NSW In-shed Sampling Trials - Summary Report

Peter Sommerville- 30 December, 1997

Prepared for the In-shed Sampling Sub-Committee.

Chairman:	Charles Armstrong
Secretary:	Ben Russell
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SUMMARY

In October 1995 Wool Council resolved: ***"That Wool Council of Australia request IWS to examine all options to develop a credible on-farm wool specifications test to assist in developing marketing alternatives"***. This report describes the outcomes of an investigation, conducted in NSW , which was initiated as a result of this resolution.

The outcomes of this investigation may be summarised as follows:

- The cost of a Certification Service, based on sampling lots stored on the Wool Grower's property, and incorporating Test House sampling supervision, or supervision by an accredited sampler, would be very similar to, if not more than, the costs associated with the current auction selling system. However, the testing costs of a system where the Grower was responsible for the sampling, and the Test House analysis is provided as a Report, is unlikely to be substantially different from the costs of the Guidance Report service that currently exists.
- A trial has been conducted to evaluate the feasibility of sampling on-farm and obtaining samples that, when tested according to the full IWTO test procedures, provided results equivalent to the results obtained by the existing Certification system. The test documents produced via this system have been titled "In-shed Reports".
- The major difficulty of sampling on farm is obtaining a suitable sample from each classed lot for the determination of Mean Staple Length, Coefficient of Variation in Staple Length, Mean Staple Strength and Position of Break.
- A sampling system has been evaluated for obtaining such a sample during shearing.
- This system produced a sample where, on average, the Mean Staple Length is longer and the Coefficient of Variation in Staple Length is lower than for samples obtained using the grab sampling technique employed for Certification. However, the bias in Length was only 2-3 mm and the bias in Coefficient of Variation was only 2-3 %
- This bias was present in the fleece wool component of the trial. There was insufficient Skirting Wool to determine whether the bias was present in this component as well.
- The range of wool types incorporated in the trial generally encompassed the range of wool types produced in NSW. However, the total number of lots involved was relatively small, and therefore the results must be treated with some caution. For example, there were few tender lots in the trial.
- The specified sampling system for staple measurement was found to be manageable. However, the participating Growers expressed a preference for an alternative system, involving sampling the wools as they were being pressed.
- A serious error in weighing bales on the farm occurred in one case. In this instance the bales were weighed in a wool press. Where bales were weighed on cattle scales or the equivalent, there was a high correspondence between these weights and the weights recorded when the lots were subsequently certified.
- Other than for the parameters specifically cited above, there was no evidence of systematic bias between the In-shed Reports and the Certificates on the same lots. For the remaining parameters the two systems produced results which were statistically equivalent.
- It is envisaged that Wool Growers who chose to market their wool on the basis of test data provided as In-shed Reports, will provide a vendor guarantee, specifying that they followed a defined set of procedures in sampling the lots. Wool Growers will accept primary responsibility for any subsequent claims and disputes.

BACKGROUND

There has been a demand from the Wool Grower organisations for Certification Services for grower lots to be extended to lots where the sampling is conducted on-farm, rather than at a registered sampling site in a Wool Broker or a Private Treaty Merchant store. Growers have expressed the belief that this would reduce their selling costs by enabling them to trade directly with the buyers and processors of greasy wool, or by increasing their flexibility to utilise alternative marketing systems.

In October 1995 Wool Council resolved: ***"That Wool Council of Australia request IWS to examine all options to develop a credible on-farm wool specifications test to assist in developing marketing alternatives"***. In June 1996, NSW Farmers Association convened a meeting broadly representative of the industry to consider the issue further. As a consequence a Working Group was established to further progress this issue[1].

The Working Group held its initial meetings on September 17 and October 23, 1996. Although the terms of the Wool Council resolution did not explicitly require a Certification service, as it is currently understood, the Group agreed that the initial evaluation would proceed on this basis, because of the credibility issues involved. The objectives of the Group then became:

- to define the necessary requirements for a service that would provide Certification for farm lots sampled on-farm

- to evaluate the cost of delivering such a service.

A constraint that was placed on such a service was that it must have the same technical and commercial integrity as the existing Certification Service.

EVALUATION OF A CERTIFICATION SERVICE BASED ON SAMPLING ON FARM

Sampling Requirements

The major Test House in Australia, AWTA Ltd, has a long established policy, of only Certifying tests where the sample has been obtained under AWTA Ltd supervision. The principle involved in this policy is the maintenance of the technical integrity of the Certificate, and it is the principal basis of the guarantees that AWTA Ltd, as a commercial Test House, provides for its Certificates. Because of this guarantee, and because of the integrity of this system, Australian wool is now traded world wide using IWTO (International Wool Textile Organisation) Test Certificates as a final basis for the objective specifications included in the contracts of sale. The Australian National Committee of IWTO has also adopted this policy as a basic requirement for the issuing of IWTO Test Certificates by any Test Houses operating in Australia.

Under the current IWTO regulations the requirement for Test House Supervision of sampling is a matter for the IWTO National Committee in the producer country. Not all countries demand that the Test House supervise the sampling of farm lots or consignments. Wool is traded in New Zealand on Certificates issued by Test Houses where the Test House has not provided sampling supervision. In recent years however there has been a trend in New Zealand towards Test House supervision by the major Wool Selling Broker. The South African practice is similar to the Australia's except for the fact that in South Africa the Test House also owns and operates the sampling equipment.

From the grower perspective the requirement for supervised sampling may be seen as an unnecessary constraint. From a buyer perspective, within Australia, it has always been seen to be a essential requirement to ensure the integrity of the Certificates. From AWTA Ltd's perspective it is an essential requirement of its Certification Services. The working group considered a number of options to resolve

[1] The members of the Working Group were:

Ben Russell :	NSW Farmers Association
Hugh Hopkins :	(then Wesfarmers Dalgety)
Peter Sommerville:	AWTA Ltd

this conflict, but finally resolved to put the issue to one side, and to concentrate on evaluating the potential costs, assuming Test House supervision or supervision by accredited samplers.

The essential requirements that were agreed are defined in the relevant IWTO Regulations and IWTO Specifications:

- Core and grab samples must be obtained as per the relevant IWTO Regulations i.e.
  - ⇒ the specified sampling schedule must be defined by the Test House in accordance with the IWTO regulations;
  - ⇒ the sampler must not be a principal (or an employee of the principal) in the subsequent sale transaction;
  - ⇒ the registration, or accreditation of the sampler must be reviewed regularly;
- The bale weights and bale markings of all individual bales within the lots must be recorded at the time of sampling;
- Bale weights must be measured on certified scales, and the scales must be checked by the sampler prior to weighing;
- The date, time and location of sampling must be recorded, together with the signature of the sampler; and
- The sample integrity must be ensured by appropriate packaging and identification.

Furthermore the Working Group agreed that the integrity of the bales must be ensured by the application of a security seal, once sampling is completed. It was also agreed that in order to satisfy AWEX requirements for auction sale. sampling site registration must also be obtained.

Guarantees

Within the existing Wool Selling System the buyer of the wool guarantees the performance of a consignment to the processor. The prediction of performance is based on the buyer's subjective evaluation of the component lots, coupled with the objective data provided by the Test House. The objective data is guaranteed by the Test House. For a Certification Service based on lots sampled on-farm it is to be expected that these guarantees would be maintained. From a buyer perspective the integrity that is part of the existing system must be maintained. From the Test House's perspective any guarantee of the objective data is contingent upon the Test House supervising the sampling operations.

Evaluation of costs.

Only two models were identified that would meet these requirements :

- sampling would be provided by mobile core lines traveling on-farm involving
  - ⇒ machine coring and machine grabbing of bales; or
  - ⇒ manual coring and machine grabbing of bales;
- sampling would be provided by mobile core lines traveling to regional stores leased by grower co-operative groups, involving
  - ⇒ machine coring and machine grabbing of bales; or
  - ⇒ manual coring and machine grabbing of bales;

Preliminary estimates, based on the first option, indicated an average cost of between $20-$30 per bale. This cost assumed machine coring and grabbing. The manual coring option reduced the capital cost, but the estimate still ranged from $15-$25 per bale. The model is very sensitive to costs associated with traveling from property to property, and the labour cost. The model assumed a sampling line productivity half that achieved in Regional NSW Wool Broking stores. On average this is approximately 25 bales per hour. Consequently the model assumed 12 bales per hour. Clearly this is a figure that could be improved. However, inevitably this would require major improvements in on-farm storage and handling facilities.

There were differences among the working group members about the accuracy of these estimates. There was a view that they were conservative, because they did not take into account downtime associated with access restrictions during wet weather, and delays arising from a range of other factors, including machinery breakdown, shearing delays, seasonal conditions etc. However in that they were remarkably similar to the range of charges used by the Wool Selling Brokers in NSW, it was agreed that the estimates did show that the model would not yield significant savings, unless there were consequent cost reductions downstream. The model also did not take into account all the delivery costs that would be incurred by the grower in delivering any wool to the final buyer, particularly if this delivery was to be effected within the constraints of the existing system i.e. 48 hours of receipt of the shipping documents..

The model also did not take into account increased costs in the testing operation itself. The proposed system would result in samples arriving into the Test House from a much greater number of individual customers, and probably not in an electronic form. The reference data for each lot would have to be manually keyed and the final results would also have to be returned to the individual customers as individual documents prior to sale. Such a system would erode the cost savings currently achieved by the existing system of centralised storage in Wool Broker stores, which allows the exchange of data in bulk in an electronic form, requiring a relatively small number of transmissions. The direct client base would also be substantially increased, increasing accounting and administration costs.

The second model was not costed in detail, because it requires growers to initiate co-operative arrangements to centralise into regional stores, and this was considered unlikely to occur in the short to medium term. It is likely that the sampling costs could be reduced, but set up and operational costs to growers would be increased. Consequently it was expected that the cost of this model would be of the same order as the first.

The results of this preliminary evaluation were reported to Wool Council in Longreach in November 1996.

DEFINING A TESTING SERVICE BASED ON SAMPLING ON-FARM

Background

Following the report to Wool Council (November 1996) the Council convened a meeting in Melbourne on 18th December to further progress this issue[2]. The following agenda was discussed:

1. Purpose of discussion

- Expedite the industry's efforts in this area
- Broaden the scope of the working group
- Concentrate some effort on the inevitable vendor guarantee
- Develop parameters for a comparative price analysis between current presentation and in-shed sampled and cored presentation with guarantee

2. Why pursue in-shed sampling

- Logistics savings
- Requirements of market alternative including future, fowards and direct
- Increase potential for better communication flow

[2] This meeting was attended by:

Charles Armstrong	Convenor
Peter Sommerville	AWTA Ltd
Ross Bawden	WI
Hugh Hopkins	Wesfarmers Dalgety
Andrew Grace	IWS
David Wolfenden	Wool Grower
Hugh Oates	IWS
Russell Pattinson	IWS
Neil Harris	Seymour Wool Marketing Group

- AWTA, IWS and WI's customer (the grower) is requesting it.

3. Report from current working group

- Costs within current system
- Example of current services including Fletchers and AWE

4. Vendor Guarantee

- Codes of practice
- Role of wool classer

5. Research requirements

- Ability and method to produce representative AM's
- Comparative price analysis to determine risk margins and cost savings

It was evident that the report of the Working Group to Wool Council had resulted in a general view that proceeding immediately to a Certification Service as it is currently understood, based on sampling on-farm, was unlikely to be viable if such a service was required to match the integrity of the existing certification system, and to be operated within the constraints imposed by this system.

The Wool Growers clearly felt that a fresh approach was required. The view that was conveyed at this meeting was that the industry needed to think laterally, and not be constrained by the mindsets created by the current system. The discussion followed the general outline of the agenda, and the view that emerged was that the Growers would be prepared to accept a modified report testing system, where the Grower provided the guarantee, and that this had to be distinguished from the existing Guidance Report system, so that it could develop credibility in its own right. Basically the Growers wanted a document which provided the same objective information as the current Certificates, where the testing precision was the same, but where the sampling was conducted on-farm, according to a documented code of practice. The Growers believed that once the industry had developed enough confidence and was convinced about the integrity of the system, such a document could be used by Growers to utilise any of the existing selling options, and any of the proposed future selling options, without the wool being moved off-farm until it was sold. The Growers believed that there will be substantial savings in such an approach.

There were some contrary views about the potential savings. However the meeting agreed that the existing working group would shift its focus to this alternative approach[3].

Information Required

AWTA Ltd had already anticipated that this shift in focus would occur, and had initiated the development of an improved Guidance Report testing service for lots sampled on-farm.

From the discussion at the meeting on the 18th December 1996, it was clear that if this Guidance Report was to be used with the flexibility required by Wool Growers, then the information required on the document would be exactly the same as the information that is currently provided on IWTO Certificates,. i.e.

Coretest :	Gross, Tare and Nett weight	
	Number of bales	
	Mean Fibre Diameter	
	Wool Base	
	Vegetable Matter Base	
	Vegetable matter breakdown	
	Processing Yields :	Schlum Dry
		JCSY
		IWTO Scoured Yield
		Australian Carbonising Yield

[3] It was also agreed that Charles Armstrong would join the group.

Length & Strength: Gross, Tare and Nett weight
Number of bales
Mean Staple Length
Mean Staple Strength
CV of Length

Colour: Gross, Tare & Nett weight
Number of bales
Y-Z

In addition the normal identification of the lot will also be required:

Brand
Description
Lot Identification
Sampling Date and Weighing Date.

The Wool Growers expressed a view that the recording of individual bale weights should not be essential. The gross, tare and nett, would be adequate. It was also suggested that weighing of the bales at the time of sampling might not be possible, and therefore the weight details should be declared weights.

Furthermore there was view that the name of the sampler should be printed on the document, together with a declaration by the vendor (in this case the Wool Grower) that the lot had been sampled and weighed as per a specified code of practice, and that provision should be made so that this could be countersigned by the sampler.

The Test House will also have some requirements of its own to be considered.

- The document needs to clearly identify that the sampling was not under Test House supervision;
- The date of sampling and the date of weighing should be specified and printed on the document;
- Provision must be made to print appropriate riders to cover situations such as:
  - ⇒ insufficient sample provided to enable the full IWTO test procedures to be followed;
  - ⇒ whether the data on the document is derived from a retest or a recore and whether or not it has been combined with previous data;
  - ⇒ when the sampling date and the weighing date differ;
  - ⇒ damage to the sample packaging when received by the laboratory;
  - ⇒ the date the sample was received and the date the document was printed
- The service must be designed to enabling the testing to be processed within the systems used for certification, applying the same business rules and technical requirements.

