of break (MID)	%	55.6	47.7	26.9	24.0	24.2	58.5
Total greasy weight	kg	19836	18985	20177	23655	22157	18528
Yield	%	56.6	57.7	63.3	65.8	67.6	57.1
Total clean weight	kg	11185	10939	12728	15517	14949	10573
Predicted top results							
Hauteur	mm	61.8	61.5	71.6	73.5	74.0	58.6
CV(H)	%	48.3	46.4	46.8	46.3	45.6	49.0
% fibres<30 mm	%	19.1	20.2	12.2	11.2	11.4	22.0
Romaine	%	9.1	10.4	6.4	5.5	5.7	10.2
Actual top results		b2c7	b2c8	b2c9	b2c10	b2c11	b2c12
Diameter of combed top	µm	21.5	20.8	22.0	22.9	21.8	21.1
Hauteur	mm	62.6	62.8	78.7	83.7	79.1	60.1
CV(H)	%	48.6	47.9	40.0	36.3	40.0	46.9
% fibres<30 mm	%	15.8	13.9	5.2	2.6	4.5	14.3
Top yield	%						
Noil	%						
Romaine	%						
Differences: Actual-predicted							
Diameter	µm	0.1	0.1	0.1	-0.1	-0.1	0.5
Hauteur	mm	0.8	1.3	7.0	10.2	5.1	1.5
CV(H)	%	0.3	1.4	-6.8	-10.0	-5.6	-2.1
% fibres<30 mm	%	-3.3	-6.3	-7.1	-8.6	-6.9	-7.8

Table 4.4.4. Results for the broker/buyer commercial consignments (b3)

Raw wool results		b3c1	b3c2	b3c3	b3c4	b3c5
Diameter	µm	23.7	23.6	23.8	23.7	23.7
Vegetable matter content	%	0.5	0.5	0.6	0.5	0.5
seed and shive	%					
Staple strength	N/ktex	38.2	36.1	38.9	38.0	39.0
Staple length	mm	99.1	100.0	98.0	96.0	96.0
Position of break (MID)	%	84.6	80.9	73.4	82.0	72.0
Total greasy weight	kg					
Yield	%					
Total clean weight	kg					
Predicted top results						
Hauteur	mm	72.2	72.3	74.1	71	73.4
CV(H)	%	54.2	54.4	51.5	53.3	50.9
% fibres<30 mm	%					
Romaine	%	3.6	3.9	3.7	4.0	3.8
Actual top results		b3c1	b3c2	b3c3	b3c4	b3c5
Diameter of combed top	µm					
Hauteur	mm	73.8	73.8	74.7	78.2	74.7
CV(H)	%	51.9	51.9	51.4	48.6	48.7
% fibres<30 mm	%					
Top yield	%					
Noil	%					
Romaine	%					
Differences: Actual-predicted						
Diameter	µm					
Hauteur	mm	1.6	1.5	0.6	7.2	1.3
CV(H)	%	-2.3	-2.5	-0.1	-4.7	-2.2
% fibres<30 mm	%					

Table 4.4.5. Results for the broker/buyer commercial consignments (b3 cont.)

Raw wool results		b3c6	b3c7	b3c8	b3c9	b3c10	b3c11	b3c12	b3c13
Diameter	µm	21.5	21.7	21.6	21.6	21.6	21.5	21.6	21.5
Vegetable matter content	%	0.6	0.5	0.5	1.3	0.6	1.0	0.6	0.7
seed and shive	%								
Staple strength	N/ktex	35.4	34.5	35.1	37.0	35.1	36.0	35.0	37.4
Staple length	mm	90.6	95.3	92.7	88.0	91.0	88.0	90.0	91.0
Position of break (MID)	%	73.0	93.2	77.6	69.0	70.6	78.0	78.0	67.9
Total greasy weight	kg								
Yield	%								
Total clean weight	kg								
Predicted top results									
Hauteur	mm	72.6	66.5	65	66.8	66.5	67.2	64.3	65.2
CV(H)	%	52.9	52.7	57.6	54	50.9	52.4	53.2	53.8
% fibres<30 mm	%								
Romaine	%	5.8	5.3	5.5	6.5	5.8	6.4	5.9	5.6
Actual top results		b3c6	b3c7	b3c8	b3c9	b3c10	b3c11	b3c12	b3c13
Diameter of combed top	µm								
Hauteur	mm	69.2	69.2	68.5	78.3	65.7	69.7	57.3	68.3
CV(H)	%	51.0	51.0	53.8	43.7	53.6	49.2	55.5	51.6
% fibres<30 mm	%								
Top yield	%								
Noil	%								
Romaine	%								
Differences: Actual-predicted									
Diameter	µm								
Hauteur	mm	2.7	4.2	1.7	11.8	-1.5	5.4	-7.9	-0.3
CV(H)	%	-1.7	-6.6	-0.2	-7.2	1.21	-4.0	1.71	0.7
% fibres<30 mm	%								

4.5 Summary of WA processing results

Summary statistics for the consignments listed in Sections 4.1 to 4.4 are given in Table 4.5.1. They include the unweighted[14] average across all consignments (Mean) and the standard deviation of the mean (SD), the maximum (max) and minimum (min) result from all consignments, and the number of consignments that had results for that parameter (N). In parameters such as actual romaine where only two results were received, statistics derived from these results should be treated with caution.

Do these consignments reflect the WA clip?
An aim of this study was to seek information about the processing performance of the WA raw wool clip. Therefore in order to be able to generalise the results from the WA processing dataset to the WA raw wool clip, the two sets of raw wool specifications need to be similar.

Statistics for the WA raw wool clip were prepared from the results of all merino combing fleece wool sold in Fremantle over a five-year period between July 1988 and June 1993. These are compared with the means of the processing consignments in Table 4.5.2.

The comparison shows little differences in average diameter or vegetable matter content but with a slightly higher shive content in the consignments. The average staple strength in the WA consignments was higher by 3 N/ktex and there are no apparent differences in averages of staple length or position of break.

We conclude that the raw wool used in the WA consignments has average results similar to the WA raw wool clip, and is typical of the types of raw wool available in WA.

Table 4.5.1. Summary of consignments listed in Sections 4.1 to 4.4

Raw wool results		Mean	SD	max	min	N
Diameter	µm	21.8	1.0	23.8	20.0	39
Vegetable matter content	%	1.1	0.6	3.3	0.5	39
seed and shive	%	1.1	0.5	2.3	0.6	19
Staple strength	N/ktex	35.9	3.4	47.2	23.3	43
Staple length	mm	90.0	5.6	100.0	75.2	43
Position of break (MID)	%	55.5	19.1	93.2	21.7	43
Total greasy weight	kg	31059	17230	79647	18528	21
Yield	%	65.6	4.2	71.0	56.6	20
Total clean weight	kg	21680	12928	54857	10573	26
Predicted top results						
Hauteur	mm	69.4	4.4	81.0	58.6	39
CV(H)	%	49.6	3.2	57.6	42.8	39
% fibres<30 mm	%	14.7	2.9	22.0	11.2	26
Romaine	%	6.1	1.6	10.4	3.6	39
Actual top results		Mean	SD	max	min	N
Diameter of combed top	µm	21.9	1.0	24.5	20.0	31
Hauteur	mm	74.0	7.8	86.2	57.3	44
CV(H)	%	45.4	6.5	55.8	32.5	44
% fibres<30 mm	%	9.1	5.4	19.5	1.5	31
Top yield	%	91.0	2.0	94.3	87.9	8
Noil	%	8.0	2.7	11.7	4.6	6
Romaine	%	6.7	0.0	6.7	6.7	2
Differences: Actual-predicted						
Diameter	µm	0.1	0.2	0.7	-0.1	26
Hauteur	mm	3.7	5.0	14.7	-7.9	39
CV(H)	%	-3.6	4.8	5.3	-12.8	39
% fibres<30 mm	%	-5.6	4.3	4.0	-12.9	26

[14] These were unweighted averages as we are looking at the differences between consignments independent of the size of the consignment. Furthermore, clean weights were not available for all lots.

Table 4.5.2 Results for the commercial consignments from WA listed in Sections 4.1 to 4.4 (Table 4.5.1) compared to the long term WA average supply for merino combing fleece wool

Raw wool results		Mean of processing consignments	Long-term WA average merino fleece[15]
Diameter	µm	21.8	22.2
Vegetable matter content	%	1.1	1.0
seed and shive	%	1.1	0.6
Staple strength	N/ktex	35.9	33.0
Staple length	mm	90.0	89.8
Position of break (MID)	%	55.5	57.2
Yield	%	65.6	66.5
Predicted top results[16]			
Hauteur	mm	69.4	67.5
CV(H)	%	49.6	51.2

The frequency distribution of the 44 Hauteur results for consignments within this WA dataset is shown in Figure 2. The distribution has an average of 74.0 mm and a standard deviation of 7.8 mm with a maximum of 86.2 mm and a minimum of 57.3 mm.

The WA combing results in Sections 4.1 to 4.4 were combined in Figures 3 to 10. Within these Figures, each consignment result is shown, and the consignment group is also identified to facilitate cross reference to the Tables 4.1 to 4.4. When examining these results, it needs to be remembered that the results are coming from a large number of scouring and combing mills. Therefore variations between the consignments in this study include differences between the mill and between orders, in addition to differences between the raw wools making up the consignments.

4.5.1 Diameter

The WA consignment results are shown in Figure 3. The measurement of raw wool diameter is done to provide an indication of the fibre diameter in the combed top. As the top diameter is dependent on the

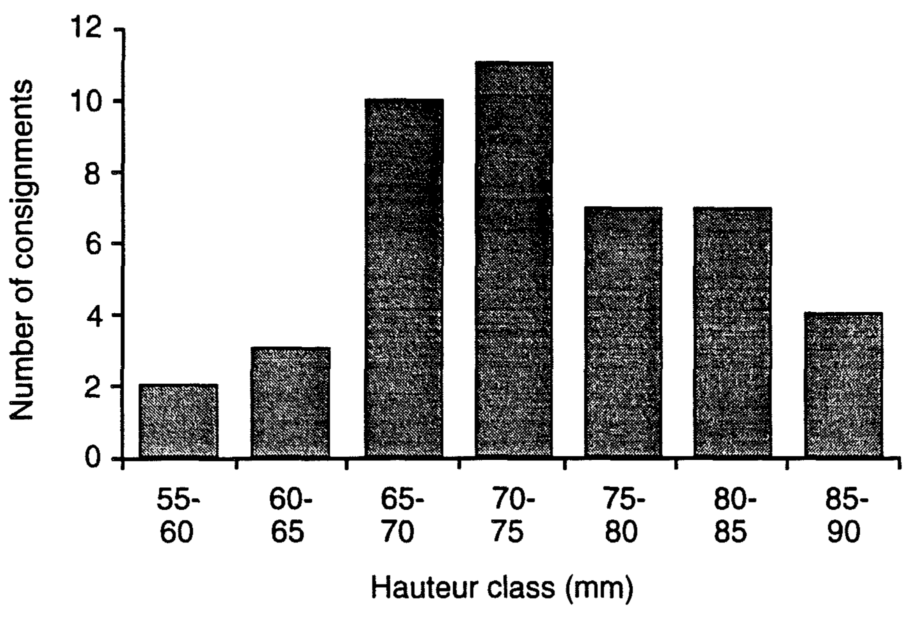

Figure 2. Frequency distribution of Hauteur in the WA consignment dataset containing the consignment groups listed in Sections 4.1to 4.4 (N=44)

[15] Results for staple measured merino combing fleece wool sold in Fremantle between July 1988 and June 1993.

[16] The TEAM prediction is calculated for each individual consignment (for processing consignments) and for individual sale lots (for the long-term average) and then averaged.

amounts removed as noil and other wastes, the relationship between raw wool diameter and top diameter can change between consignments. The diagonal line indicates where the predicted equals the actual diameter results. The majority of the consignment results lie close to or on the diagonal and there is no apparent pattern in those lots that lie off the diagonal. The regression explaining top diameter from the raw wool diameter is highly significant and the slope is not significantly different from the diagonal (see Appendix 1.1). This indicates that the raw wool diameter can be used as a reliable estimate of the top diameter.

The differences between the top and raw wool diameter are independent of Hauteur in these WA consignments (as shown in Figure 4 and Appendix 1.2). The largest single deviation of 0.7 µm from consignment b2c1 had a Hauteur of 68.5 mm and the next two largest deviations of 0.5 µm were from b2c6 (Hauteur of 84.6 mm) and b2c12 (Hauteur of 60.1 mm). Therefore the raw wool diameter can be used to estimate top diameter across all the Hauteur range in these WA consignments.

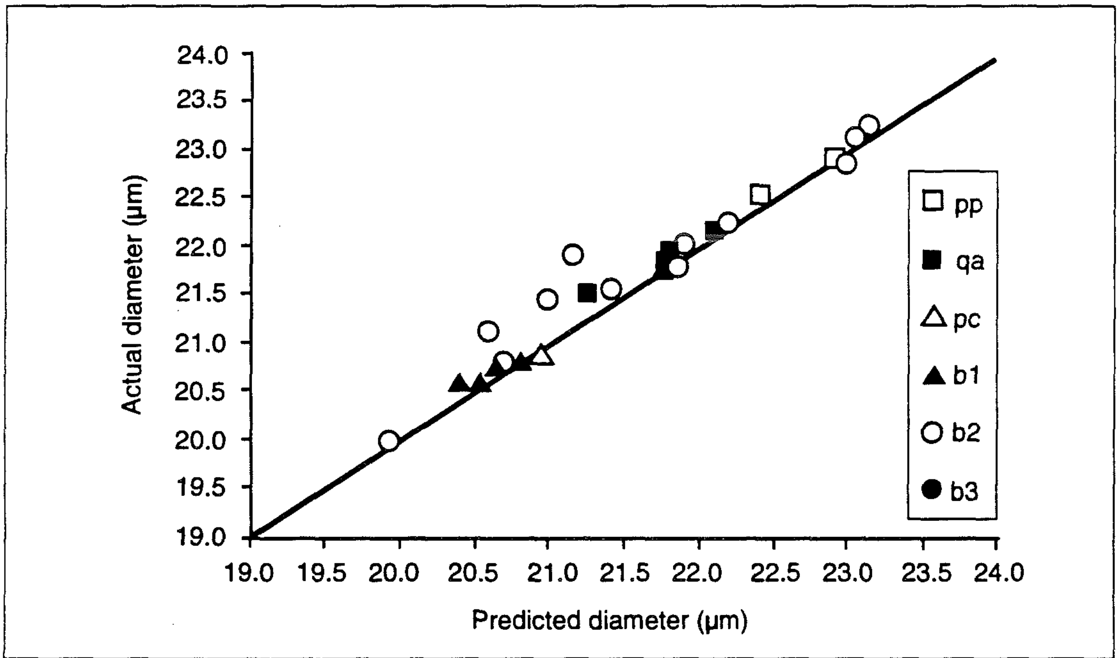

Figure 3. Predicted diameter compared to actual diameter for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=26)

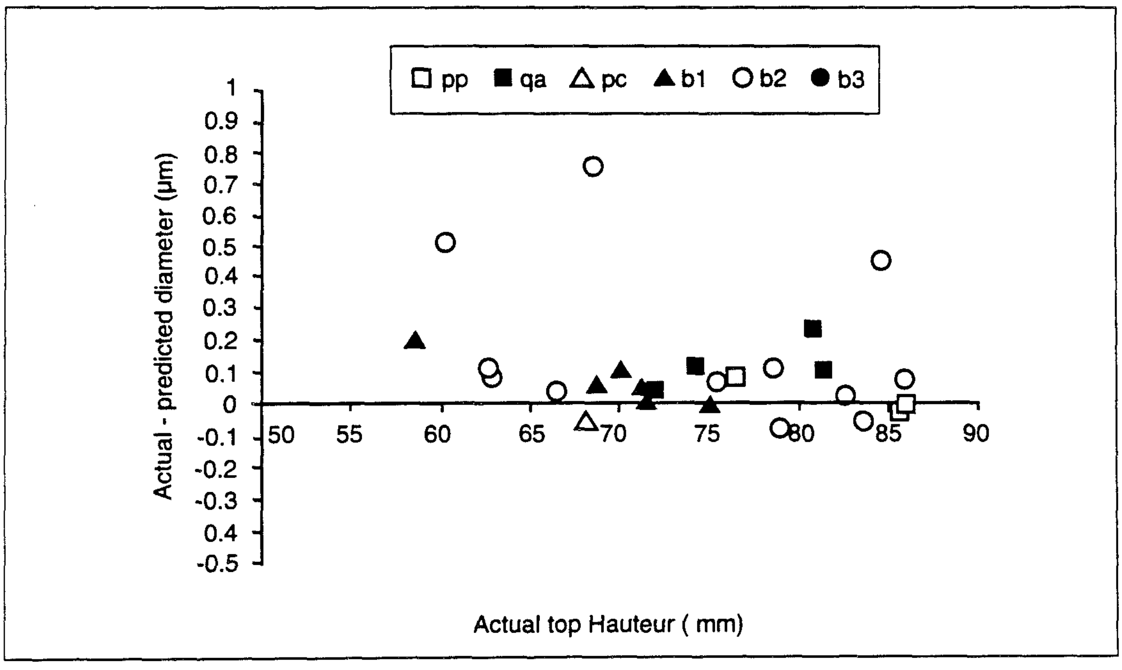

Figure 4. Actual top Hauteur compared to actual – predicted diameter for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=26)

4.5.2 Hauteur

The relationship between the prediction of Hauteur and the actual (that is, achieved) Hauteur in the WA consignments is shown in Figure 5. The average Hauteur for all consignments was 74.0 mm for an average fibre diameter of 21.9 µm. This result is in excess of the generally accepted requirements for a worsted spinning operation for this fibre diameter.

The range of Hauteur results is evident, showing that the results were derived from a variety of consignments, and not a narrow range of uniform consignments. The diagonal line indicates where the predicted equals the actual Hauteur result. In the low Hauteur range the results lie either side of this line while at the higher Hauteur results, the actual results are in excess of predicted. This pattern is spread across all consignment groups, and not from a single consignment group or source.

The regression explaining the actual Hauteur from the predicted Hauteur (see Appendix 1.3) has a slope of 1.36, which is a significantly different slope ($P<0.05$) to the diagonal (slope of 1). Although the number of consignment results is restricted, the pattern shown in Figure 5 would suggest that the prediction needs be adjusted to get a better fit of the actual result. Such a shift would address the average Hauteur difference of 3.7 mm and underestimation of the high Hauteur results. This issue is discussed in Section 6.

4.5.3 CV(H)

The range of individual consignment results is shown in Figure 6. The coefficient of variation in fibre length within the tops from these consignments averaged 45.4% which is in the middle of the 'desirable' CV(H) range of 42 to 48%. This can be compared with the average predicted CV(H) of 49.6%.

While the average actual CV(H) is acceptable, about one-third of the consignments had CV(H) results in excess of 50%. In this region, tops can expect a reduced demand by the spinning sector as the short fibre content of this wool may cause problems with spinning end-breaks and yarn faults. However it should also be noted that the majority of the higher CV(H) lots were on knitting yarn length where higher CV(H) are acceptable. The relationship between short fibre content and CV(H) is shown in Figure 12. The short fibre content for consignments with CV(H) over 50% is in excess of 15%.

The predicted CV(H) range was between 42.8% and 57.6% and the actual range was 32.5% to 55.8%. The diagonal line shows equal prediction and actual results. The results at the low CV(H) range fall below this line while the high results lie about the line. The regression explaining actual CV(H) from predicted CV(H) has a slope of 1.46 (see Appendix 1.4). The pattern would suggest that the prediction was relatively insensitive in predicting the full range of results, and that the prediction was not detecting the low CV(H) consignments.