The Test House will also need to consider a number of business rules;

- *Payment* : on account or in advance
- *Retesting*: the Certification service provides retesting and if necessary recoring of queried lots at no expense to the grower. The in-shed service is likely to attract more queries than the Certification Service because the brokers will not be directly involved, and therefore the advice currently provided by the brokers about seasonal trends will not be as readily available to the grower.. It is therefore probable that the Test House will charge for all queries , unless a statistical tolerance failure generates a reissue.
- *Storage & Freight* : it is presumed that grab samples submitted for length and strength testing will need to be delivered somewhere, once testing is complete. Currently these costs are shared with the broker. In this instance the cost must fall to the grower. Alternatively, retention of the grab sample by the Test House may provide a mechanism for off-setting the testing costs.
- *Disputes* : The statistical tolerances used for IWTO Certificates must be used to determine whether an error has occurred. However it is probable that the Test House would only accept

liability when the error is identified through testing residual sample, that has been under the control of the Test House, and not in cases involving recoring or regrabbing.

- *Combinations*: Mathematical combinations of Guidance Reports with Test Certificates for shipping consignments, produced according IWTO 31, must be issued as reports, not as IWTO Combined Certificates.

EVALUATION OF A TESTING SERVICE BASED ON SAMPLING ON-FARM

The Working Group[4] then concentrated on the problem of obtaining a representative sample for the determination of Mean Staple Strength and Mean Staple Length, recognising that the manual core sampling procedures defined in the IWTO Regulations could readily be applied to sampling on farm. However the display sample currently used for Staple Measurements is obtained by mechanical grab sampling of the bales and this is not a technique that can be readily applied to on-farm sampling. The group therefore focused on developing an alternative sampling technique that could be utilised by any Wool Grower in any shearing shed, and provide a representative sample of each farm lot for subsequent testing.

Furthermore the group recognised that there are a number of logistical problems involved in sampling on-farm, delivering the samples to the Test House and in returning results to the Wool Grower. It was agreed that a trial would be organised to evaluate the technical and logistical feasibility of sampling on-farm and replicating the results obtained in the existing Certification system.

TRIAL DESIGN

OBJECTIVES

- To evaluate the logistics of a sampling procedure designed to enable Wool Growers to manage, supervise and control the preparation of documentation and the drawing of representative samples from their farm lots for the subsequent determination of Yield, Vegetable Matter Base and Mean Fibre diameter, and Staple Length, Staple Strength and Position of Break.

- To evaluate the relationship between the test results based on these samples, when they are tested in accordance with current IWTO Test Methods, and Certificate results for the same lots when they are subsequently sampled under AWTA Ltd supervision and tested in accordance with current IWTO Regulations and Test Methods, and AWEX guidelines.

SCOPE

- The trial was limited to approximately 50 lots, involving approximately 40 fleece lines and approximately 10 skirting lines.

- Approximately 10 Wool Growers willing to participate in the trial were nominated by the NSW Farmers Association.

- Each Wool Grower was be requested to provide approximately four fleece lines and one skirting line.

- The selection of participating Wool Growers was made to ensure a broad cross-section of types is included in the trial.

- The sampling and testing commenced late July, early August 1997, and concluded by the end of November, 1997.

- All lots were tested for Wool Base, Vegetable Matter Base and Mean Fibre Diameter, and Processing Yields calculated. All lots were also tested for Staple Length, Staple Strength and Position of Break.

[4] Charles Armstrong became the Convenor of the Working Group.

- The testing precision of the samples obtained on-farm was the same as the testing precision of the samples obtained for certification. That is, the same test methods and calculation procedures were used in both cases.

PROCEDURAL OVERVIEW

AWTA Ltd prepared a set of documented procedures, based on protocols decided by the working group, and supplied the sampling equipment and documentation. The purpose of the following is to provide an overview of the trial procedures. A copy of the Sampling Manual is attached in Appendix A.

On-farm Sampling for Staple Measurement

The determination of staple length, staple strength and position of break requires a representative sample of wool to be drawn from each lot, with no damage occurring to the staples.

- Once a fleece was skirted on the table, a sample tuft was taken at random from one quadrant of the fleece. Subsequent fleeces were sampled from the adjacent quadrants, rotating in a consistent direction (clockwise or anti-clockwise).

- The random sample from the fleece was placed in a container which was unique to the bin to which the classer allocated the fleece.

- A random sample was drawn from the skirtings from each fleece, and likewise placed in a container unique to the bin to which the skirtings were allocated.

- When the bin was pressed into bales the sample in the container corresponding to the bin was transferred into a plastic bag, sealed with a rubber band and cross referenced to the bales pressed from the bin. This sample was retained until lotting is complete.

- The Wool Grower lotted the wool. The random samples for the bales in the lot were then aggregated into a single plastic bag, to form a global sample for the determination of Staple Length, Staple Strength and Position of Break. The bag was sealed with a rubber band and appropriately identified.

On-farm Sampling for Yield, Vegetable Matter and Mean Diameter

The determination of Yield, Vegetable Matter and Mean Fibre Diameter requires a representative sample to be obtained from each bale in the lot, and the weight of the bales to be determined at the time of sampling.

- Each lot was manually core sampled, according to the IWTO core sampling procedure. Core sampling equipment was supplied by AWTA Ltd.
- The core samples from each lot were placed in a plastic bag and sealed with a rubber band.
- The lot details, grower identification details, the weights of the individual bales and the tare weights of the packs were recorded on a weight note supplied by AWTA Ltd.
- The sealed core sample was placed in a second plastic bag, and the weight note inserted between the outer bag and the sealed inner bag. This second bag was also sealed with a rubber band.
- The sealed core sample could be placed inside the bag containing the tuft samples from the individual fleeces classed into the lot . If this was not done then a duplicate of the weight note was placed inside the tuft sample bag.
- The samples were delivered to AWTA Ltd’s Sydney laboratory.

Testing of Samples obtained On-farm

- The core samples submitted by the Wool Grower were tested for Yield, Vegetable Matter and Mean Fibre Diameter, using the procedures defined by IWTO-19, IWTO-28, and the IWTO Coretest Regulations.

- The tuft samples submitted by the Wool Grower were tested for Staple Length, Staple Strength, and Position of Break, using the procedures defined by IWTO-30 and the IWTO Staple Test Regulations.
- The test results were printed on Report stationery and delivered to the Wool Grower

Certification for Yield, Vegetable Matter, Mean Diameter, Staple Strength, Staple Length and POB.

- The Wool Grower advised AWTA Ltd of the name of their Selling Agent and when the lots had been delivered to the Selling Agent.
- The Wool Grower provided lotting instructions to the Selling Agent to ensure that the same lots sampled on-farm were certified.
- AWTA Ltd monitored the certification of the lots, and ensured that all the required sampling and testing was completed.
- Plain paper copies of the certificates were provided to the Wool Grower.

FUNDING

- AWTA Ltd supplied all sampling equipment (on loan), documentation and instructions at no charge.
- The Wool Grower met all costs associated with the sampling on-farm.
- The Wool Grower paid the cost of freighting samples to the AWTA Ltd Sydney Laboratory.
- The testing of these samples was conducted by AWTA Ltd at no charge to the Wool Grower.
- The Wool Grower paid the cost of subsequent Certification.
- AWTA Ltd returned test results to the Wool Grower, at no charge.
- AWTA Ltd agreed to provide a statistical analysis of the comparative data once the trial was complete.

TRIAL RESULTS

Logistics and Participants

NSW Farmers arranged for ten Wool Growers to participate in the trial[5]. AWTA Ltd produced the Sampling Manual (Appendix A) and this was reviewed by the Working Group. AWTA Ltd provided the sampling equipment and other documentation, delivered this equipment to the participants as required, and co-ordinated the collation of the In-shed Report and Certificate data.

Co-ordination of distribution of sampling equipment was provided by Ben Russell (NSW Farmers Association), John Cheshire and Michael Moffitt (AWTA Ltd).

[5] The following Wool Growers volunteered to participate in the trial.

Charles Armstrong	"Callubri"
Richard Black	"B/Wallangra"
Katrina & Rob Bloomfield	"WRBG/Karori/Walcha"
Ian Cathles	"Coradigbee/Yass"
Terry Coventry	"I C/Bailey Park"
John Crawford	"Bibaringa"
Ted Croft & Jenny Croft	"C/Lugwardine"
Howard Crozier	"HC/Borenore"
Don Hamblin	"H & Co"
John Oldfield	"Belalie"

Number of Lots Received

The intention of the Working Group was to obtain approximately 50 lots. At the conclusion of the trial 42 lots were received that could be incorporated in the analysis - 9 skirting lines and 33 fleece lines. However, two nominated brokers elected not to certify a total of 3 lots. One of these was a line of skirtings. The other two were fleece lines. On the basis of the initial In-shed Report Test result, both of these were slightly tender. It may be presumed that the decision by the broker not to test these lines was made for this reason.

One of the participants submitted insufficient sample for 4 of the 5 lots, and consequently only one lot from this property could be incorporated into the trial. Another participant submitted only one lot.

Consequently, the statistical analysis reported here includes 42 lots for Wool Base (WB), Mean Fibre Diameter (MFD) and Vegetable Matter Base (VMB), and 39 lots for Mean Staple Length (SS), Coefficient of Variation of Staple Length, and Mean Staple Strength.

Analysis Technique

The approach taken in this analysis is to treat the In-shed Report and the IWTO Certificate as two separate test methods, and to assess whether these two methods were statistically equivalent. Of course the only real difference in the two methods was the sampling, so any non-equivalence arising from such an analysis can be attributed to the differences in the sampling systems employed.

A comparison of different test methods, or of objective measurement processes, must consider two aspects:

- relative bias of a practical magnitude; and
- level dependent bias of a practical magnitude.

IWTO has established standard statistical techniques to be used to evaluate the equivalence of two test methods (IWTO-0), and this standard is now used in all comparisons of test methods presented to IWTO. The methods described in IWTO-0 have also been used in this analysis.

In this report the participating properties have been coded in order to ensure that specific results or comments cannot be associated with the individual participants

Additional Assumptions

There were instances where the participating Wool Grower made errors in documentation, where it was evident that the sampling and weighing procedures defined in Appendix A were not rigorously followed, and where the Brokers did not maintain the integrity of the lots when they were prepared for auction. Any documentation errors detected at the time the In-shed Report or the IWTO Certificate were issued have been corrected. However, all lots have been incorporated in the analysis, even in instances where it was clear that the sampling and weighing procedures had not been followed.

The justification for this approach is that the trial was intended to evaluate two different systems for providing objective measurements on farm lots. Part of the system is the management and control of the sampling and weighing operations in the shed. To ignore instances where the sampling and weighing procedures had not been followed would be to remove one source of variation from the system.

Specific Instances of Deviations from Specified Sampling Procedures.

Apart from documentation errors, a number of specific deviations from the specified procedures occurred.

- Bale weighing errors - one serious instance of this occurred and this will be discussed separately later in this report.
- Inadequate sample weight - one grower submitted insufficient core sample to enable a full IWTO test to be conducted. The test results for the In-shed Reports in this instance were based on the sample provided.

- Failure to provide a core sample - one grower did not provide a core sample for one lot. Consequently the WB, MFD and VMB were determined using the sample submitted for length and strength. This result could have been excluded from the analysis, but as it has only a small effect, it has been included to illustrate the consequences of not sampling correctly for WB, MFD and VMB
- Brokers varying lotting instructions - in one instance the Broker split a 3 bale lot into a 2 bale and a one bale lot, and certified each separately. However this was really in the Grower's best interest, because there was a 2 micron difference in Mean Fibre Diameter between the two lots. The two certificates were mathematically combined for the purposes of the analysis in this report.

Determination of Relative Bias

The existence of a relative bias implies that, on average, two different test methods deliver different results. In this particular case our concern is to determine whether or not In-shed Sampling results in measurements that are either always higher than, or lower than, the corresponding measurement provided by the Certification system.

The relative bias of two methods is determined using a paired t-test. The summary statistics for this analysis for all the lots included in this trial are shown in Table 1 below.

TABLE 1: All Lots - Statistical Summary of the differences between Certificate and In-shed Report

Statistic	WB	MFD	VMB	SL	CVL	SS	Position of Break		
							Tip	Middle	Base
Observations	42	42	42	39	39	39	39	39	39
Mean Difference	-0.38	0.01	0.08	-2.41	2.36	-0.74	-1.28	-0.90	2.18
Standard Deviation of Differences	1.35	0.32	1.29	3.80	2.97	3.48	6.07	12.51	12.59
t-value	-1.85	0.29	0.40	-3.96	4.96	-1.34	-1.32	-0.45	1.08
Significance at 95%	NS	NS	NS	S (***)	S (***)	NS	NS	NS	NS

Note: *** denotes significance at the 0.1% level of confidence

The first point to be made is that both the Mean Staple Length and the Coefficient of Variation in Staple Length are significantly different. The second point is that these differences are highly significant to the extent that that we can be 99.9% confident that the differences are real. However, despite the fact that the differences are significant, the absolute differences are relatively small. The Mean Staple Length reported on the Certificate was 2.4 mm shorter than the Mean Staple Length of the In-shed report. Likewise the Coefficient of Variation in Staple Length reported on the Certificate was 2.4% (2.36% rounded to one decimal place) greater than the equivalent result for the In-shed Report. The commercial ramifications of this observation are discussed later.

Tables 2 and 3 show the same analysis for the fleece lots and skirting lots respectively.

TABLE 2: Fleece Wool - Statistical Summary of the differences between Certificate and In-shed Report

Statistic	WB	MFD	VMB	SL	CVL	SS	Position of Break		
							Tip	Middle	Base
Observations	33	33	33	31	31	31	31	31	31
Mean Difference	-0.26	0.04	0.02	-2.48	2.29	-0.26	-1.32	-1.94	3.26
Standard Deviation of Differences	0.72	0.32	0.42	3.58	2.92	3.30	6.18	12.65	12.48
t-value	-2.11	0.66	0.33	-3.87	4.36	-0.44	-1.19	-0.85	1.45
Significance at 95%	S	NS	NS	S (***)	S (***)	NS	NS	NS	NS

Note: *** denotes significance at the 0.1% level of confidence

The observations made previously for the data represented in Table 1 also apply in the case of Fleece Wool (see Table 2). However, Table 3 shows that for Skirting Wool the same conclusions cannot be drawn, even though the absolute mean differences are similar.