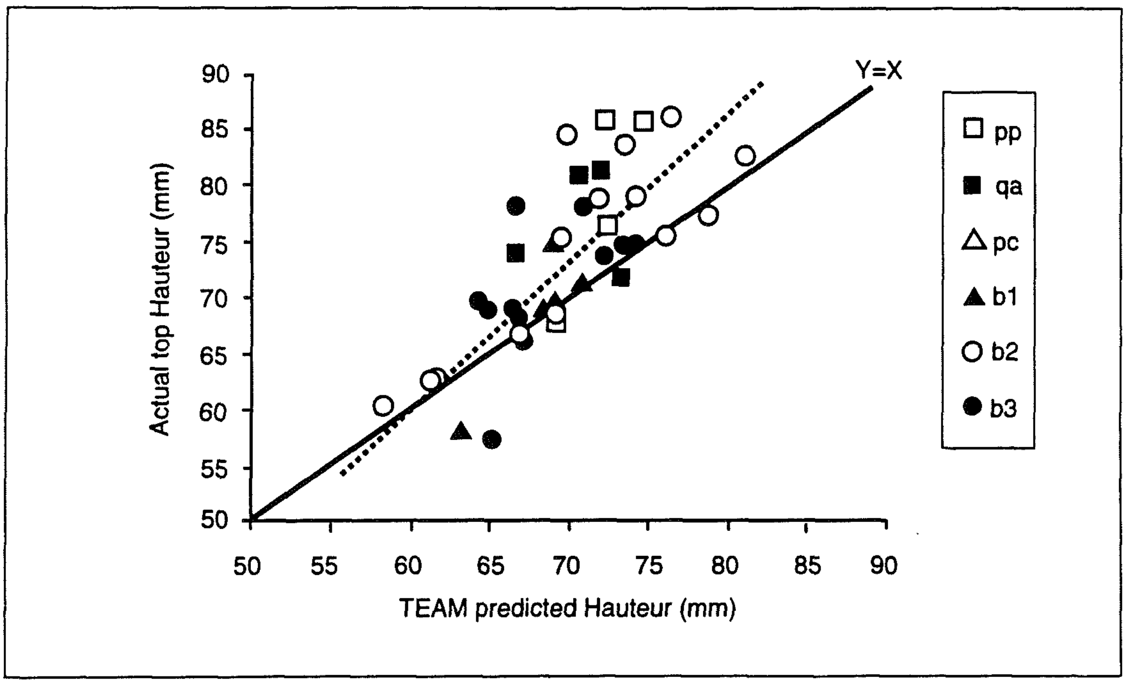

Figure 5. TEAM predicted Hauteur compared to actual Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=39). The dotted line is the regression of predicted and actual Hauteur (adj. $R^2 = 0.598$).

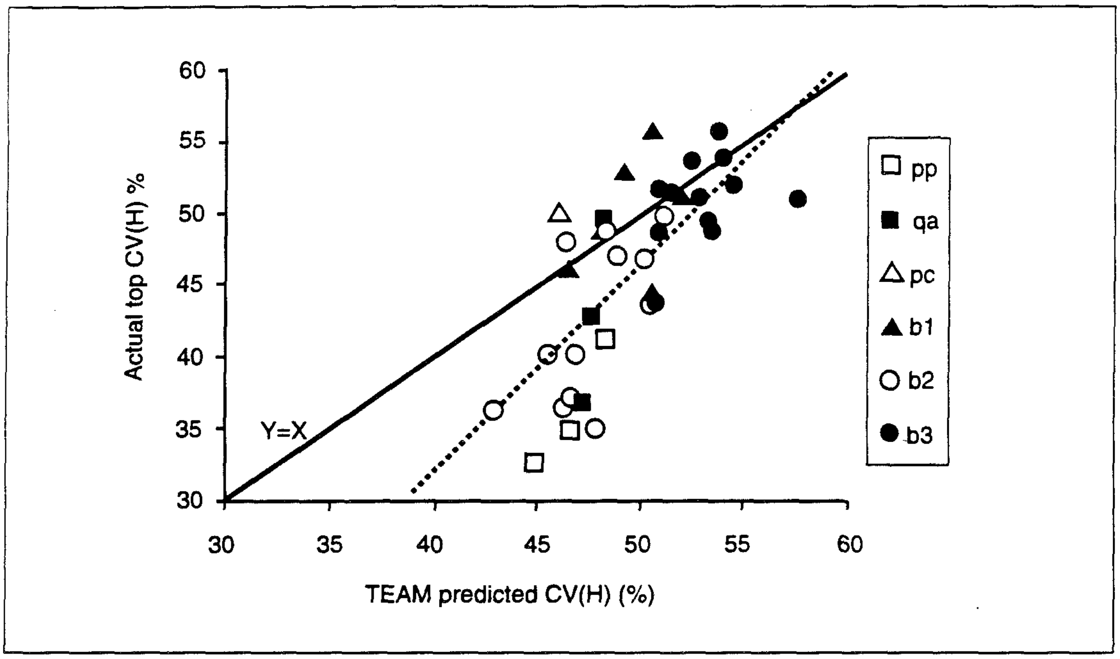

Figure 6. TEAM predicted CV of Hauteur compared to actual CV of Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=39). The dotted line is the regression of predicted and actual CV(H) (adj. $R^2 = 0.497$).

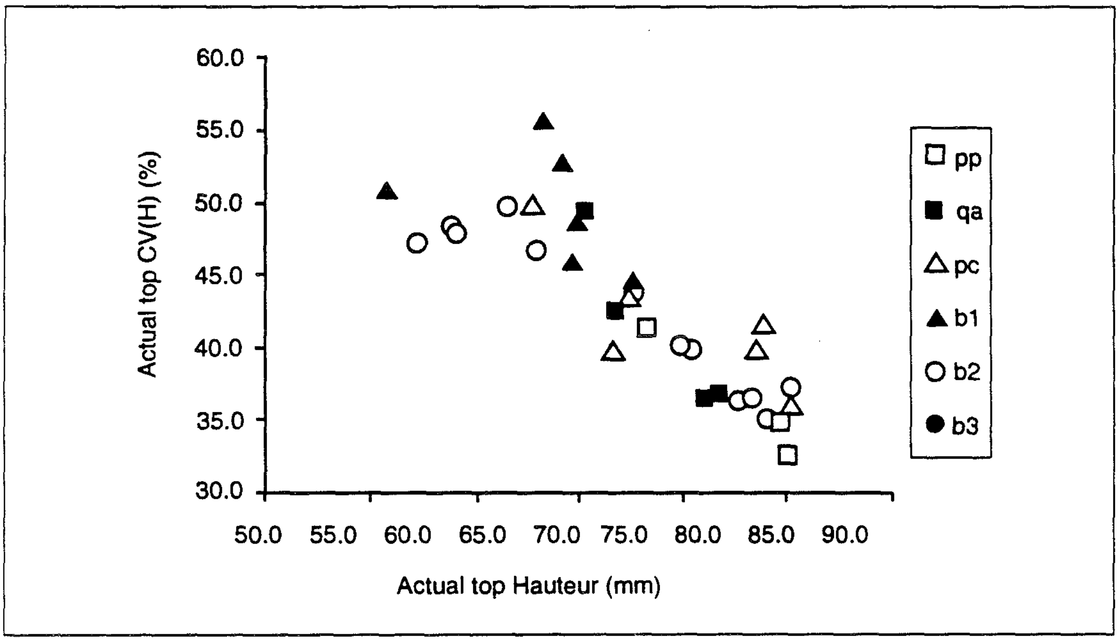

Figure 7. TEAM predicted Hauteur compared to actual CV of Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=39)

Figures 7 and 8 illustrate the relationship between actual Hauteur against CV(H) and the difference between actual and predicted CV(H). Both Figures show a declining CV(H) and increasing differences as the Hauteur increases.

4.5.4 Combining Hauteur and CV(H)

The deviations of actual from predicted Hauteur and CV(H) are combined in Figure 9 to illustrate the range and direction of these differences. The more desirable quadrant for the deviations is in the positive Hauteur and negative CV(H) sector. Only 12 of the 39 results fall outside this quadrant. The average deviation of the Hauteur was +3.7 mm and for the CV(H) was -3.6%. Good individual results extend these deviations to +14.7 mm and -12.8%. The correlation coefficient between the two differences was -0.86 which is highly significant ($P<0.0001$).

The distribution of the deviations suggests that there are consignment/mill combinations that are forcing significant deviations in the actual result from the predicted result. Conversely, there is no evidence that the consignments are indicating the existence of poor processing results, which would show up as strong negative deviations from predicted Hauteur or strong

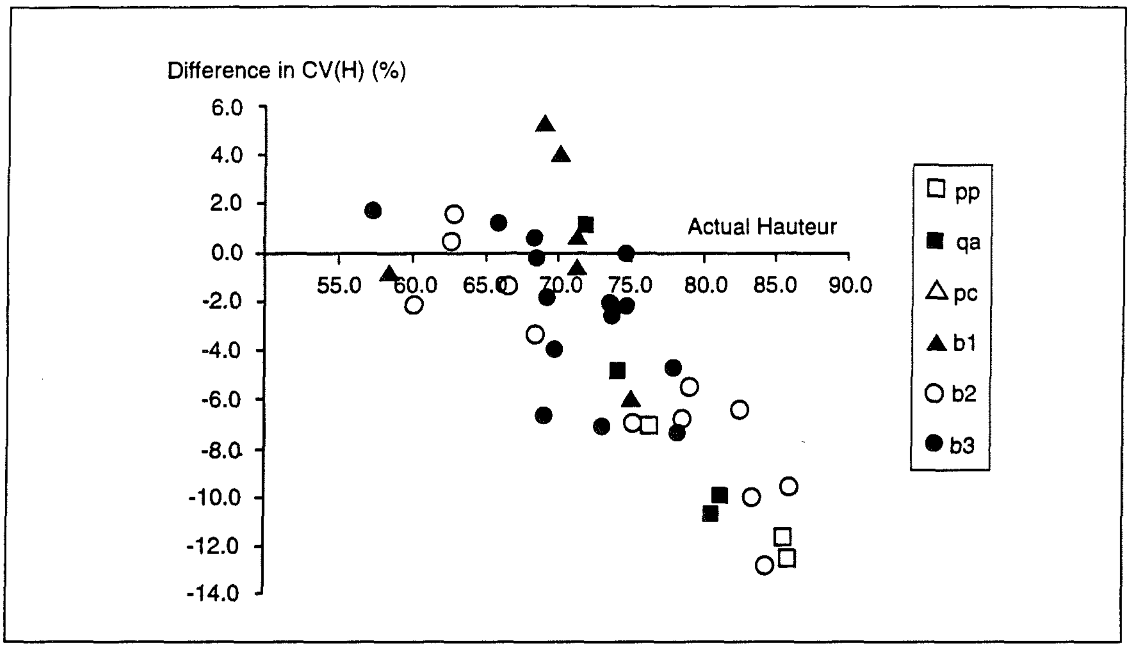

Figure 8. Differences between actual and predicted CV of Hauteur compared to actual Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=39)

positive deviations in CV(H) from predicted. The largest deviations in these directions in this data are -7.9 mm (b3c12) and +5.3% (b1c6). This Hauteur deviation appears to be an extreme observation as other consignments with similar raw wool characteristics processed in the same mill had deviations of +5.4 mm (b3c11) and -0.3 mm (b3c13).

This deviation illustrates that although the raw wool specifications appear very close, there can be significant between-consignment differences within a mill. The next largest deviation in Hauteur was -4.1 mm (b1c4) which was the consignment with the lowest staple strength of 23.3 N/ktex and the only consignment with a strength under 30 N/ktex.

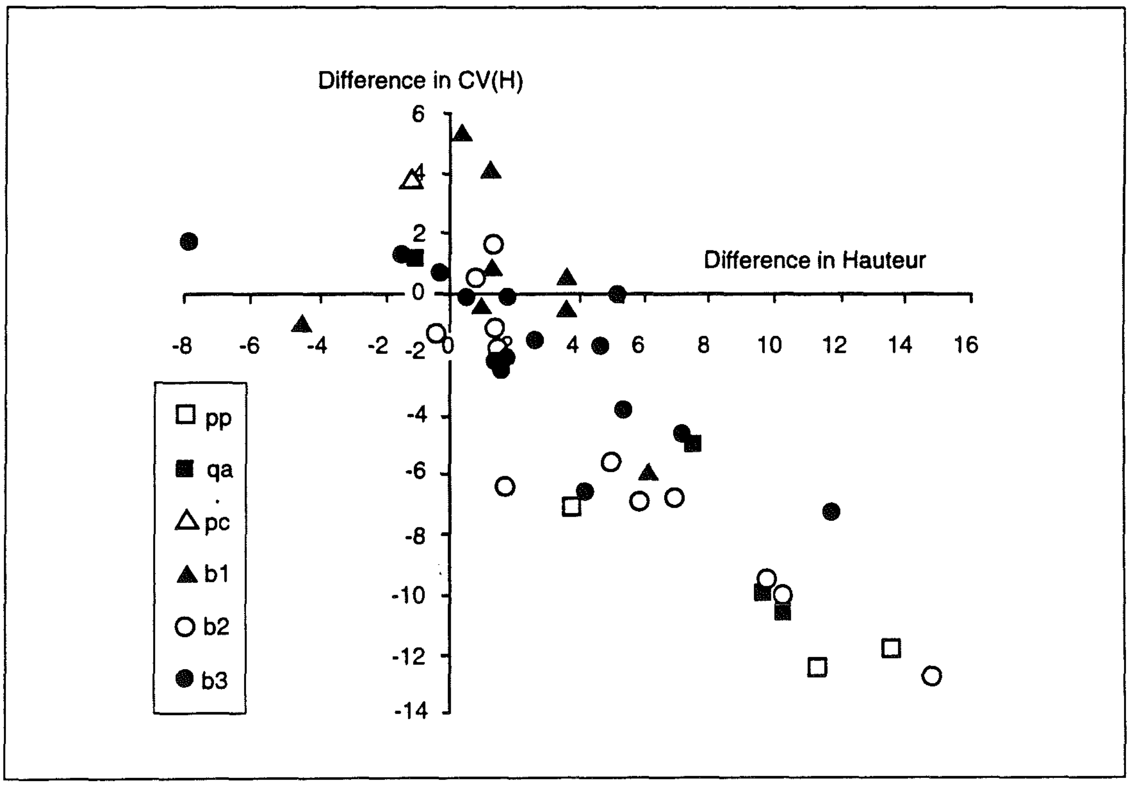

Figure 9. Differences between actual and predicted Hauteur and CV of Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=39)

4.5.5 Short fibre content

The short fibre content is becoming increasingly important in the commercial valuation of combed tops. The TEAM equations do not estimate the short fibre content, so the SiroHauteur equations were used. Due to a lack of information on the consignments, the short fibre content was only calculated and compared with the actual result on a subset of 26 consignments.

The achieved (or actual) average short fibre content was 9.1%. This can be compared with some commercial expectations for worsted spinning of less than 15%. Only five of the 31 consignments exceeded this value. The actual and predicted results are shown in Figure 10. The diagonal line represents equal actual and predicted results. While the predictions ranged from 11.2% to 22.0%, the actual results ranged from 1.5% to 19.5%.

The regression explaining actual short fibre content from the predicted short fibre content (see Appendix 1.5) had a significant slope of 1.39, but this was not significantly different from the diagonal. The intercept (where the line crosses the vertical axis) is also significantly different to zero. The prediction was also able to give only a rough indication of the ranking of the consignments. Clearly the prediction cannot quantify the level of short fibre content in the lower end of the range, and has high variance between consignments at the high levels. Further comparisons with short fibre content are therefore done with actual short fibre content and Hauteur or CV(H) and are shown in Figures 11 and 12.

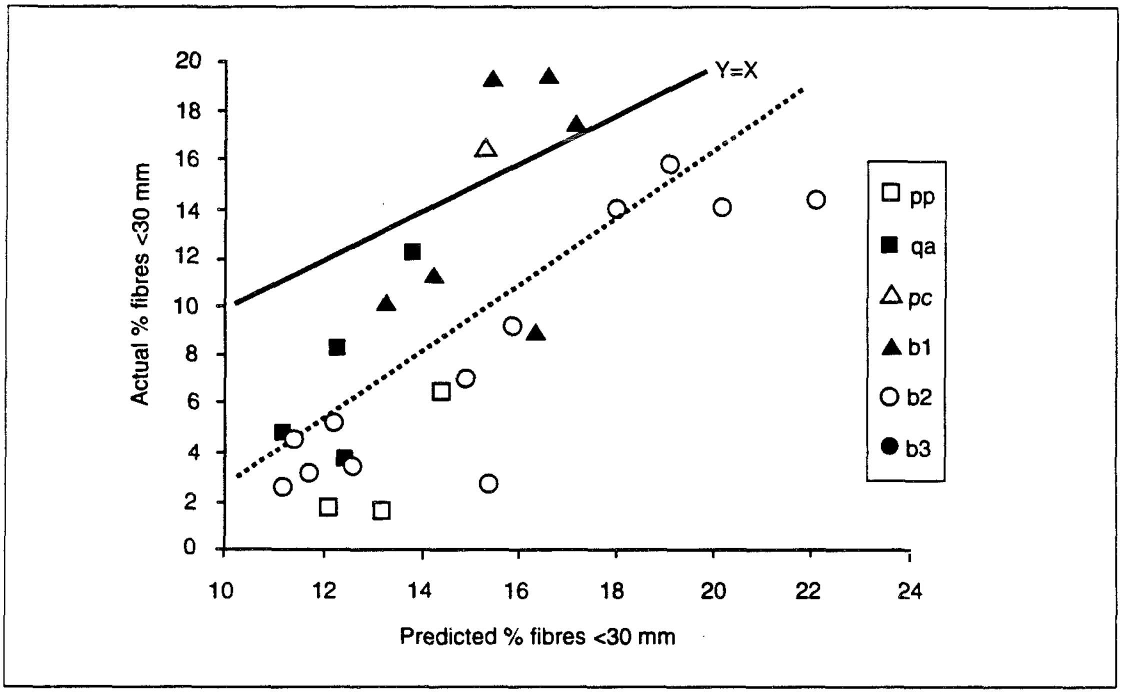

Figure 10. SiroHauteur predicted short fibre content compared to actual short fibre content for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=26). The dotted line is the regression of predicted and actual percentage of fibres less than 30 mm (adj. $R^2 = 0.460$).

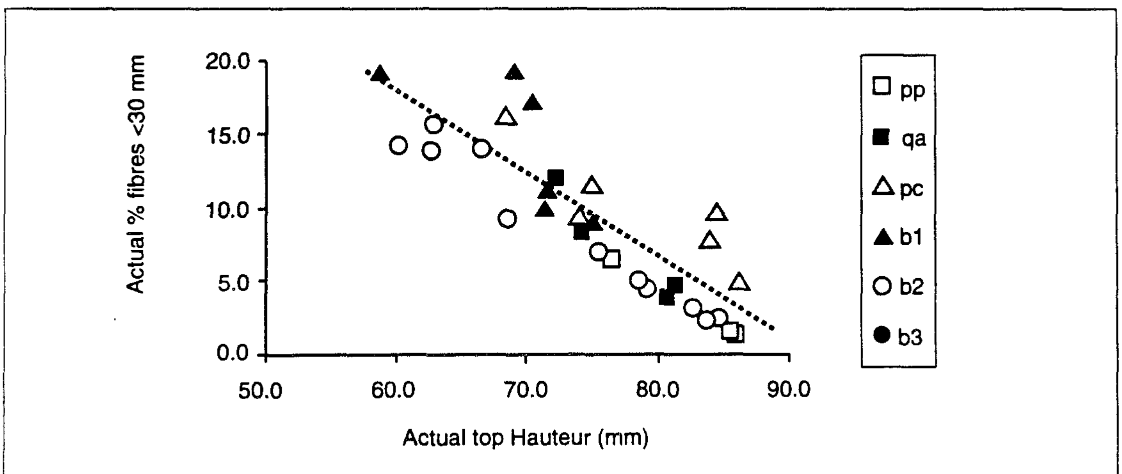

Figure 11. Actual short fibre content compared to actual Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=31). The dotted line is the regression of Hauteur and actual percentage of fibres less than 30 mm (adj. $R^2 = 0.748$).

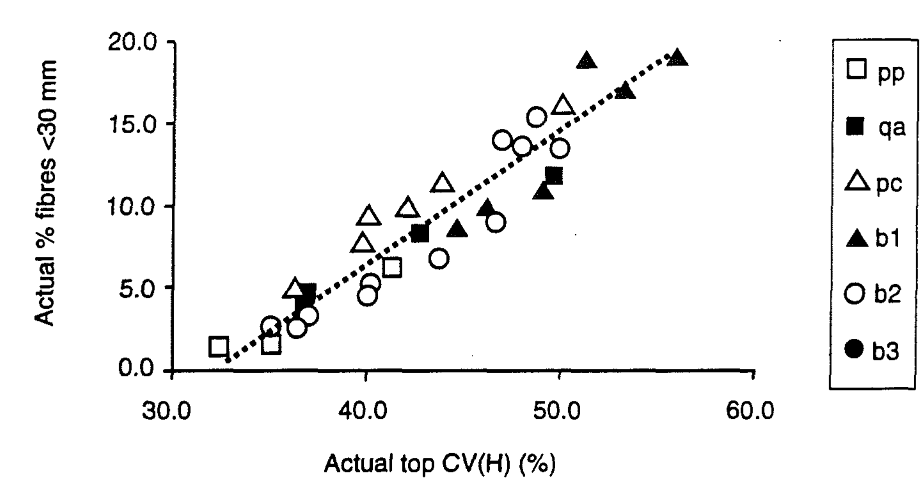

Figure 12. Actual short fibre content compared to actual CV of Hauteur for individual consignments, the symbols representing the consignment groups listed in Sections 4.1 to 4.4 (N=31). The dotted line is the regression of CV(H) and actual percentage of fibres less than 30 mm (adj. R^2 = 0.896).

The relationship between short fibre content and Hauteur (adj. R^2 = 0.748) (see Appendix 1.6) is less stable than with CV(H) (adj. R^2 = 0.896) (see Appendix 1.7) across all consignments. This suggests that CV(H) may be able to be used as a reliable predictor for short fibre content in the top.