There are two possible explanations for this. Firstly the Skirting Wools were sampled differently from the Fleece Wools (see Appendix A). It is conceivable that a more representative sample of the Skirting Wools was obtained, in spite of the fact that the Staple Length and Coefficient of Variation of Staple Length of these wools are inherently more variable than for Fleece Wools. Secondly, the standard deviations of differences of these measurements for the Skirting Wools were relatively large, while the size of the sample population (8 lots) was very much smaller. In these circumstances the paired t-test is much less likely to show a significant difference.

TABLE 3: Skirting Wool - Statistical Summary of the differences between Certificate and In-shed Report

Statistic	WB	MFD	VMB	SL	CVL	SS	Position of Break		
							Tip	Middle	Base
Observations	9	9	9	8	8	8	8	8	8
Mean Difference	-0.83	-0.07	0.28	-2.13	2.63	-2.63	-1.13	3.13	-2.00
Standard Deviation of Differences	2.64	0.33	2.78	4.85	3.34	3.74	6.06	11.89	12.94
t-value	-0.94	-0.60	0.30	-1.24	2.23	-1.99	-0.53	0.74	-0.44
Significance at 95%	NS	NS	NS	NS	NS	NS	NS	NS	NS

From the data obtained it is not possible to infer which of these explanations is correct. A trial incorporating a larger sample population of Skirting Wools is required before any definitive inference can be made. However, In-shed Sampling trials currently under way in Western Australia and in Queensland may provide more information, because in these case the sampling technique being employed is very similar to the technique employed to sample the Skirting Wools in this Trial.

A similar analysis to the above has also been conducted on a property by property basis. The results of this, together with a summary of all the raw data for each property, is included in Tables B1 to B10 in Appendix B. However it must be noted that the sensitivity of the analysis for each property is considerably limited by the small sample size.

However a comment can be made about a particularly large divergence (-7.5%) in Wool Base between the Certificate and the corresponding In-shed Report for lot number 5920 for Property A (see Table B1, Appendix B). In this particular case, the Grower failed to provide a core sample, and consequently the Yield, Vegetable Matter Base and the Mean Fibre Diameter were determined using the grab sample.

Determination of Level Dependent Bias.

The existence of a level dependent bias implies that two test methods deliver different results, but the magnitude of the difference is dependent upon the absolute value of the measurement. There are basically four scenarios for this type of bias:

- the difference between Method A and Method B is positive and increases or decreases as the absolute value of the parameter concerned increases; or
- the difference between Method A and Method B is negative and increases or decreases as the absolute value of the parameter concerned increases; or
- the difference between Method A and Method B is initially positive (or negative) but as the absolute value of the parameter concerned increases the difference becomes negative (or positive)

In the first and second scenarios it is also likely that the two methods will also exhibit a relative bias, as discussed previously. However in the third scenario it is quite possible that there is no relative bias, because of the compensating errors over the range of the measurement.

IWTO-0 relies on two separate tests for level dependent bias. The first of these is based on the assumption that if a level dependent bias exists, the geometric mean slope of a regression line fitted to the data provided by both methods will be significantly different from unity. The second examines the slope of a regression line based on the absolute differences between corresponding pairs of measurements and the average values of these pairs. If a level dependent bias exists, then the slope of this regression can be expected to be significantly different from zero.

This analysis is quite detailed, and consequently the complete analysis for all the parameters involved here (WB, MFD, VMB, SL, CVL, SS) is included in Appendix C. However, in order to illustrate the process the data for Mean Staple Length and for Coefficient of Variation of Staple Length has been included in the body of this report as Figures 1 and 2 respectively. These two parameters were deliberately chosen because, as previously discussed, they both showed a significant relative bias.

Overall, the analysis incorporated in Appendix C shows that **there is no evidence that a level dependent bias exists for any the parameters considered**. This an encouraging result, but it does require some qualification.

These qualifications apply to the results for Mean Staple Length and Coefficient of Variation of Staple Strength. Consider Figure 1 first. The analysis is presented in the form of two graphs and a table. The first graph plots the In-shed result as the dependent variable (Y) and the Certificate result as the independent variable (X). Each data pair is shown as a single point on the graph. On the same graph the line for Y = X has been plotted as a solid line. If both measurement systems gave identical results, and there was no variation (random error) in the measurements for both systems, then all the data points would lie along this line. A second line (Y = a +bX) has also been plotted as a dotted line. This line is the line which, on a statistical basis, best describes the relationship between the two systems, taking into account the random errors involved in each system. If there is a level dependent bias then the line corresponding to Y = a + bX should have an obviously different slope than that corresponding to Y = X.

In Figure 1 the slopes of the two lines are obviously different. However, the statistics in the table at the bottom of the page (Geometric Mean) tell us that we can be 95% confident that this difference is not statistically significant.

The statistics in the table also tell us the strength of the relationship between the results provided by the two systems. This information is contained in the value of the variable R. In this case R = 0.930. If the relationship was exact, with no variation due to random error or level dependent bias, then R = 1. In short, the closer the value of R to unity, the more confident we can be that there is a direct association between the measurements obtained by the two systems[6].

The second graph in Figure 1 plots the differences between the corresponding data points as the dependent variable (Y) and the averages of the corresponding data points as the independent variable (X). If there is not a level dependent bias then the slope of the line Y = a + bX, fitted to the data points should not be significantly different from zero. The corresponding statistics in the table (Difference versus Average) tell us that in this instance this is indeed the case.

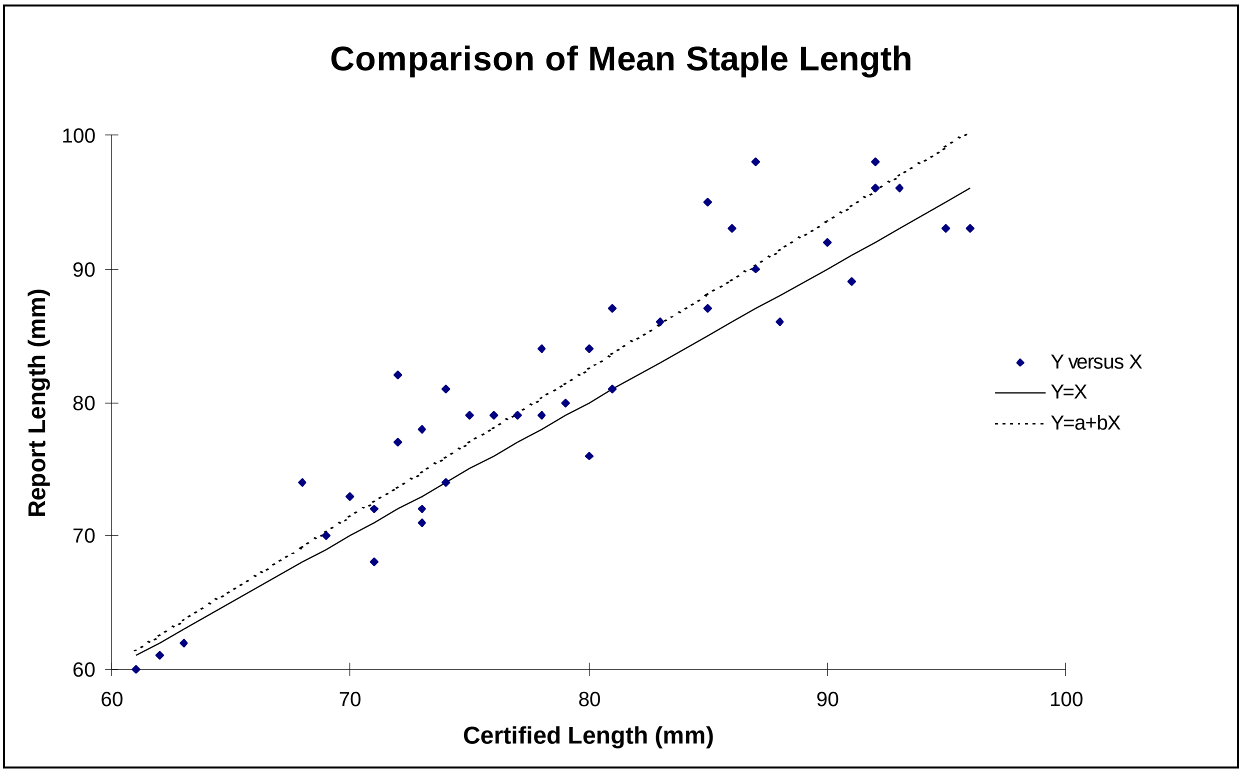
On the same graph, the 95% confidence intervals have been plotted as horizontal straight lines (UCL and LCL). The distance between these lines is calculated from the data. If the assumptions made in the statistical analysis are valid, then we would expect no more than 5% of the data points would fall outside these lines. In this case there are 39 data points so our expectation is that approximately 2 points would be outside the lines. There are in fact 3 points in outside the lines, which is close to expectations, so it can be inferred that the assumptions in the statistical analysis are valid.

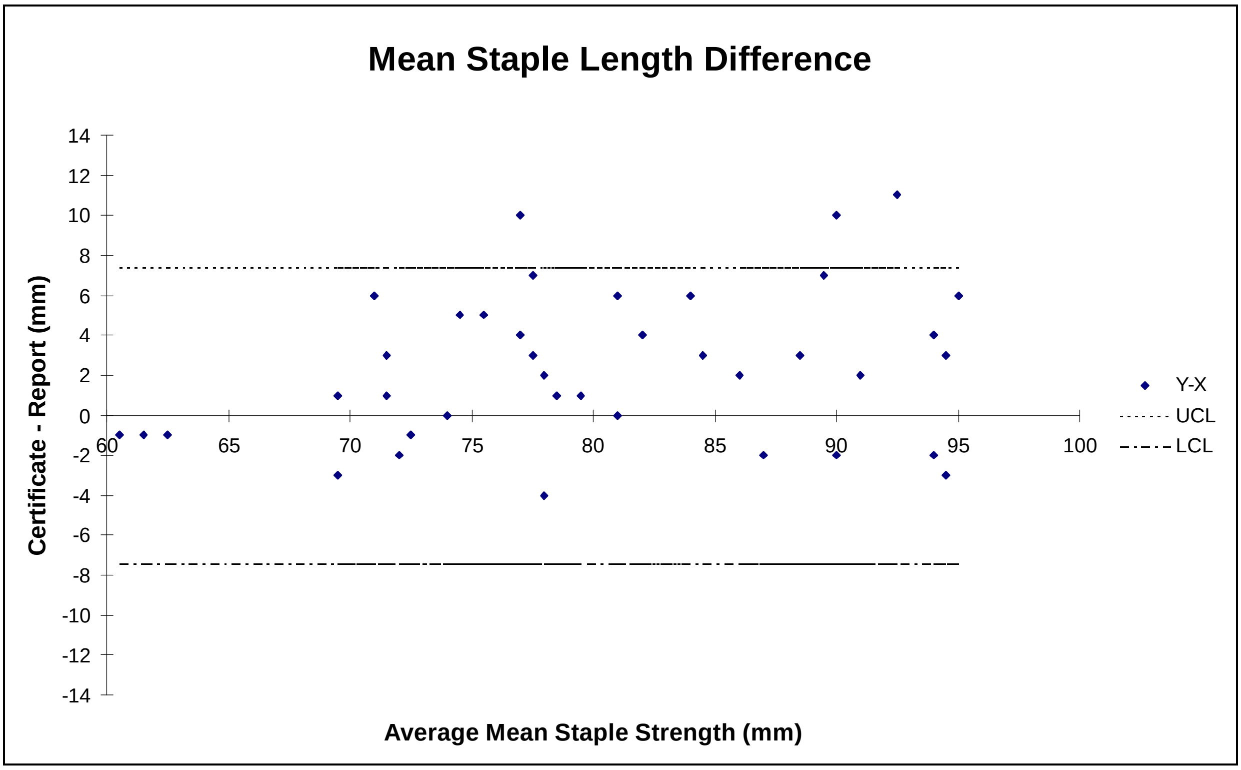
Consider now Figure 2. In the first graph the regression line Y = a + bX has almost an identical slope to the line Y = X, but the line appears to be offset by a constant amount. Note also that the association between the data, as indicated by the coefficient of determination is relatively weak (R = 0.693 or R^2 = 0.480). Note further that 5 of the data points lie outside the confidence intervals. The conclusions that can be drawn are that there is no evidence of a level dependent bias, but the data provided by both systems is inherently more variable than for the Mean Staple Length data. This is not an unexpected result.

However, it here that some further qualifications can be made. If the results of the relative bias analysis and this analysis are considered together, it may be concluded that there is a definitely a relative bias between results provided for Mean Staple Length and Coefficient of Variation of Staple Length by the In-shed Sampling system and by the Certification system. It may be inferred this is due to the In-shed system providing samples lower coefficient of variation in length. In other words, the In-shed sampling procedure used in this trial did not obtain a sample that was equivalent to the grab sampling technique employed in the Certification system, in that it did not obtain a similar proportion of shorter staples and second cuts. It must be emphasised that this is an inference, not a firm conclusion. A more extensive trial, incorporating more lots, is required before definitive conclusions can be drawn.

6 Statisticians normally use the value of R^2. Defined as the coefficient of determination this value (in this case 0.865) describes the proportion of the data points that can be attributed to the linear relationship defined by the regression equation Y = a + bX.

FIGURE 1 Testing for Level Dependent Bias for Mean Staple Length

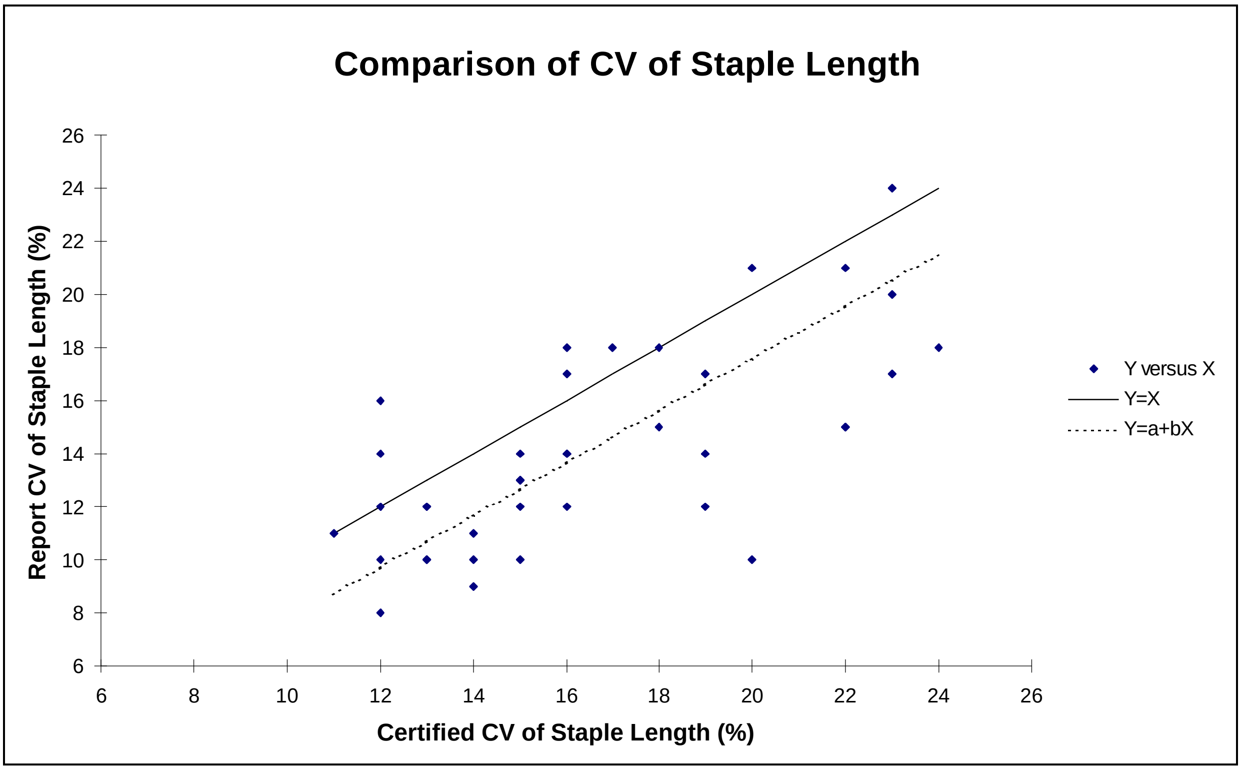


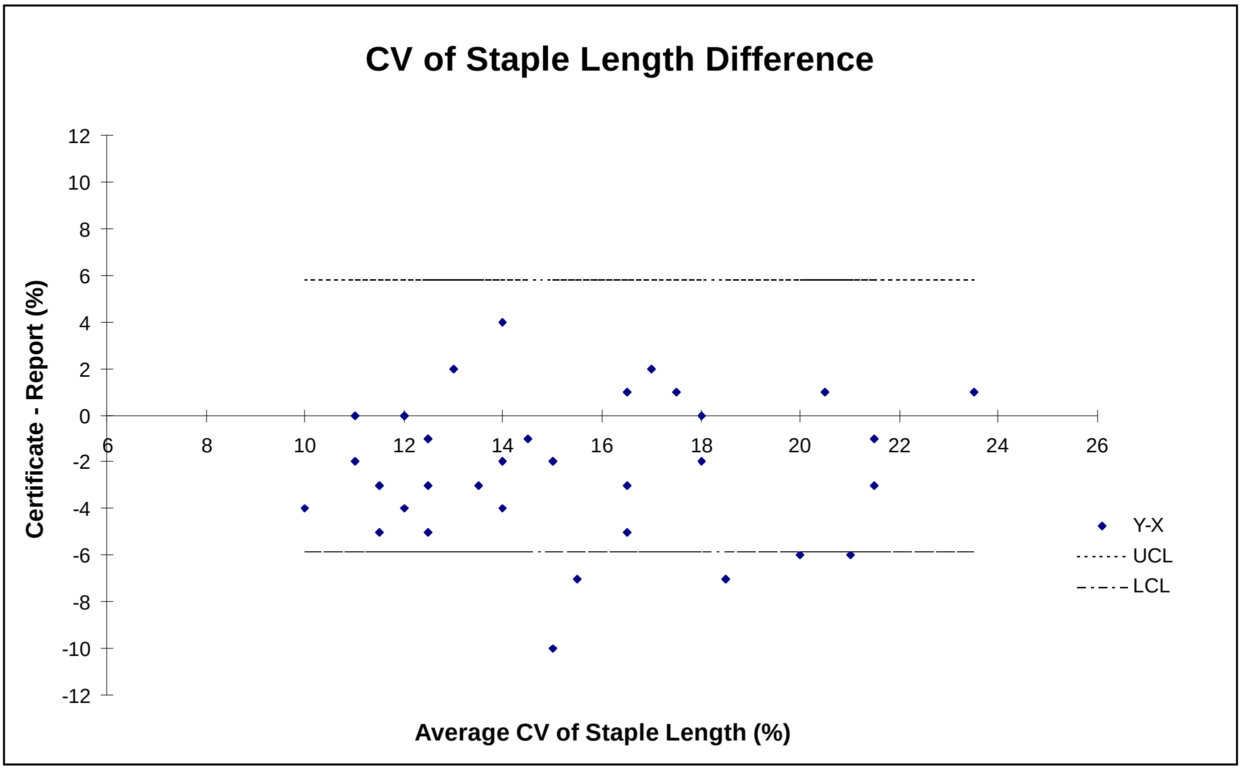


Summary of Regression Statistical data for Mean Staple Length

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.930	1.109	0.067	-1.622	NS
Difference versus Average	0.271	0.107	0.062	1.710	NS

FIGURE 2 Testing for Level Dependent Bias for CV of Staple Length

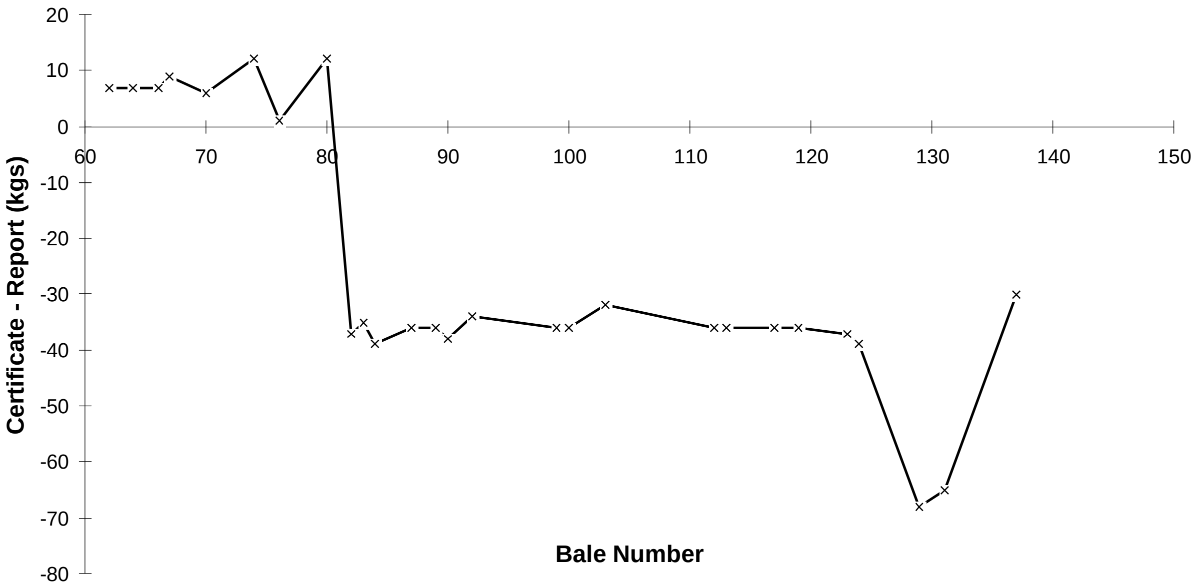




Summary of Regression Statistical data for CV of Staple Length

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.693	0.985	0.117	0.131	NS
Difference versus Average	0.021	-0.018	0.140	-0.130	NS

FIGURE 3: Bale Weight differences - Property C



Examination of Bale Weights

If In-shed Reports are to be used as a basis for determining the value of a farm lot then the accuracy of the bale weights provided with the data in the report is critical. The bale weights are used both to determine the total value of the lot, when it is priced on a greasy basis, and also to determine the clean weights for the processing yields

Two of the participants in the trial had some difficulty in obtaining accurate bale weights. In one case, Property C, gross errors occurred. This is illustrated in Figure 3, which plots the differences between the weights obtained when the lots involved were certified and when they were weighed in the shed, as a function of bale number.. Initially the shed weights were approximately 10 kg lower than the certified weights. However something happened after bale number 80 was weighed, when the certified weights suddenly became 40 kgs lower than the shed weights.

The pattern of these discrepancies also suggests that the weights provided on the documentation submitted by the Grower were not obtained when the lots were core sampled. If this did occur then it was another instance of a deviation from the specified procedure (Appendix A) which clearly stated that it was essential to record the bale weights at the time of core sampling. However, must also be recognised that in shearing sheds where wool press scales are used to record bale weights it is logistically very difficult, if not impossible in some instances, to re-weigh the bales in the press. Clearly, it would be to the advantage of the Grower to have some more accessible scales to facilitate this. Some Growers used cattle scales to weigh the bales, and in these cases there was a close correspondence between the shed weights and the certified weights.

COMMERCIAL IMPLICATIONS

The two issues that have been identified in this trial as having significant commercial implications are:

- Bale weighing errors
- Possible bias in Mean Staple Length and Coefficient of Variation of Staple Length.

These implications will now be considered on the basis of the justifications presented by Wool Growers for the In-shed Report service, namely:

- logistics savings;
- requirements of market alternative including future, fowards and direct; and
- increase potential for better communication flow

Bale Weighing Errors

As a preface to this discussion it must be stated that only one of the 10 properties involved in the trial, Property C, experienced serious difficulties in obtaining accurate bale weights. Differences in total nett weight observed for Property A were due to a decision by the Grower to remove one bale from one lot, and sell it privately, and by a documentation error on another lot.

Wool Growers have consistently expressed an expectation that the documentation provided by the In-shed Report would enable their wool to be purchased directly from the farm and also to be used for the purposes of further trading. For the trading and processing sectors to have any confidence to do this they must be confident that the bale weights are always correct. If this confidence does not exist, then the usefulness of the document will be limited to direct sales to Private Treaty Merchants or to mills located within Australia.

In itself this is not a limitation if the Wool Grower intends to confine his or her marketing to these sectors of the industry. In which case the buyers will undoubtedly check the weights on arrival in store, and make their own decisions regarding whether or not further testing will be required. Commercially, these sectors are the most likely to achieve real economic benefits from the In-shed Report system.

Extension of the system to trading in other marketing systems will, in the long term, depend entirely on the confidence of the other markets in the data provided by the In-shed report. Development of this confidence is in the hands of the Wool Growers who utilise the system. Ensuring accurate bale weights is a critical requirement for this to occur.

The Working Group considers a standard Vendor Declaration, to be signed by the Grower, to be an essential requirement of the system. On this the Grower will declare the weighing system used, and also declare that the weights are correct. The Grower will assume responsibility for any subsequent claims arising from weighing errors. However, if the incidence of claims arising from such errors is significant, then it is highly probable that end-users either revert to checking all the deliveries they receive, or make an allowance in the prices they offer. In either case, the costs will be born directly by Wool Growers, and reflected in the prices paid.

Relative Bias in Staple Measurements

Again, as a preface to this discussion, it must be emphasised that the relative bias in Mean Staple Strength and Coefficient of Variation of Staple Strength identified in this trial is quite small. Furthermore, the number of lots involved in the trial was also relatively small, and the significance of the bias must be considered in this context. In the final analysis any commercial judgement on this issue is a commercial decision which will be made by the participants in the market. However some general comments can be made.

It is well recognised that the Certification system delivers an estimate of Mean Staple Length where the 95% confidence limit is ± 6 mm. This is two to three times the bias indicated by this trial. However, most processing consignments are assembled from a large number of lots, so the precision of the estimate of Mean Staple Length for the consignment is considerably better. The improvement in precision provided by the aggregation of tested lots is shown in Table 4.

TABLE 4: **Improvement in precision of Staple Length estimates for processing consignments achieved by increasing the number of component lots**

Number of Lots	95 % Confidence limits
1	± 6 mm
5	± 2.7 mm
10	± 1.9 mm
15	± 1.5 mm
20	± 1.3 mm
30	± 1.1 mm

Clearly, a bias of 2 -3 mm for In-shed Reports is not likely to be commercially significant in mill consignments, provided the proportion of such lots in the consignments is small. The bias will become increasingly important as the proportion is increased.

The TEAM formula, which is used to calculate the Hauteur of a mill processing batch from the Staple Measurements, takes the form

$$H = 0.52L + 0.47S + 0.95D - 0.95M^{*} - 0.45V - 3.5$$

where H = Hauteur (mm) or mean fibre length in the top

L = Staple Length (mm)

S = Staple Strength (Newtons/kilotex)

D = Fibre Diameter (micrometres)

M^{*} = Adjusted Percentage of Middle Breaks

V = Vegetable Matter Base (%)

A bias of 2 mm in Staple Strength results in a bias of only 1 mm in Hauteur.

Additional Factors

One of the issues that has not been considered by the Working Group is the overall cost-benefit of In-shed sampling. Fortunately such a study is underway in Western Australia. However, it unlikely that the results of this study will be directly applicable to New South Wales, where the wool production units are, on average, considerably smaller. Nevertheless this study will provide some information to assist Wool Growers in deciding whether or not they will become involved in sampling their wool on-farm and assuming direct responsibility for their own marketing.

ACKNOWLEDGMENTS

The author gratefully acknowledges the contributions of the other members of the Working Group, and the Wool Grower participants in the trial.