4.5.6 Comparison of prediction systems

The prediction of Hauteur and CV(H) in the WA consignments has used the TEAM equations. However there are a number of equations available to predict the performance of processing performance of raw wool, and these need to be compared. Table 4.5.3 compares two main sets of predictive equations, TEAM and SiroHauteur, with the actual results for the WA consignments. This table includes only those consignments where both TEAM and SiroHauteur predictions were possible and the actual top results were available.

The comparison of the prediction systems needs to be on the basis of:

1. Differences between the average predicted and the average actual result which will measure bias in the estimations.
2. Differences in the predicted range of results (measured using the SD and the maximum/ minimum results) which would indicate different sensitivity of the predictions to changes in the input (or raw wool) specifications.

Table 4.5.3. Comparisons between actual processing results and TEAM and SiroHauteur predictions for WA consignments

Predicted top results		Mean	SD	max	min	N[17]
Hauteur	TEAM	69.8	4.8	81.0	58.6	26
	SiroHauteur	70.1	4.1	77.0	59.7	26
CV(H)	TEAM	47.9	2.1	52.0	42.8	26
	SiroHauteur	46.5	2.2	50.3	42.7	26
Actual top results						
Hauteur		74.3	8.4	86.2	58.4	26
CV(H)		43.5	6.5	55.8	32.5	26
Differences[18]: Actual-predicted						
Hauteur	TEAM	4.5	5.2	14.7	-4.6	26
	SiroHauteur	4.1	5.5	15.2	-8.1	26
CV(H)	TEAM	-4.3	5.4	5.3	-12.8	26
	SiroHauteur	-2.9	5.2	6.5	-12.8	26

17 The SiroHauteur equation required CV of staple length in the prediction. In some cases this result was not available.

18 The mean differences are the mean of the individual consignment differences not the differences between the overall means.

There were only 26 consignments that had both predictions and the actual processing results so any conclusions must be considered in this context. Both formulae underpredicted Hauteur, TEAM being lower but not significantly different. Both also overpredicted CV(H). However, the means of the CV(H) predictions are significantly different ($P<0.05$).

The average difference between actual and estimated Hauteur is slightly larger using the TEAM equations (4.5 mm versus 4.1 mm) but not significantly different. The differences in the ranges and SD of the prediction suggest that the SiroHauteur equations may be more conservative than TEAM and therefore less sensitive to raw wool changes. The CV(H) results show the same patterns with SiroHauteur with no significant difference between the means but SiroHauteur being less sensitive to raw wool changes.

5. Comparisons with other processing results

The results in Section 4.5 contain comparisons of the WA processing results against various prediction equations that used raw wool specifications. This section takes the actual results for the WA consignments and compares them with other actual processing results.

This has been done in two parts. Section 5.1 compares consignments using WA wool and eastern Australian wool in the same mill. The differences in the two sets of processing results are therefore due to differences between wool batches and not due to differences between mills. Section 5.2 compares the WA processing results from Section 4 with the ASMAP consignments that were assembled from across Australia and processed in a wide range of mills. Therefore the differences represent between wool and between mill differences.

5.1 Comparisons from the same mill

A series of consignments comparing WA with 'Eastern Australia' (EA) are available from the one mill. The results in Table 5.1 allow the comparison of WA raw wool with EA wool. The comparison is complicated by the WA raw wool having high staple mid breaks (75.9% and 78.5%) while the EA wool had low mid breaks (46.5% and 45.4%). The data also supports comparisons of 'WA+high POB' and 'EA+low POB' over two diameter ranges (23.7 µm and 21.5 µm).

The results were examined to see if the WA predictions were satisfactory, and to see if the actual WA Hauteur and CV(H) results were satisfactory, compared to the EA wool.

In the broad wool consignments, the predicted Hauteur differences (EA: 76.7 mm versus WA: 72.6 mm – a difference of 4.1 mm) failed to be realised in the top Hauteur (76.4 mm versus. 75.0 – a difference of 1.4 mm). This resulted from a difference between actual and predicted Hauteur in the EA consignments of -0.3 mm, compared to 2.4 mm for the WA consignments. Similarly the differences between the predicted CV(H) (45.7% versus 52.9%) were reduced in the actual result (45.7% versus 50.5%).

In contrast, in the fine wool consignments, actual results for both EA and WA deviated from prediction in the same direction and extent for Hauteur and CV(H).

Table 5.1. Results for the Western and Eastern Australia consignments

Number of consignments		5	19	8	11
Raw wool results		WA1	EA1	WA2	EA2
Diameter	µm	23.7	23.7	21.5	21.5
Vegetable matter content	%	0.5	1.0	0.7	0.9
seed and shive	%				
Staple strength	N/ktex	38.0	38.7	35.6	35.8
Staple length	mm	97.8	93.8	90.8	90.6
Position of break (MID)	%	78.5	46.5	75.9	45.4
Predicted top results					
Hauteur	mm	72.6	76.7	66.1	71.8
CV(H)	%	52.9	45.7	53.3	47.0
% fibres<30 mm	%				
Romaine	%	3.8	4.6	5.9	6.0
Actual top results		WA1	EA1	WA2	EA2
Diameter of combed top	µm				
Hauteur	mm	75.0	76.4	68.2	74.4
CV(H)	%	50.5	45.7	51.1	43.9
% fibres<30 mm	%				
Differences: Actual-predicted					
Diameter	µm				
Hauteur	mm	2.4	-0.3	2.1	2.6
CV(H)	%	-2.4	0.0	-2.2	-3.1
% fibres<30 mm	%				

Overall, the results show WA wool in two diameter categories processed longer than expected and with a lower CV(H) within the same mill. EA wool with similar specifications except for position of break processed as predicted in the broad diameter category and better than expected in the fine diameter category. The evidence suggests that WA wool is not processing below the expected result and that the effect of mid break in all predictions needs to be re-examined.

5.2 Comparisons from different mills

5.2.1 Comparing WA results with ASMAP consignments

The ASMAP dataset is a series of 340 consignments that contains both raw wool results and processing results for consignments that originated from across Australia. It was used here as a basis to compare consignment results from WA with consignments of wool from all over Australia.

The first step when making such a comparison is to check the similarity of the raw wool used in both datasets. This was done in Table 5.2.1. The raw wool and prediction averages are similar in both datasets suggesting that a valid comparison of both predicted and actual top results can be made. The differences in the average predicted Hauteur (WA: 69.4 mm versus ASMAP: 67.4 mm) are significant and due to the slightly shorter but significantly different average staple length used in the ASMAP consignments. The predicted CV(H) means (WA: 49.6% versus ASMAP: 48.6%) were also significantly different. The actual Hauteur results averaged 74.0 and 69.4 mm respectively and were significantly different. The actual Hauteur increased from prediction by 3.7 mm (WA) and 2.0 mm (ASMAP). Actual CV(H) decreased by 3.6% and 1.4% to be significantly different at 45.4% and 47.3% respectively.

The average results show the actual Hauteur and CV(H) of the WA consignments were significantly better than the ASMAP consignments. In addition, the improvement between actual and prediction of the WA consignments is significantly larger than seen in the ASMAP consignments.

The distributions of the actual top Hauteur results for the two datasets are shown in Figure 13. The Hauteur results averaged 74.0 mm (WA) and 69.4 mm (ASMAP) and were significantly different. The pattern of distribution is also different with the ASMAP set slightly skewed to lower Hauteur and the WA set slightly skewed to higher Hauteur.

Table 5.2.1. Results from average WA and ASMAP consignments

		MEAN		SD		N	
Raw wool results		WA	ASMAP	WA	ASMAP	WA	ASMAP
Diameter	µm	21.8	21.8	1.0	1.9	39	339
Vegetable matter content	%	1.1	1.7	0.6	1.3	39	339
seed and shive	%	1.1		0.5		19	
Staple strength	N/ktex	35.9	36.9	3.4	4.5	43	339
Staple length	mm	90.0	86.0	5.6	7.5	43	339
Position of break (MID)	%	55.5	58.4	19.1	8.8	43	339
Predicted top results							
Hauteur	mm	69.4	67.4	4.4	5.5	39	339
CV(H)	%	49.6	48.6	3.2	2.5	39	339
% fibres<30 mm	%	14.7		2.9		26	
Romaine	%	6.1	7.0	1.6	1.9	39	339
		MEAN		SD		N	
Actual top results		WA	ASMAP	WA	ASMAP	WA	ASMAP
Diameter of combed top	µm	21.9	22.0	1.0	2.0	31	310
Hauteur	mm	74.0	69.4	7.8	7.3	44	316
CV(H)	%	45.4	47.3	6.5	4.6	44	314
% fibres<30 mm	%	9.1	11.2	5.4	5.5	31	112
Differences: Actual-predicted							
Diameter	µm	0.1	0.0	0.2	0.2	26	309
Hauteur	mm	3.7	2.0	5.0	4.5	39	315
CV(H)	%	-3.6	-1.4	4.8	4.0	39	313
% fibres<30 mm	%	-5.6		4.3		26	

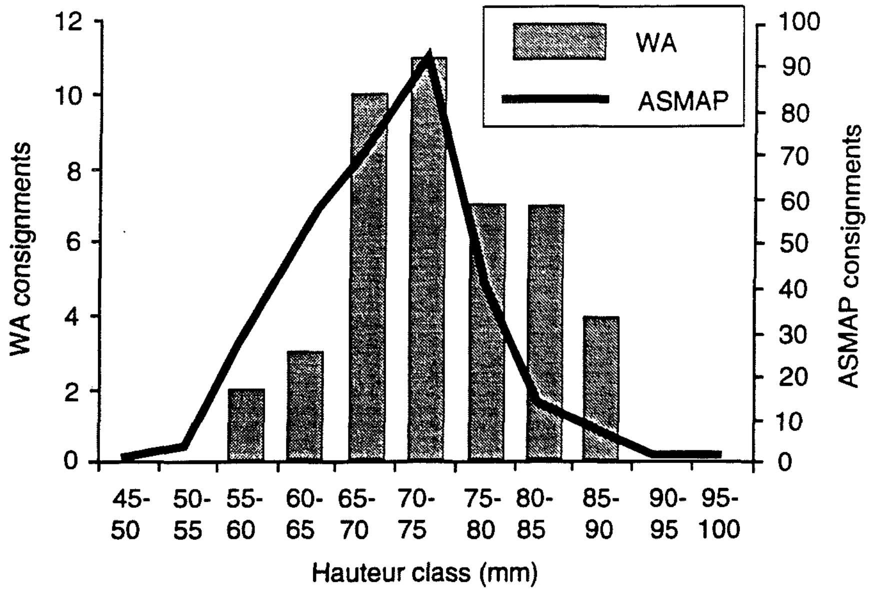

Figure 13. Frequency distributions of the Hauteur results from the WA consignments (N= 44) and the ASMAP consignments (N=316)

Comparisons can also be made by overlaying the individual results from WA and ASMAP consignments. This is done to compare the distribution of the two sets of results as a supplement to the results from Table 5.2.1.

The results for actual and predicted Hauteur are shown in Figure 14. The WA consignments are distributed on the high side of the ASMAP results, and with fewer observations in the high predicted/ low actual Hauteur region. This suggests that there were more 'bad surprises' in the ASMAP consignments than in the WA consignments. The slope of the regression line connecting the WA consignments is not different to that for the ASMAP results (see Appendices 1.3 and 1.8).

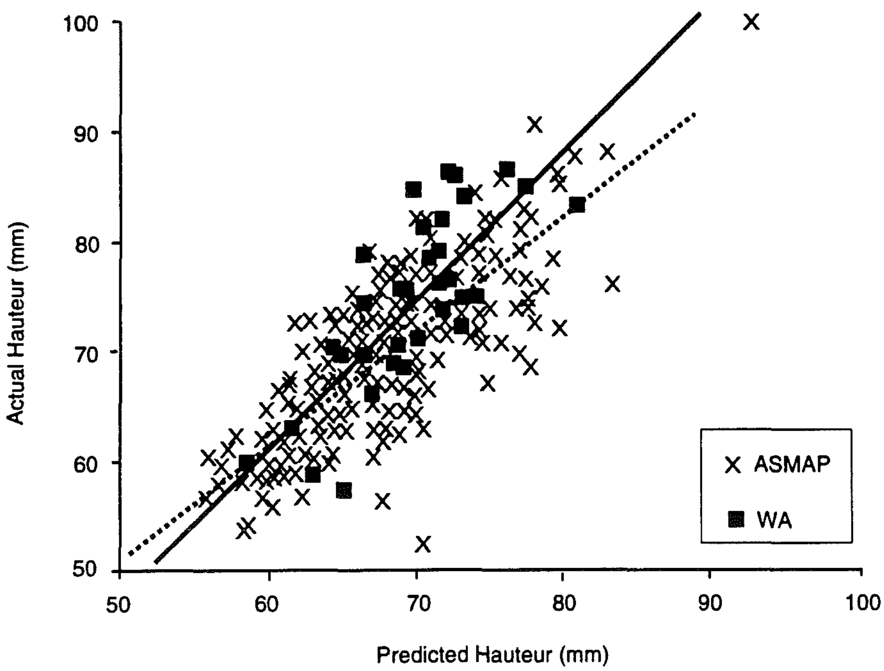

Figure 14. TEAM predicted Hauteur compared to actual Hauteur for individual consignments, the symbols representing the WA (N=39) and ASMAP (N=315) results. The lines represent the regression equations from the WA (adj. R^2 = 0.598) and ASMAP (adj. R^2 = 0.629) results.

Figure 15 shows a similar plot for the actual and predicted CV(H) from the WA consignments and the ASMAP consignments. The two distributions appear similar in their distribution. The regressions explaining the actual CV(H) from the predicted CV(H) are shown (see Appendices 1.4 and 1.9). The low R^2 value for the ASMAP makes comparison of the regression lines uncertain. Therefore there is no evidence to expect that the actual CV(H) of WA consignments should be above the range of consignments originating from elsewhere in Australia. However the existence of three actual CV(H) results in the WA consignments of about 35% was neither predicted nor are they comparable to consignments in the ASMAP distribution.

The deviations from both predicted Hauteur and CV(H) are plotted in Figure 15 for the WA and the ASMAP consignments. This was done to examine the effect of combining Hauteur and CV(H) in the description of the individual consignments from the two datasets. The plot should expose unexpected deviations from prediction by individual consignments which is a criticism often levelled at WA wool.

The WA consignments appear to be displaced in a favourable direction – that is to the positive Hauteur and negative CV(H) quadrant. Indeed the highest deviations in this direction come from the WA consignments. Furthermore, no WA consignments exist at the extremes in the opposite quadrant. There are only two WA consignments that have negative deviations in Hauteur greater than 4 mm. The rest of the WA consignments are either about zero or have positive deviations up to 15 mm. The ASMAP consignments are more uniformly distributed about the zero deviations.

The results in Figure 16 would suggest that some WA consignments have different processing properties to those observed in the ASMAP consignments, and/or the prediction systems need to be revised to removed the differences in the distributions of the ASMAP and WA consignments.

5.2.2 ASMAP consignments which contain WA sale lots

Some of the ASMAP consignments contain sale lots from WA. The WA content ranges from 0 – 100% (by greasy weight).

If WA wool has an overall poor processing performance, then its presence in Australian consignments would depress the consignment Hauteur, and the depression would increase as the

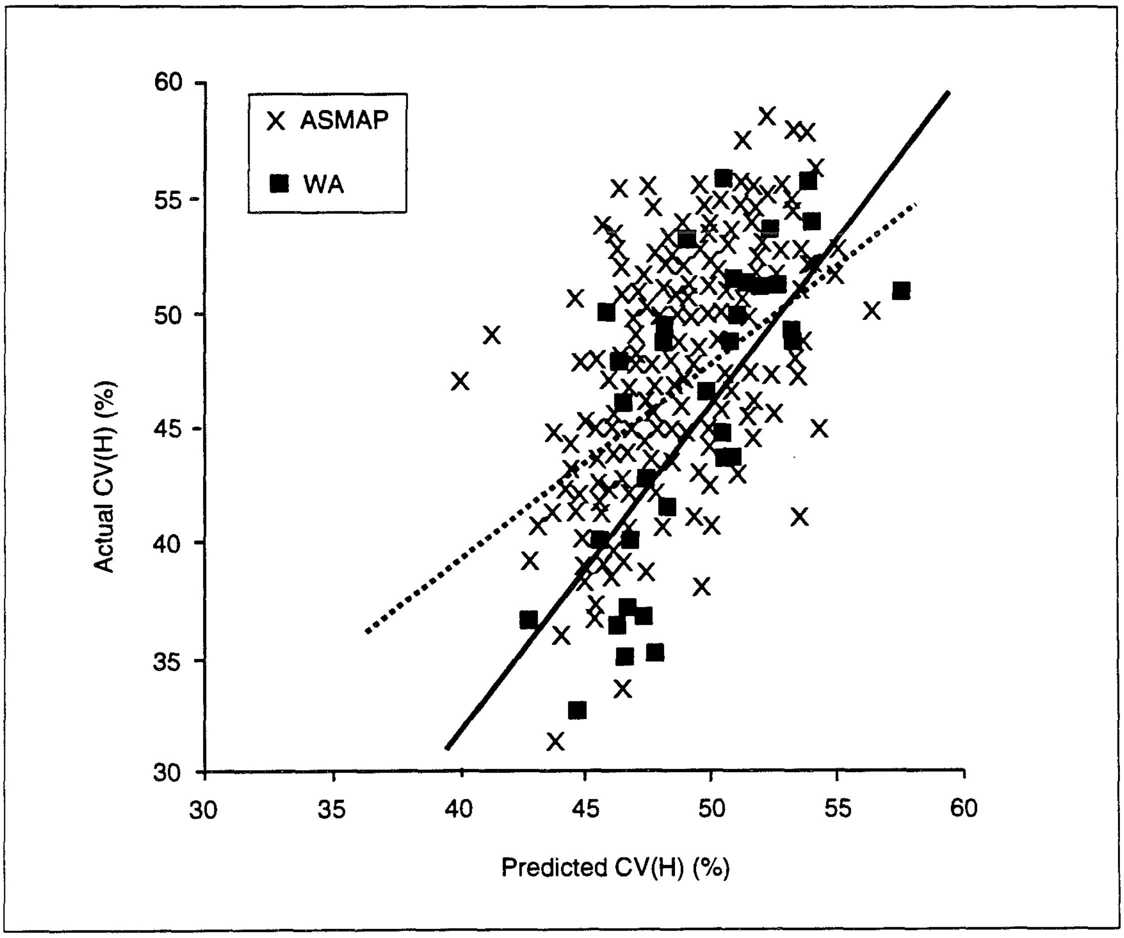

Figure 15. TEAM predicted coefficient of variation of Hauteur (CV(H)) compared to actual CV(H) for individual consignments, the symbols representing the WA (N=39) and ASMAP (N=313) results. The lines represent the regression equations from the WA (adj. R^2 = 0.497) and ASMAP (adj. R^2 = 0.244) results.

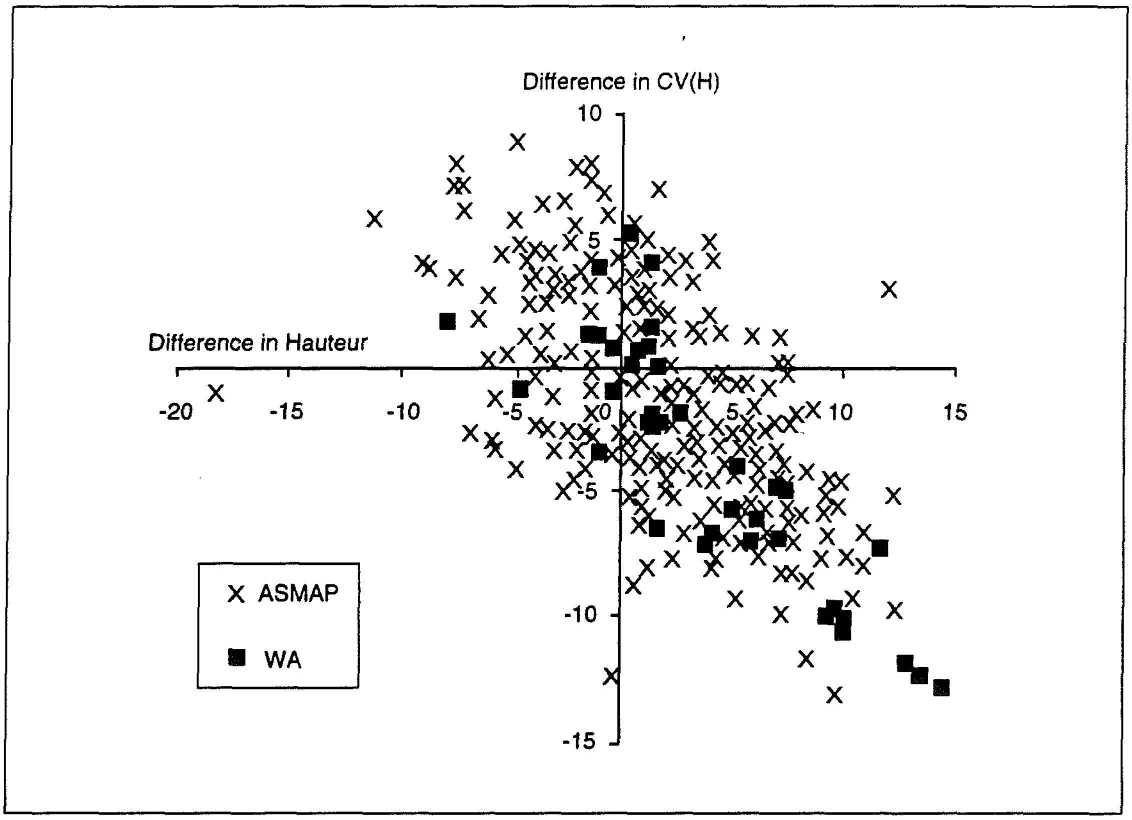

Figure 16. Differences between actual and predicted Hauteur and CV(H) for individual consignments, the symbols representing the WA (N=39) and ASMAP (N=313) results. The correlation coefficients are -0.86 for WA, and -0.58 for ASMAP.

percentage of WA in the consignment increased. Alternatively, if the WA wool contributed to the unpredictability of the consignment, then the differences between the actual and predicted Hauteur would increase as the proportion of WA wool increased.