In particular the author wishes to thank Ben Russell for co-ordinating the involvement of the Grower participants, and Mike Moffitt (former Sampling Manager - NSW, AWTA Ltd), John Cheshire (Sampling Controller - Sydney, AWTA Ltd) and Mike Powell (Data Processing Manager - NSW, AWTA Ltd) for their efforts in co-ordinating the distribution of sampling equipment, receivals of samples and distribution and correlation of the In-shed Reports and the corresponding Certificates.

APPENDIX A

APPENDIX B

TABLE B1: Property A

Sampling Method	Wool Type	Lot No		Bales	Gross	Tare kg	Nett kg		WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	396		6	1160	12	1148		58.03	21.9	3.2	0	87	12	39	5	40	55
	Fleece	397		17	3297	34	3263		60.68	21.2	3.4	0.1	95	17	42	0	79	21
	Fleece	394		15	2913	30	2883		59.21	22.0	3.5	0	93	11	39	5	50	45
	Skirtings	5920		10	1924	20	1904		53.90	20.9	9.4	0.1	81	18	36	15	75	10
	Fleece	395		13	2519	26	2493		60.57	21.8	3.3	0	92	12	42	2	49	49
			TOTALS	61	11813	122	11691	MEAN	58.48	21.56	4.6	0.04	90	14	40	5	59	36
								Std Dev	2.78	0.48	2.7	0.05	6	3	3	6	17	19
Certificate	Fleece	396		7	1323	14	1309		57.84	21.9	3.3	0	81	16	40	0	42	58
	Fleece	397		18	3418	36	3382		58.22	21.5	3.6	0	85	16	39	2	46	52
	Fleece	394		15	2871	30	2841		58.96	21.9	3.7	0.1	95	11	36	9	56	35
	Skirtings	5920		10	1910	20	1890		46.38	20.5	16.5	0	74	24	35	6	88	6
	Fleece	395		13	2487	26	2461		59.71	22.2	4	0	90	13	37	5	44	51
			TOTALS	63	12009	126	11883	MEAN	56.22	21.60	6.2	0.02	85	16	37	4	55	40
								Std Dev	5.55	0.66	5.8	0.04	8	5	2	4	19	21
Differences	Fleece	396		1	163	2	161		-0.19	0	0.1	0	-6	4	1	-5	2	3
	Fleece	397		1	121	2	119		-2.46	0.3	0.2	-0.1	-10	-1	-3	2	-33	31
	Fleece	394		0	-42	0	-42		-0.25	-0.1	0.2	0.1	2	0	-3	4	6	-10
	Skirtings	5920		0	-14	0	-14		-7.52	-0.4	7.1	-0.1	-7	6	-1	-9	13	-4
	Fleece	395		0	-32	0	-32		-0.86	0.4	0.7	0	-2	1	-5	3	-5	2
			TOTALS	2	196	4	192	MEAN	-2.26	0.04	1.7	-0.02	-5	2	-2	-1	-3	4
								Std Dev	3.08	0.32	3.1	0.08	5	3	2	6	18	16
								t-value	-1.637	0.279	1.217	-0.5	-2.203	1.534	-2.157	-0.39	-0.43	0.624
								Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

TABLE B2: Property B

Sampling Method	Wool Type	Lot No		Bales	Gross	Tare kg	Nett kg		WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	177		7	1336	14	1322		64.19	20.5	1.1	0	93	12	37	0	8	92
	Fleece	179		7	1221	14	1207		64.01	21.1	1.3	0.1	86	14	35	0	12	88
	Fleece	182		6	1152	12	1140		61.56	17.9	1.6	0.1	78	14	42	9	55	36
	Skirtings	2090		4	620	8	612		57.12	19.7	4.1	0.1	71	20	37	12	51	37
	Skirtings	2092		4	759	8	751		57.74	16.9	3.5	0.2	60	24	36	19	66	15
			TOTALS	28	5088	56	5032	MEAN	60.92	19.22	2.3	0.10	78	17	37	8	38	54
								Std Dev	3.36	1.77	1.4	0.07	13	5	3	8	27	34
Certificate	Fleece	177		7	1338	14	1324		64.49	20.7	1.2	0	86	12	33	2	8	90
	Fleece	179		7	1236	14	1222		64.39	20.8	1.1	0.1	88	15	34	0	25	75
	Fleece	182		6	1143	12	1131		62.31	17.8	1.3	0.1	73	16	40	8	39	53
	Skirtings	2090		4	615	8	607		57.86	19.5	4.1	0.1	73	23	30	7	62	31
	Skirtings	2092		4	748	8	740		58.34	17.1	2.1	0.1	61	23	33	18	66	16
			TOTALS	28	5080	56	5024	MEAN	61.48	19.18	2.0	0.08	76	18	34	7	40	53
								Std Dev	3.21	1.68	1.3	0.04	11	5	4	7	25	30
Differences	Fleece	396		0	2	0	2		0.3	0.2	0.1	0	-7	0	-4	2	0	-2
	Fleece	397		0	15	0	15		0.38	-0.3	-0.2	0	2	1	-1	0	13	-13
	Fleece	394		0	-9	0	-9		0.75	-0.1	-0.3	0	-5	2	-2	-1	-16	17
	Skirtings	5920		0	-5	0	-5		0.74	-0.2	0	0	2	3	-7	-5	11	-6
	Skirtings	395		0	-11	0	-11		0.6	0.2	-1.4	-0.1	1	-1	-3	-1	0	1
			TOTALS	0	-8	0	-8	MEAN	0.55	-0.04	-0.4	-0.02	-1	1	-3	-1	2	-1
								Std Dev	0.21	0.23	0.6	0.04	4	2	2	3	12	11
								t-value	6.01	-0.389	-1.34	-1	-0.732	1.414	-3.302	-0.88	0.31	-0.12
								Significance	S	NS	NS	NS	NS	NS	S	NS	NS	NS

TABLE B3: Property C

Sampling Method	Wool Type	Lot No		Bales	Gross	Tare kg	Nett kg		WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	5010		6	1103	12	1091		66.46	17.6	0.9	0	73	13	50	7	75	18
	Fleece	5012		5	944	10	934		63.14	17.9	1	0	62	14	43	25	57	18
	Fleece	5015		7	1310	14	1296		67.55	19.7	0.7	0	76	18	47	17	49	34
	Fleece	5019		4	783	8	775		66.11	16.5	1.2	0	61	18	53	9	54	37
	Skirtings	5506		5	950	10	940		61.08	17.9	2.3	0						
			TOTALS	27	5090	54	5036	MEAN	64.87	17.92	1.2	0.00	68	16	48	15	59	27
								Std Dev	2.67	1.15	0.6	0.00	8	3	4	8	11	10
Certificate	Fleece	5010		6	1069	12	1057		66.54	17.5	0.9	0	70	15	47	16	65	19
	Fleece	5012		5	764	10	754		63.35	18.3	0.7	0	63	16	45	4	46	50
	Fleece	5015		7	1108	14	1094		67.12	19.4	0.8	0	80	16	49	14	37	49
	Fleece	5019		4	639	8	631		66.49	16.8	1	0	62	17	49	11	46	43
	Skirtings	5506		5	887	10	877		61.24	17.8	2.2	0						
			TOTALS	27	4467	54	4413	MEAN	64.95	17.96	1.1	0.00	69	16	48	11	49	40
								Std Dev	2.55	0.97	0.6	0.00	8	1	2	5	12	15
Differences	Fleece	396		0	-34	0	-34		0.08	-0.1	0	0	-3	2	-3	9	-10	1
	Fleece	397		0	-180	0	-180		0.21	0.4	-0.3	0	1	2	2	-21	-11	32
	Fleece	394		0	-202	0	-202		-0.43	-0.3	0.1	0	4	-2	2	-3	-12	15
	Fleece	5920		0	-144	0	-144		0.38	0.3	-0.2	0	1	-1	-4	2	-8	6
	Skirtings	395		0	-63	0	-63		0.16	-0.1	-0.1	0						
			TOTALS	0	-623	0	-623	MEAN	0.08	0.04	-0.1	0.00	1	0	-1	-3	-10	14
								Std Dev	0.31	0.30	0.2	0.00	3	2	3	13	2	14
								t-value	0.585	0.302	-1.41	0	0.522	0.243	-0.469	-0.51	-12	1.982
								Significance	NS	NS	NS	NS	NS	NS	NS	NS	S	NS

TABLE B4: Property D

Sampling Method	Wool Type	Lot No		Bales	Gross	Tare kg	Nett kg		WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	568		12	2095	24	2071		56.65	19.9	5.2	0.1	93	13	34	0	82	18
	Fleece	569		15	2713	30	2683		55.8	19.8	5.5	0.1	96	11	36	0	82	18
	Fleece	570		18	3374	36	3338		54.85	20.4	3	0.1	96	10	41	2	98	0
	Fleece	571		19	3425	38	3387		54.81	20.5	2.8	0	98	10	38	2	91	7
	Skirtings	5993		10	1661	20	1641		46.58	18.8	15.7	0	82	17	30	4	76	20
			TOTALS	74	13268	148	13120	MEAN	53.74	19.88	6.4	0.06	93	12	36	2	86	13
								Std Dev	4.07	0.68	5.3	0.05	6	3	4	2	9	9
Certificate	Fleece	568		12	2104	24	2080		56.44	20.4	4.6	0	96	15	36	0	89	11
	Fleece	569		15	2721	30	2691		55.82	19.9	4.4	0	93	14	38	0	86	14
	Fleece	570		18	3403	36	3367		54.17	21	3.1	0.1	92	13	38	5	92	3
	Fleece	571		19	3450	38	3412		54.44	20.6	2.9	0	92	20	37	6	74	20
	Skirtings	5993		10	1659	20	1639		47.59	18.7	12.6	0	72	23	30	5	93	2
			TOTALS	74	13337	148	13189	MEAN	53.69	20.12	5.5	0.02	89	17	36	3	87	10
								Std Dev	3.54	0.89	4.0	0.04	10	4	3	3	8	8
Differences	Fleece	396		0	9	0	9		-0.21	0.5	-0.6	-0.1	3	2	2	0	7	-7
	Fleece	397		0	8	0	8		0.02	0.1	-1.1	-0.1	-3	3	2	0	4	-4
	Fleece	394		0	29	0	29		-0.68	0.6	0.1	0	-4	3	-3	3	-6	3
	Fleece	5920		0	25	0	25		-0.37	0.1	0.1	0	-6	10	-1	4	-17	13
	Skirtings	395		0	-2	0	-2		1.01	-0.1	-3.1	0	-10	6	0	1	17	-18
			TOTALS	0	69	0	69	MEAN	-0.05	0.24	-0.9	-0.04	-4	5	0	2	1	-3
								Std Dev	0.64	0.30	1.3	0.05	5	3	2	2	13	12
								t-value	-0.16	1.809	-1.56	-1.6	-1.886	3.281	0	1.969	0.172	-0.5
								Significance	NS	NS	NS	NS	NS	S	NS	NS	NS	NS

TABLE B5: Property E

Sampling Method	Wool Type	Lot No		Bales	Gross	Tare kg	Nett kg		WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	1185		1	151	2	149		68.58	20	1.1	0.2	89	12	40	2	5	93
	Fleece	1236		7	1280	14	1266		66.56	21.5	2.5	0	84	10	51	6	14	80
	Fleece	1237		2	370	4	366		67.83	23.5	1.7	0.1	84	12	48	8	22	70
	Skirtings	3418		3	490	6	484		52.9	20.3	8.1	0.2	68	21	35	9	59	32
	Fleece	1189 &1238		3	492	6	486		64.6	22.1	2	0.4	74	12	44	5	31	64
			TOTALS	16	2783	32	2751	MEAN	64.09	21.48	3.1	0.18	80	13	44	6	26	68
								Std Dev	6.44	1.42	2.9	0.15	9	4	6	3	21	23
Certificate	Fleece	1185		1	148	2	146		68.27	20.5	1.4	0.3	91	13	43	6	14	80
	Fleece	1236		7	1329	14	1315		67.08	21.6	2.4	0.2	78	14	54	3	33	64
	Fleece	1237		2	378	4	374		67.29	23.5	2.6	0.3	80	12	52	6	37	57
	Skirtings	3418		3	513	6	507		52.69	20.8	8.2	0.5	71	22	35	14	47	39
	Fleece	1189 &1238		3	493	6	487		64.27	21.5	2.4	0.2	74	15	48	4	40	56
			TOTALS	16	2861	32	2829	MEAN	63.92	21.58	3.4	0.30	79	15	46	7	34	59
								Std Dev	6.45	1.17	2.7	0.12	8	4	8	4	12	15
Differences	Fleece	396		0	-3	0	-3		-0.31	0.5	0.3	0.1	2	1	3	4	9	-13
	Fleece	397		0	49	0	49		0.52	0.1	-0.1	0.2	-6	4	3	-3	19	-16
	Fleece	394		0	8	0	8		-0.54	0	0.9	0.2	-4	0	4	-2	15	-13
	Skirtings	5920		0	23	0	23		-0.21	0.5	0.1	0.3	3	1	0	5	-12	7
	Fleece	395		0	1	0	1		-0.33	-0.6	0.4	-0.2	0	3	4	-1	9	-8
			TOTALS	0	78	0	78	MEAN	-0.17	0.10	0.3	0.12	-1	2	3	1	8	-9
								Std Dev	0.41	0.45	0.4	0.19	4	2	2	4	12	9
								t-value	-0.958	0.494	1.899	1.4	-0.577	2.449	3.81	0.368	1.496	-2.09
								Significance	NS	NS	NS	NS	NS	S	S	NS	NS	NS