Figure 17 shows the Hauteur for the ASMAP consignments plotted against the proportion of WA wool in the consignment. The points on the vertical axis are ASMAP consignments that have no WA wool content. They have been included to give an indication of the range of results amongst the consignments that contain no WA wool.

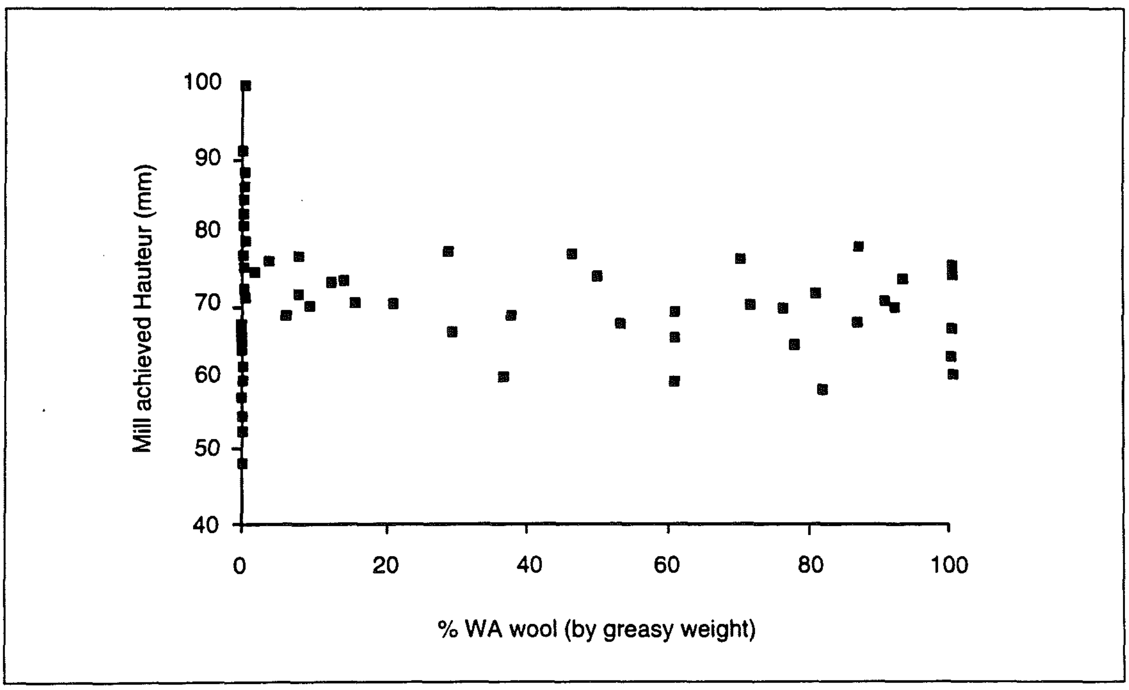

Figure 17. Mill achieved Hauteur for ASMAP consignments with varying WA content. The regression of Hauteur and the proportion of WA wool was not significant (F=2.219, adj. R^2 = 0.058).

The regression of Hauteur and the proportion of WA wool was not significant, and the slope was not significant from zero (see Appendix 1.10). Therefore the results show no evidence of a depression in Hauteur as the proportion of WA wool increases. Therefore there is no support for the perception that WA wool process shorter than wool from the rest of Australia, either because of the specification of the consignment or because of the actual outcome.

The range (or variance) between the points at any given proportion of WA wool also appears unchanged as the proportion changes from 20 to 100%. Therefore it is concluded that there is no evidence in this data (accepting that there are only 38 consignments identified with WA wool) that the variance of the Hauteur result increases as the proportion of WA wool increases, as would be expected if the presence of WA wool would make the actual result uncertain.

The results in Figure 17 do not take into account differences in the construction of the consignments that make up the ASMAP dataset. The 'unpredictable' nature of WA wool can be tested by plotting the differences between actual and predicted Hauteur against the proportion of WA wool in the consignment. Figure 18 shows the average of the points is above the zero difference axis (+2.7 mm), and that the difference is maintained for all proportions of WA wool. The regression of the difference in Hauteur against the proportion of WA wool approached significance (P=0.055) and the slope was not significantly different from zero (see Appendix 1.11). Therefore the proportion of the WA wool is not related to the extent of the deviation between actual and predicted Hauteur in the ASMAP dataset.

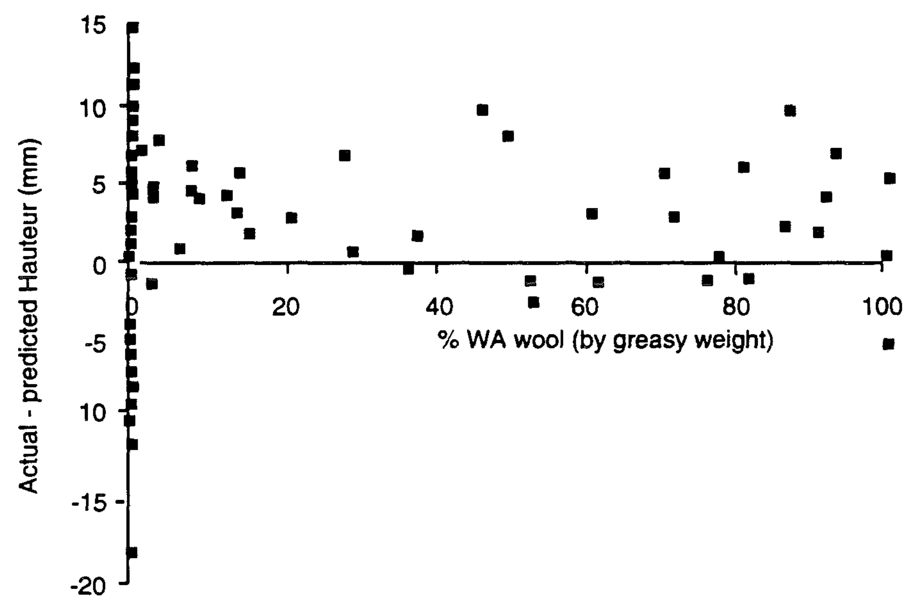

Figure 18. Difference between actual and predicted Hauteur for ASMAP consignments with varying WA content (N=38). The regression of the difference and the proportion of WA wool was not significant (F=3.95, adj. R^2 = 0.074).

6. Discussion

Previous analyses of the raw wool characteristics of the Western Australian clip have not been able to identify differences in the measured characteristics that would explain the perceived poor processing qualities of WA wool. However these analyses did not exclude the possibility that:

1. One or more non-measured characteristics of the WA raw wool are causing difficulties in the early stage processing of WA wool through scouring, carding and combing.
2. The process of assembling the WA sale lots into consignments is causing difficulties in processing these WA consignments.

This study involved the collection of information from the processing of 44 WA consignments over the period 1991 to 1995 and comparison of these results with other processing results of Australian consignments.

The options that this study allows to be considered are:

a) all WA wool processes short or shorter than expected

b) WA wool processes unpredictably – that is, differently from consignment to consignment.

The concept that all WA wool processes poorly assumes that the WA raw wool clip is suspect because of differences in the known characteristics or in an unknown or unmeasured characteristic. Previous analyses of the measured raw wool characteristics of the Western Australian clip have not been able to identify important differences in known characteristics. The effect of unknown or unmeasured characteristic could be to reduce the average Hauteur of the WA consignments below industry benchmarks, or to reduce the average Hauteur to below the predicted Hauteur based on the raw wool measurements.

The results show that the average of the 44 WA consignments was 74.0 mm (at 21.9 μm), compared to the ASMAP result of 69.4 mm (at 22.0 μm). The actual WA results were in excess of prediction by, on average, +3.7 mm compared to the ASMAP results of +2.0 mm. This suggests that the WA wool is not a poor processing wool at the average and, in fact, processes above expectation. The fact that 79% of the WA Hauteur results were above the average indicates that most of these WA consignments processed well.

The second option addresses the question of whether the processing performances are uniform across the consignments. As there is a need to remove the between consignment differences, the SD of the differences between actual and predicted Hauteur and CV(H) were used. The SD of the Hauteur differences (5.0 mm and 4.5 mm) and CV(H) differences (4.8% and 4.0%) are not significantly different. Therefore there are no differences evident between the WA and ASMAP datasets in terms of the predictability of these results.

Significant differences exist in the WA and ASMAP datasets in the deviations from prediction of Hauteur (+3.7 mm versus +2.0 mm). These differences could be due to:

(a) The TEAM equation was released in 1988 and since then mills have been learning how to interpret and use these predictions to assemble consignments to meet top specifications. As the ASMAP consignments were assembled in 1989 to 1991 and the WA consignments were assembled in 1991 to 1995 it is reasonable to expect that mills could do better in the later set through better use of the TEAM equations.

(b) The techniques and technology of wool processing have advanced between when the ASMAP and WA results were received.

Between mill differences were not taken into account in either the WA or the ASMAP datasets. The fact that the above results are not mill specific allows the results to be generalised across all mills with a reasonable degree of confidence.

However, because the mill differences were not taken into account, there is a possibility that there are some differences in the data that were masked by this increased variance.

There are routine positive deviations of the actual Hauteur result from the predicted result that need to be addressed. This could be done by re-examining the prediction equations and by including the between mill variances in the predictions.

Addressing these problems will improve the identification of non-performing consignments, and improve the specification of the WA raw wool component of all consignments.