TABLE B6: Property F

Sampling Method	Wool Type	Lot No		Bales	Gross	Tare kg	Nett kg		WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	2551		7	1240	14	1226		67.87	18.6	1	0	86	9	49	16	21	63
	Fleece	2554		6	1068	12	1056		66.05	18.4	1.3	0	72	10	46	16	60	24
	Skirtings	5577		8	1472	16	1456		58.36	18.4	6.5	0	72	15	33	0	40	60
	Fleece	6509		5	908	10	898		67.35	18.8	1.3	0	80	8	42	8	28	64
	Fleece	6512		4	715	8	707		69.53	18.9	1	0	90	16	48	18	30	52
			TOTALS	30	5403	60	5343	MEAN	65.83	18.62	2.2	0.00	80	12	44	12	36	53
								Std Dev	4.36	0.23	2.4	0.00	8	4	7	8	15	17
Certificate	Fleece	2551		7	1229	14	1215		68.07	18.3	1.1	0	83	14	43	5	30	65
	Fleece	2554		6	1061	12	1049		65.98	18.3	1.3	0	71	13	46	15	67	18
	Skirtings	5577		8	1462	16	1446		58.26	18.3	6.4	0	73	22	36	9	52	39
	Fleece	6509		5	906	10	896		67.44	18.8	1.1	0	79	12	45	3	29	68
	Fleece	6512		4	711	8	703		69.54	19.2	0.9	0	87	12	46	14	40	46
			TOTALS	30	5369	60	5309	MEAN	65.86	18.58	2.2	0.00	79	15	43	9	44	47
								Std Dev	4.44	0.41	2.4	0.00	7	4	4	5	16	20
Differences	Fleece	396		0	-11	0	-11		0.2	-0.3	0.1	0	-3	5	-6	-11	9	2
	Fleece	397		0	-7	0	-7		-0.07	-0.1	0	0	-1	3	0	-1	7	-6
	Skirtings	394		0	-10	0	-10		-0.1	-0.1	-0.1	0	1	7	3	9	12	-21
	Fleece	5920		0	-2	0	-2		0.09	0	-0.2	0	-1	4	3	-5	1	4
	Fleece	395		0	-4	0	-4		0.01	0.3	-0.1	0	-3	-4	-2	-4	10	-6
			TOTALS	0	-34	0	-34	MEAN	0.03	-0.04	-0.1	0.00	-1	3	0	-2	8	-5
								Std Dev	0.12	0.22	0.1	0.00	2	4	4	7	4	10
								t-value	0.476	-0.408	-1.18	0	-1.871	1.604	-0.237	-0.73	4.146	-1.23
								Significance	NS	NS	NS	NS	NS	NS	NS	NS	S	NS

TABLE B7: Property H

Sampling	Wool Type	Lot No		Bales	Gross	Tare	Nett		WB	MFD	VMB	HH	Length	Length	Strength	Position of Break		
Method						kg	kg		kg	micron	%	%	mm	CV%	Nkt	Tip	Middle	Base
Report	Fleece	333		3	480	6	474		64.47	16.9	0.6	0	79	10	39	0	54	46
	Fleece	335		2	262	4	258		65.47	16.9	0.6	0	81	10	37	3	58	39
	Fleece	337		5	845	10	835		62.74	16.6	0.7	0	77	15	30	2	42	56
	Fleece	339		3	521	6	515		62.64	17	0.7	0	70	17	31	0	56	44
	Skirtings	2156		3	435	6	429		61.44	17.1	2.9	0	74	18	39	4	56	40
			TOTALS	16	2543	32	2511	MEAN	63.35	16.90	1.1	0.00	76	14	35	2	53	45
								Std Dev	1.60	0.19	1.0	0.00	4	4	4	2	6	7
Certificate	Fleece	333		3	481	6	475		64.25	17.1	0.7	0	75	15	42	2	33	65
	Fleece	335		2	262	4	258		65.64	17	0.6	0	81	12	37	0	52	48
	Fleece	337		5	853	10	843		62.85	16.8	0.5	0	72	22	30	3	30	67
	Fleece	339		3	522	6	516		62.49	17.1	0.6	0	69	19	30	2	31	67
	Skirtings	2156		3	433	6	427		61.1	17.3	2.3	0	68	18	33	2	42	56
			TOTALS	16	2551	32	2519	MEAN	63.27	17.06	0.9	0.00	73	17	34	2	38	61
								Std Dev	1.74	0.18	0.8	0.00	5	4	5	1	9	8
Differences	Fleece	396		0	1	0	1		-0.22	0.2	0.1	0	-4	5	3	2	-21	19
	Fleece	397		0	0	0	0		0.17	0.1	0	0	0	2	0	-3	-6	9
	Fleece	394		0	8	0	8		0.11	0.2	-0.2	0	-5	7	0	1	-12	11
	Fleece	5920		0	1	0	1		-0.15	0.1	-0.1	0	-1	2	-1	2	-25	23
	Skirtings	395		0	-2	0	-2		-0.34	0.2	-0.6	0	-6	0	-6	-2	-14	16
			TOTALS	0	8	0	8	MEAN	-0.09	0.16	-0.2	0.00	-3	3	-1	0	-16	16
								Std Dev	0.22	0.05	0.3	0.00	3	3	3	2	8	6
								t-value	-0.881	6.532	-1.32	0	-2.764	2.579	-0.547	0	-4.65	6.091
								Significance	NS	S	NS	NS	S	S	NS	NS	S	S

TABLE B8: Property I

Sampling	Wool Type	Lot No		Bales	Gross	Tare	Nett		WB	MFD	VMB	HH	Length	Length	Strength	Position of Break		
Method						kg	kg		kg	micron	%	%	mm	CV%	Nkt	Tip	Middle	Base
Report	Fleece	5025		2	306	4	302		63.53	18.3	2	0.2						
	Fleece	5026		4	713	8	705		66.81	19.8	1.5	0.4	79	14	33	0	11	89
	Fleece	5027		4	735	8	727		67.36	20.6	0.7	0	87	15	34	0	26	74
	Fleece	5028		5	784	10	774		65.5	19.4	1.3	0.3						
	Skirtings	5214		6	1043	12	1031		58.52	19.1	6.5	1.6	79	21	36	14	51	35
			TOTALS	21	3581	42	3539	MEAN	64.34	19.44	2.4	0.50	82	17	34	5	29	66
								Std Dev	3.57	0.85	2.3	0.63	5	4	2	8	20	28
Certificate	Fleece	5025		2	301	4	297		63.88	17.7	1.8	0.3						
	Fleece	5026		4	708	8	700		65.4	19.8	1.4	0.3	77	12	40	0	16	84
	Fleece	5027		4	729	8	721		65.38	20.3	1.5	0.4	85	18	36	2	22	76
	Fleece	5028		5	782	10	772		63.81	18.7	2.2	0.6						
	Skirtings	5214		6	1038	12	1026		56.73	18.5	7.1	1.4	78	20	29	7	49	44
			TOTALS	21	3558	42	3516	MEAN	63.04	19.00	2.8	0.60	80	17	35	3	29	68
								Std Dev	3.61	1.04	2.4	0.46	4	4	6	4	18	21
Differences	Fleece	396		0	-5	0	-5		0.35	-0.6	-0.2	0.1						
	Fleece	397		0	-5	0	-5		-1.41	0	-0.1	-0.1	-2	-2	7	0	5	-5
	Fleece	394		0	-6	0	-6		-1.98	-0.3	0.8	0.4	-2	3	2	2	-4	2
	Fleece	5920		0	-2	0	-2		-1.69	-0.7	0.9	0.3						
	Skirtings	395		0	-5	0	-5		-1.79	-0.6	0.6	-0.2	-1	-1	-7	-7	-2	9
			TOTALS	0	-23	0	-23	MEAN	-1.30	-0.44	0.4	0.10	-2	0	1	-2	0	2
								Std Dev	0.95	0.29	0.5	0.25	1	3	7	5	5	7
								t-value	-3.078	-3.415	1.737	0.88	-5	0	0.163	-0.61	-0.12	0.495
								Significance	S	S	NS	NS	S	NS	NS	NS	NS	NS

TABLE B9: Property G

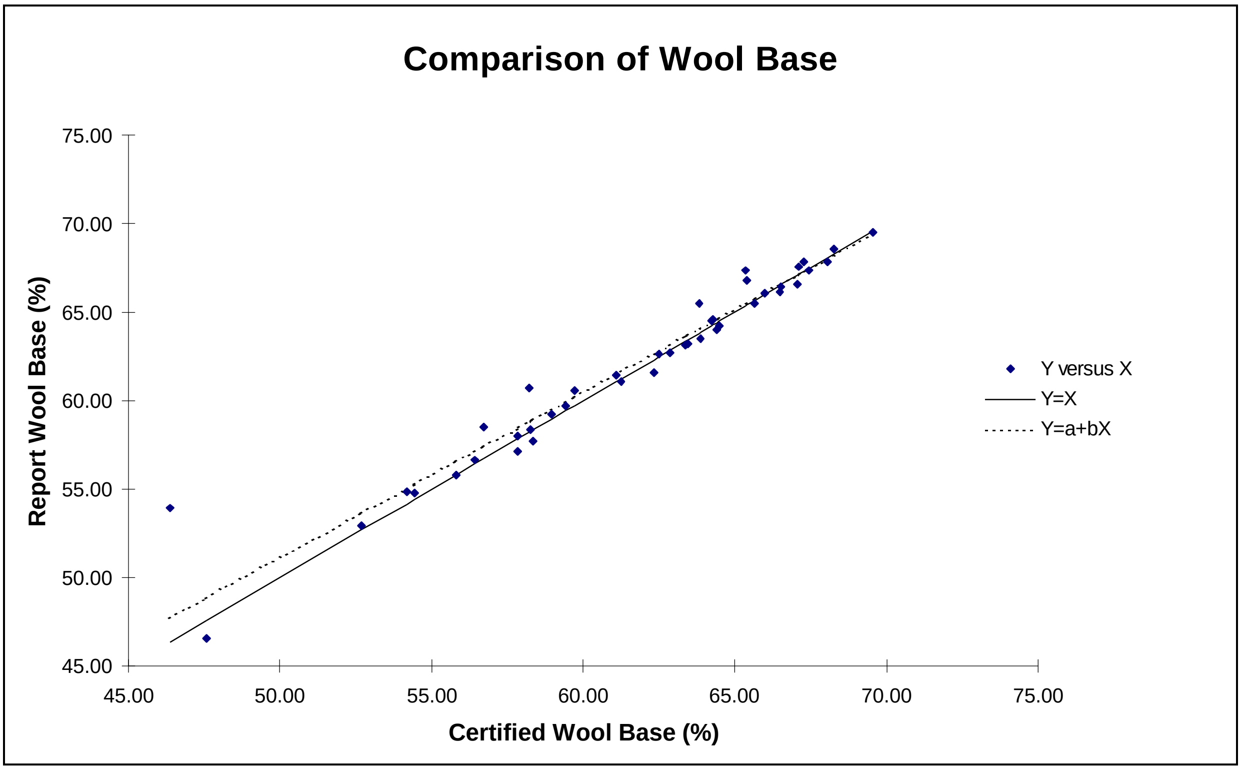
Sampling Method	Wool Type	Lot No	Bales	Gross	Tare kg	Nett kg	WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	4460	20	3834	40	3794	59.7	19.7	3.1	0.1	98	12	36	42	55	3
Certificate	Fleece	4460	20	3765	40	3725	59.43	19.8	2.4	0.1	87	19	35	23	70	7
Difference	Fleece	4460	0	-69	0	-69	-0.27	0.1	-0.7	0	-11	7	-1	-19	15	4

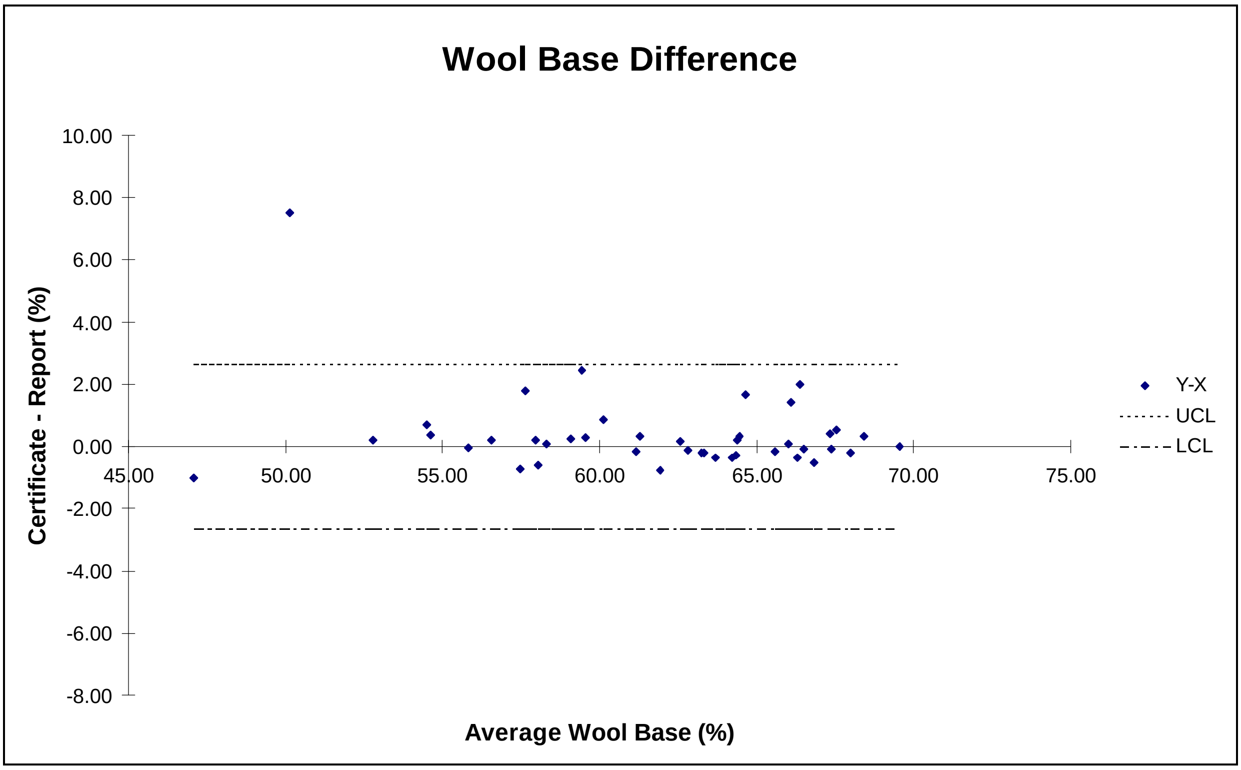
TABLE B10: Property J

Sampling Method	Wool Type	Lot No	Bales	Gross	Tare kg	Nett kg	WB kg	MFD micron	VMB %	HH %	Length mm	Length CV%	Strength Nkt	Position of Break Tip	Middle	Base
Report	Fleece	751	4	775	8	767	63.25	19.3	0.5	0	79	14	40	7	7	86
Certificate	Fleece	751	4	785	8	777	63.44	19.5	0.6	0	76	19	33	5	2	93
Difference	Fleece	751	0	10	0	10	0.19	0.2	0.1	0	-3	5	-7	-2	-5	7

APPENDIX C

FIGURE C1

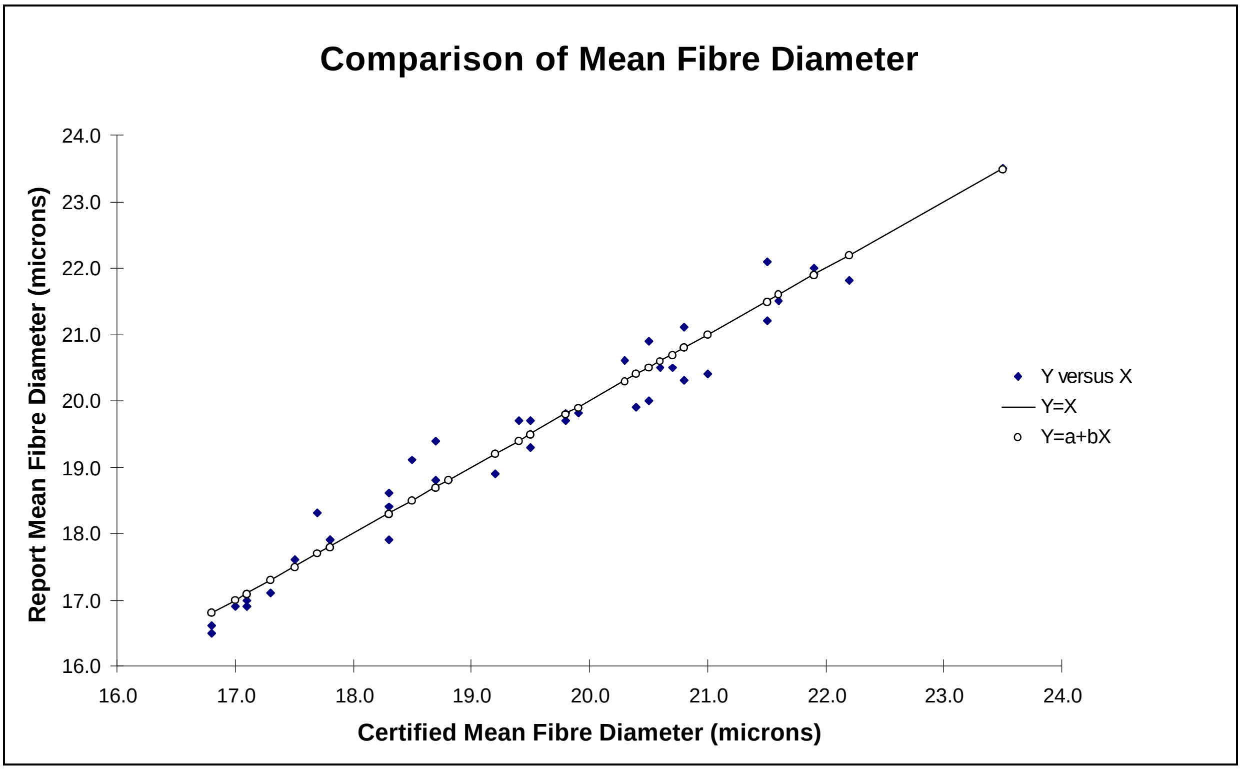


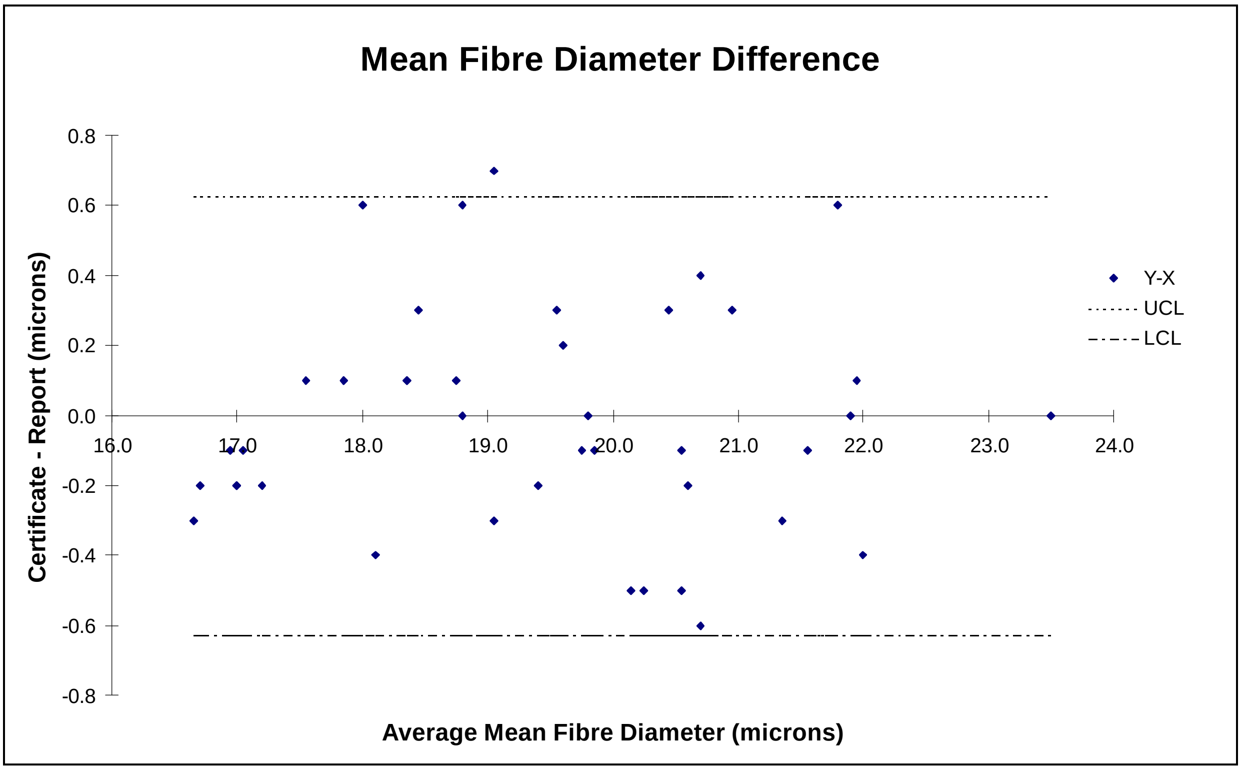


Summary of Regression Statistical data for Wool Base

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.969	0.936	0.036	1.758	NS
Difference versus Average	0.260	-0.067	0.039	-1.702	NS

FIGURE C2

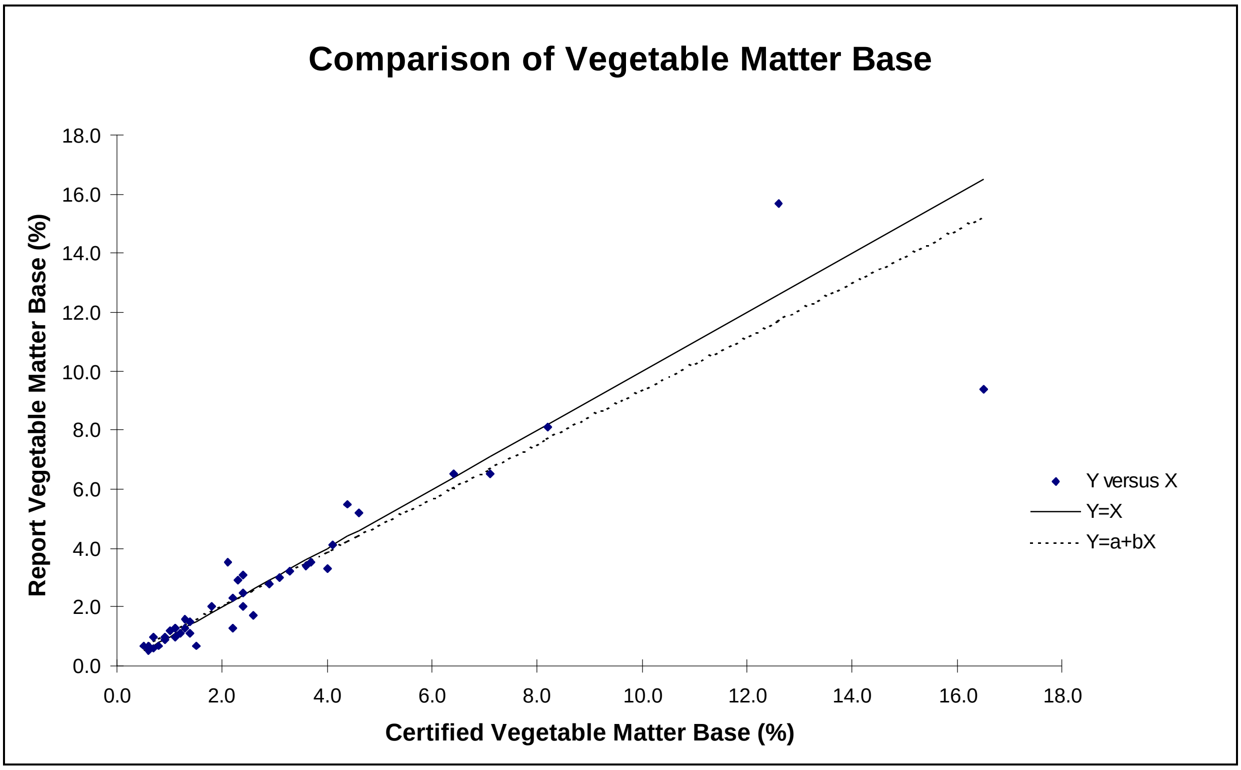


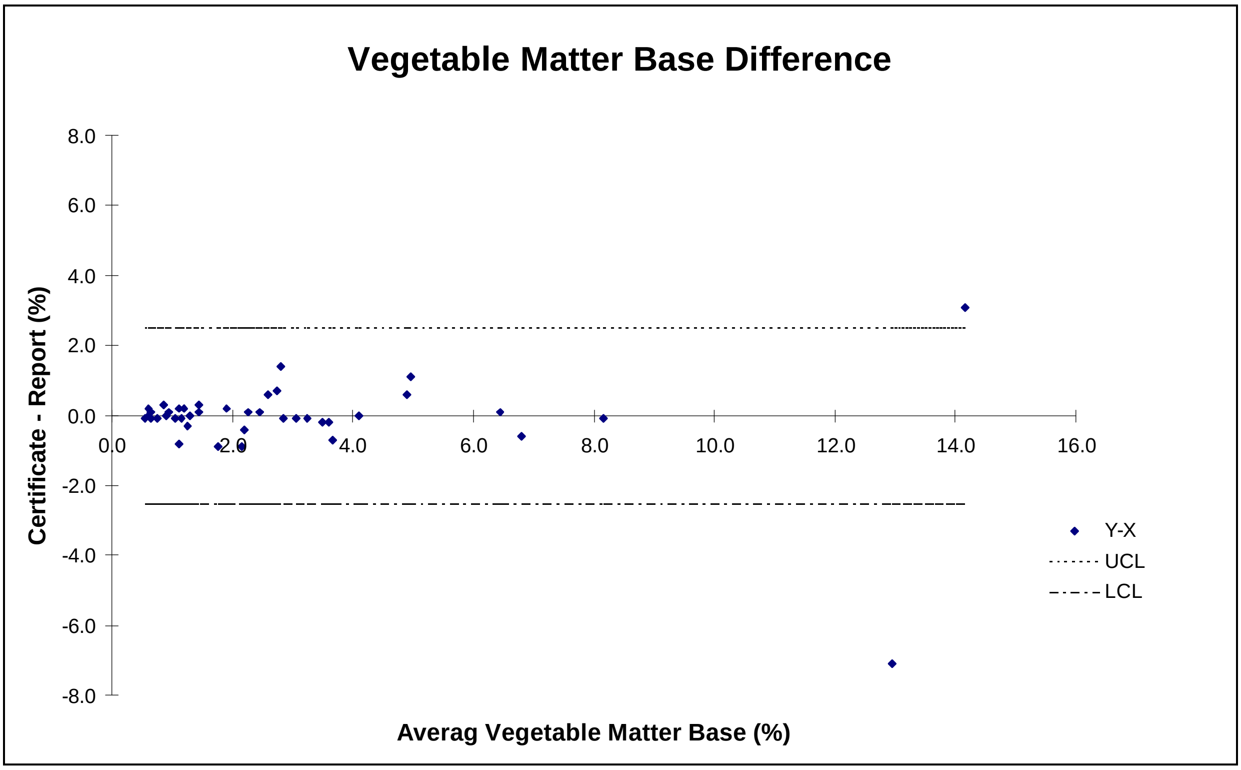


Summary of Regression Statistical data for Mean Fibre Diameter

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.983	1.000	0.029	-0.004	NS
Difference versus Average	0.001	-0.017	0.029	0.004	NS