7. Further work

These analyses were based on processing results collected from commercial groups. The collection of processing results needs to continue to improve the accuracy of the analyses, and of the comparisons.

There is also a need to improve the understanding of the processing effects caused by seasonal changes in the raw wool specifications. These changes do not necessarily occur in other regions of Australia. These seasonal effects on the prediction equations need to be examined especially when comparisons between WA and the rest of Australia are made.

The difference in the slopes between predicted and actual Hauteur and CV(H) in the WA and ASMAP consignments also needs to be examined. There are actually two different problems. The slopes differ from a value of 1. This indicates there is a need to review the prediction equations and/or take into account mill effects on the slope, although the mill effect to date is usually addressed in the TEAM formula as an intercept adjustment. The slopes for WA and ASMAP are also different from each other. This indicates a need to examine the differences between the two groups.

It is also necessary to address the unexplained variances (the scatter about the prediction line) between actual and predicted Hauteur and CV(H) results. There will be a limit on the improvement in accuracy of these predictions while the between mill differences are ignored. This will need to be addressed by working on within-mill differences between consignments.

The subset of high deviation WA consignments needs to be explained. These Hauteur results were so far from prediction that the combed top had to be transferred from weaving yarns to knitting yarns with associated cost penalties. Therefore a method needs to be established to identify these types of consignments, and procedures put in place to understand the raw wool characteristics and/or the processing technology that cause these deviations. Again, part of the solution will require reviewing the processing prediction equations.

Other areas of potential concern about WA consignments processed to combed tops also need to be addressed. These include colour, high VM specs, high residual ash and low top yields, which together with unreliable fibre length predictions, may have contributed to the perception of 'poor processing' WA wool.

APPENDIX 1

Results of regression analyses

1.1. WA : Actual diameter = Predicted diameter

Dependent Variable : Actual Diameter

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	16.95	16.95	511.04	0.0001
Error	24	0.80	0.03		
C Total	25	17.75			

Root MSE	0.18	R-square	0.9551
Dep Mean	21.69	Adj R-sq	0.9533
C.V.	0.84		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	1.64	0.89	1.85	0.0766
Predicted Diameter	1	0.93	0.04	22.61	0.0001

1.2. WA : Actual-predicted diameter = Actual Hauteur

Dependent Variable : Actual-predicted Diameter

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.06	0.06	1.86	0.1848
Error	24	0.83	0.03		
C Total	25	0.89			

Root MSE	0.19	R-square	0.0721
Dep Mean	0.11	Adj R-sq	0.0334
C.V.	164.32		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	0.56	0.33	1.70	0.1026
Actual Hauteur	1	-0.01	0.00	-1.36	0.1848

1.3. WA : Actual Hauteur = Predicted Hauteur

Dependent Variable : Actual Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1355.72	1355.72	57.42	0.0001
Error	37	873.56	23.61		
C Total	39	2229.28			

Root MSE	4.86	R-square	0.6081
Dep Mean	73.13	Adj R-sq	0.5976
C.V.	6.64		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-20.99	12.44	-1.69	0.1001
Predicted Hauteur	1	1.36	0.18	7.58	0.0001

1.4. WA : Actual CV(H) = Predicted CV(H)

Dependent Variable : Actual CV(H)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	829.35	829.35	38.55	0.0001
Error	37	795.99	21.51		
C Total	38	1625.34			

Root MSE	4.64	R-square	0.5103
Dep Mean	46.00	Adj R-sq	0.4970
C.V.	10.08		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-26.47	11.70	-2.26	0.0296
Predicted CV(H)	1	1.46	0.24	6.21	0.0001

1.5. WA : Actual short fibre content = Predicted short fibre content

Dependent Variable : Actual short fibre content

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	402.09	402.09	22.35	0.001
Error	24	431.76	17.99		
C Total	25	833.85			

Root MSE	4.24	R-square	0.4822
Dep Mean	9.14	Adj R-sq	0.4606
C.V.	46.39		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-11.41	4.43	-2.58	0.0165
Predicted short fibre content	1	1.40	0.30	4.73	0.0001

1.6. WA : Actual short fibre content = Actual Hauteur

Dependent Variable : Actual short fibre content

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	643.22	643.22	86.27	0.0001
Error	29	216.21	7.46		
C Total	30	859.44			

Root MSE	2.73	R-square	0.7484
Dep Mean	9.09	Adj R-sq	0.7397
C.V.	30.04		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	51.31	4.57	11.22	0.0001
Actual Hauteur	1	-0.56	0.06	-9.29	0.0001

1.7. WA : Actual short fibre content = Actual CV(H)

Dependent Variable : Actual short fibre content

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	770.07	770.07	249.91	0.0001
Error	29	89.36	3.08		
C Total	30	859.44			

Root MSE	1.76	R-square	0.8960
Dep Mean	9.09	Adj R-sq	0.8924
C.V.	19.31		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-26.49	2.27	-11.66	0.0001
Actual CV(H)	1	0.83	0.05	15.81	0.0001

1.8. ASMAP : Actual Hauteur = Predicted Hauteur

Dependent Variable : Actual Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	10592.14	10592.14	533.58	0.0001
Error	313	6213.40	19.85		
C Total	314	16805.54			

Root MSE	4.46	R-square	0.6303
Dep Mean	69.39	Adj R-sq	0.6291
C.V.	6.42		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	0.82	2.98	0.27	0.7836
Predicted Hauteur	1	1.02	0.04	23.10	0.0001

1.9. ASMAP : Actual CV(H) = Predicted CV(H)

Dependent Variable : Actual CV(H)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1609.91	1609.91	101.91	0.0001
Error	311	4913.01	15.80		
C Total	312	6522.92			

Root MSE	3.97	R-square	0.2468
Dep Mean	47.31	Adj R-sq	0.2444
C.V.	8.40		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	3.61	4.33	0.83	0.4055
Predicted CV(H)	1	0.90	0.09	10.09	0.0001

1.10. ASMAP : Actual Hauteur = % WA wool (by greasy weight)

Dependent Variable : Actual Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	58.20	58.20	2.22	0.1450
Error	36	944.16	26.23		
C Total	37	1002.36			

Root MSE	5.12	R-square	0.0581
Dep Mean	69.64	Adj R-sq	0.0319
C.V.	7.35		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	71.59	1.55	46.05	0.0001
% WA wool	1	-0.04	0.02	-1.49	0.1450

1.11. ASMAP : Actual-predicted Hauteur = %WA wool (by greasy weight)

Dependent Variable : Actual-predicted Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	46.86	46.86	3.95	0.0545
Error	36	426.86	11.86		
C Total	37	473.72			

Root MSE	3.44	R-square	0.0989
Dep Mean	2.77	Adj R-sq	0.0739
C.V.	124.38		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	4.52	1.05	4.33	0.0001
% WA wool	1	-0.03	0.02	-1.99	0.0545

1.12. WA : Actual Hauteur = Predicted diameter

Dependent Variable : Actual Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	569.03	569.03	12.68	0.0010
Error	37	1660.25	44.87		
C Total	38	2229.28			

Root MSE	6.70	R-square	
Dep Mean	73.13	Adj R-sq	0.2553
C.V.	9.16		0.2351

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-9.94	23.35	-0.43	0.6729
Predicted diameter	1	3.80	1.07	3.56	0.0010

1.13. ASMAP : Actual Haùteur = Predicted diameter

Dependent Variable : Actual Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1230.26	1230.26	24.72	0.0001
Error	313	15575.28	49.76		
C Total	314	16805.54			

Root MSE	7.05	R-square	0.0732
Dep Mean	69.39	Adj R-sq	0.0702
C.V.	10.17		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob> I T I
Intercept	1	47.23	4.47	10.55	0.0001
Predicted diameter	1	1.01	0.20	4.97	0.0001

1.14. WA : Actual CV(H) = Predicted diameter

Dependent Variable : Actual CV(H)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	55.62	55.62	1.31	0.2596
Error	37	1569.72	42.42		
C Total	38	1625.34			

Root MSE	6.51	R-square	0.0342
Dep Mean	46.00	Adj R-sq	0.0081
C.V.	14.16		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob> I T I
Intercept	1	71.97	22.71	3.17	0.0031
Predicted diameter	1	-1.19	1.04	-1.14	0.2596

1.15. ASMAP : Actual CV(H) = Predicted diameter

Dependent Variable : Actual CV(H)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	593.68	593.68	31.14	0.0001
Error	311	5929.24	19.07		
C Total	312	6522.92			

Root MSE	4.37	R-square	0.910
Dep Mean	47.31	Adj R-sq	0.0881
C.V.	9.23		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	31.92	2.77	11.52	0.0001
Predicted diameter	1	0.70	0.13	5.58	0.0001

1.16. WA : Actual-predicted Hauteur = Predicted diameter

Dependent Variable : Actual-predicted Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	54.85	54.85	2.22	0.1443
Error	37	912.06	24.65		
C Total	38	966.91			

Root MSE	4.96	R-square	0.0567
Dep Mean	3.71	Adj R-sq	0.0312
C.V.	133.94		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-22.08	17.31	-1.28	0.2099
Predicted diameter	1	1.18	0.79	1.49	0.1443

1.17. ASMAP : Actual-predicted Hauteur = Predicted diameter

Dependent Variable : Actual-predicted Hauteur

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	402.26	402.26	21.63	0.0001
Error	313	5820.15	18.59		
C Total	314	6222.41			

Root MSE	4.31	R-square	0.0646
Dep Mean	1.98	Adj R-sq	0.0617
C.V.	217.30		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	14.66	2.74	5.36	0.0001
Predicted diameter	1	-0.58	0.12	-4.65	0.0001

1.18. WA : Actual-predicted CV(H) = Predicted diameter

Dependent Variable : Actual-predicted CV(H)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	92.40	92.40	4.35	0.0440
Error	37	786.20	21.25		
C Total	38	878.60			

Root MSE	4.61	R-square	0.1052
Dep Mean	-3.60	Adj R-sq	0.0810
C.V.	-127.99		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	29.87	16.07	1.86	0.0710
Predicted Hauteur	1	-1.53	0.73	-2.08	0.0440

1.19. ASMAP : Actual-predicted CV(H) = Predicted diameter

Dependent Variable : Actual-predicted CV(H)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	570.18	570.18	40.52	0.0001
Error	311	4375.99	14.07		
C Total	312	4946.17			

Root MSE	3.75	R-square	0.1153
Dep Mean	-1.37	Adj R-sq	0.1124
C.V.	-273.04		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|
Intercept	1	-16.46	2.38	-6.92	0.0001
Predicted Hauteur	1	0.69	0.11	6.37	0.0001