FIGURE C3

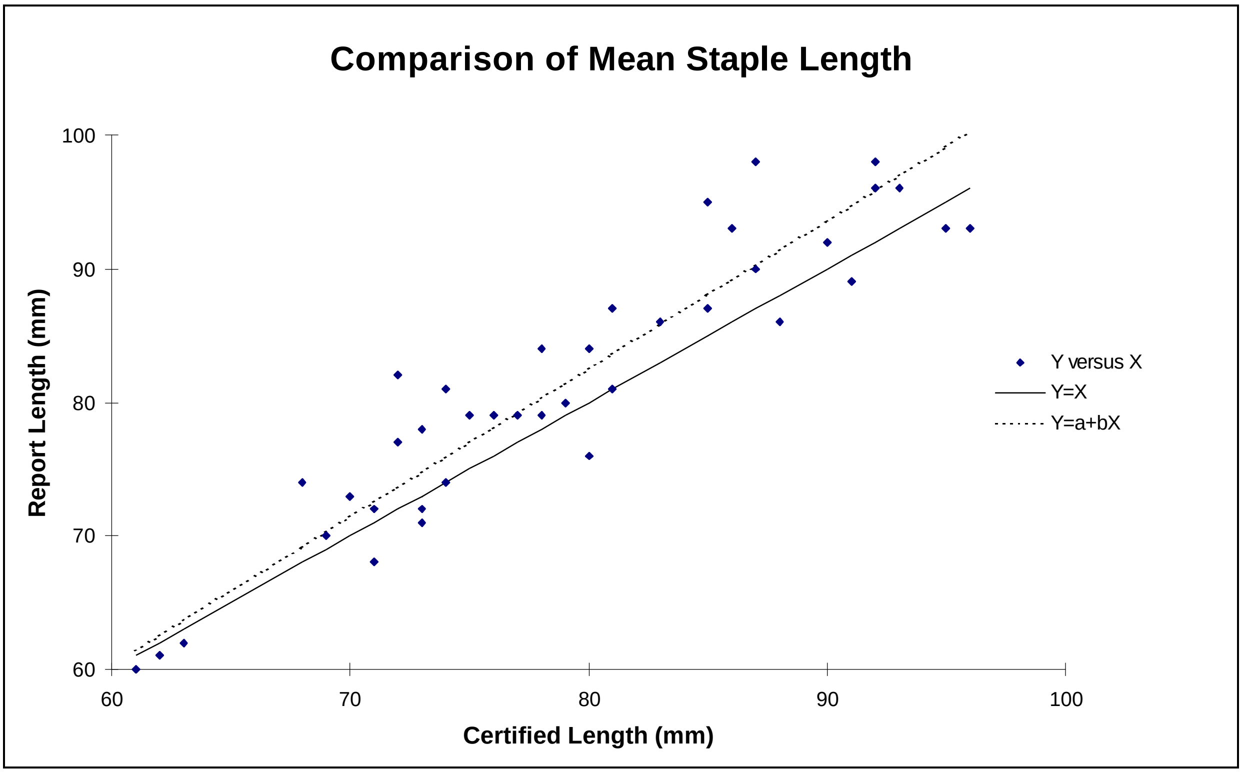


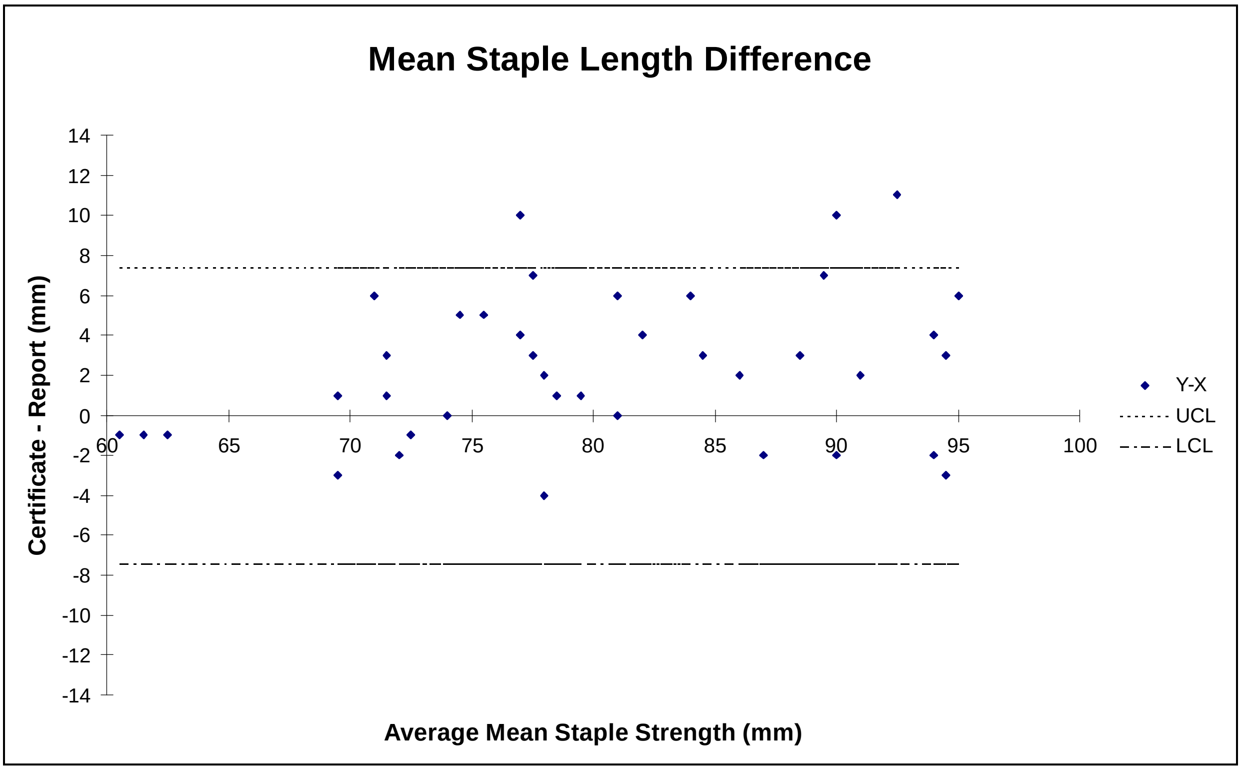


Summary of Regression Statistical data for Vegetable Matter Base

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.916	0.913	0.058	1.507	NS
Difference versus Average	0.222	-0.095	0.066	-1.441	NS

FIGURE C4

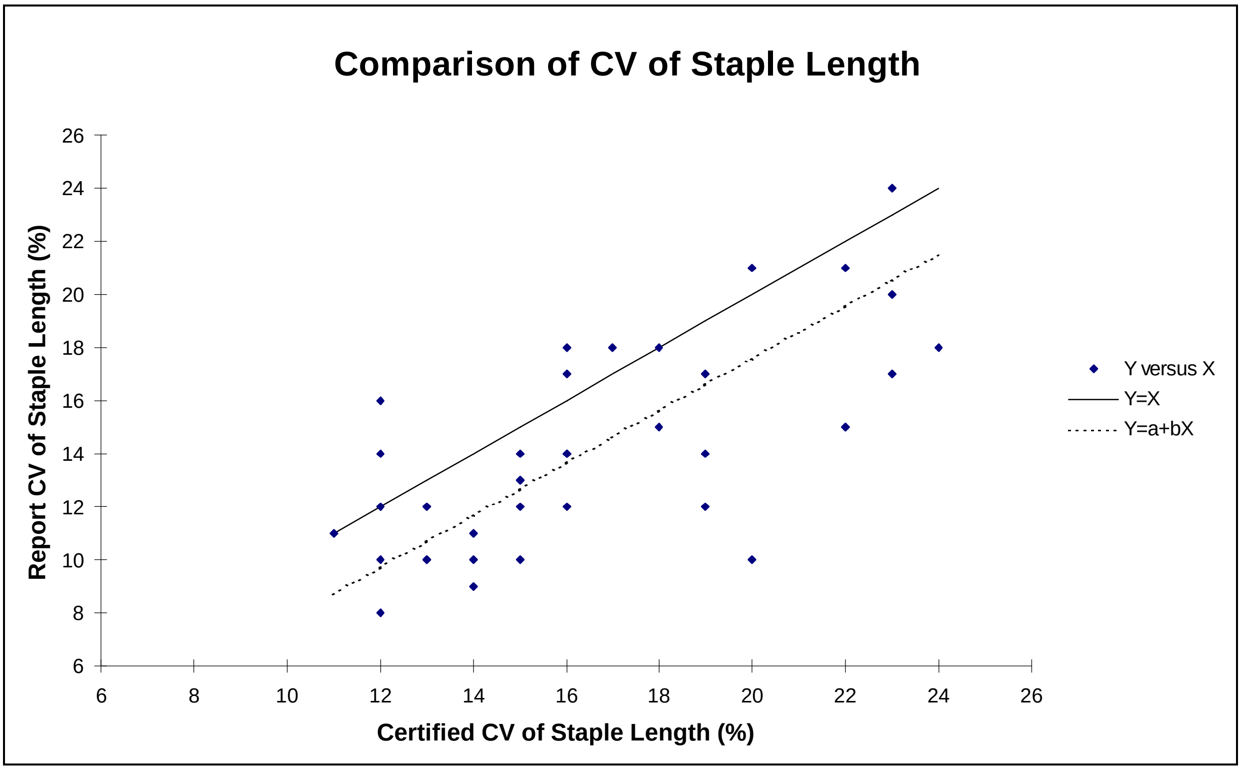


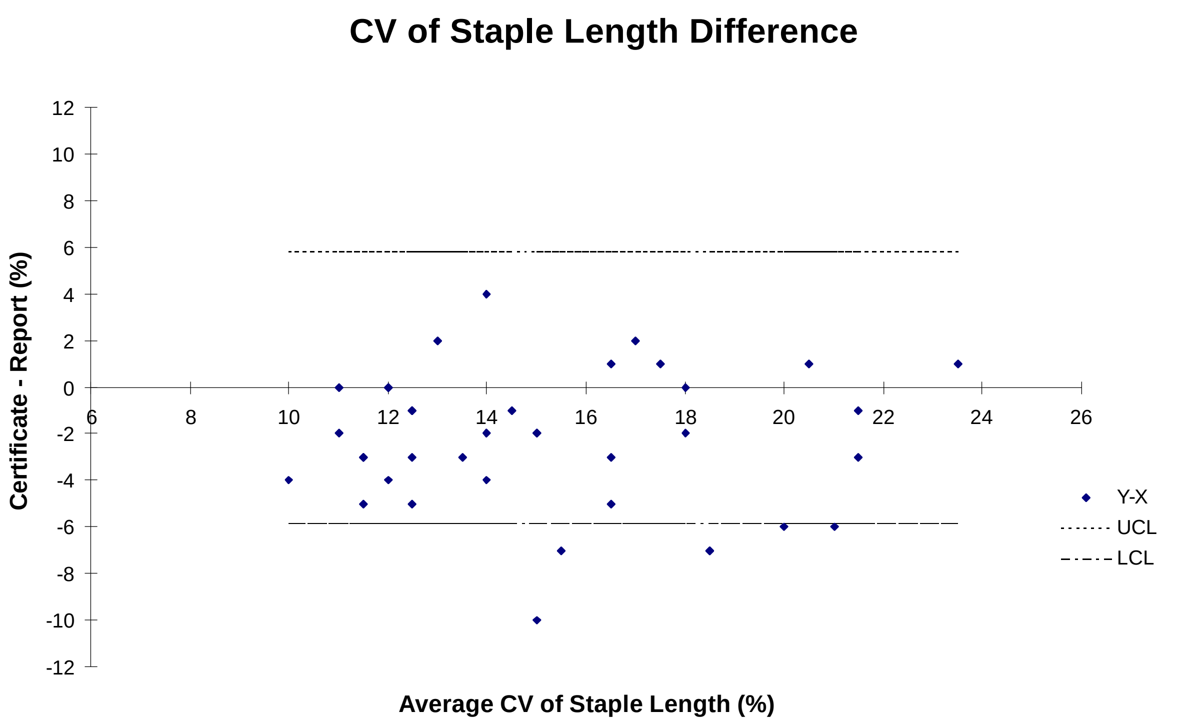


Summary of Regression Statistical data for Mean Staple Length

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.930	1.109	0.067	-1.622	NS
Difference versus Average	0.271	0.107	0.062	1.710	NS

FIGURE C5

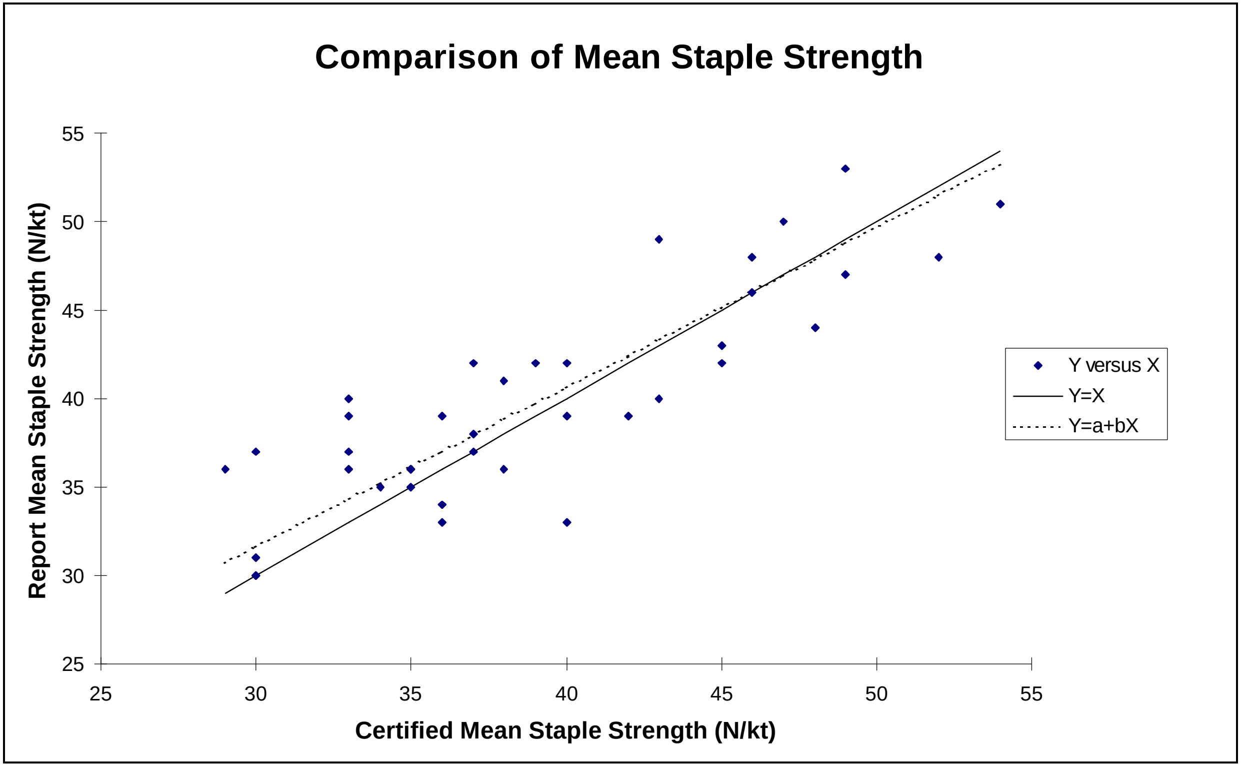


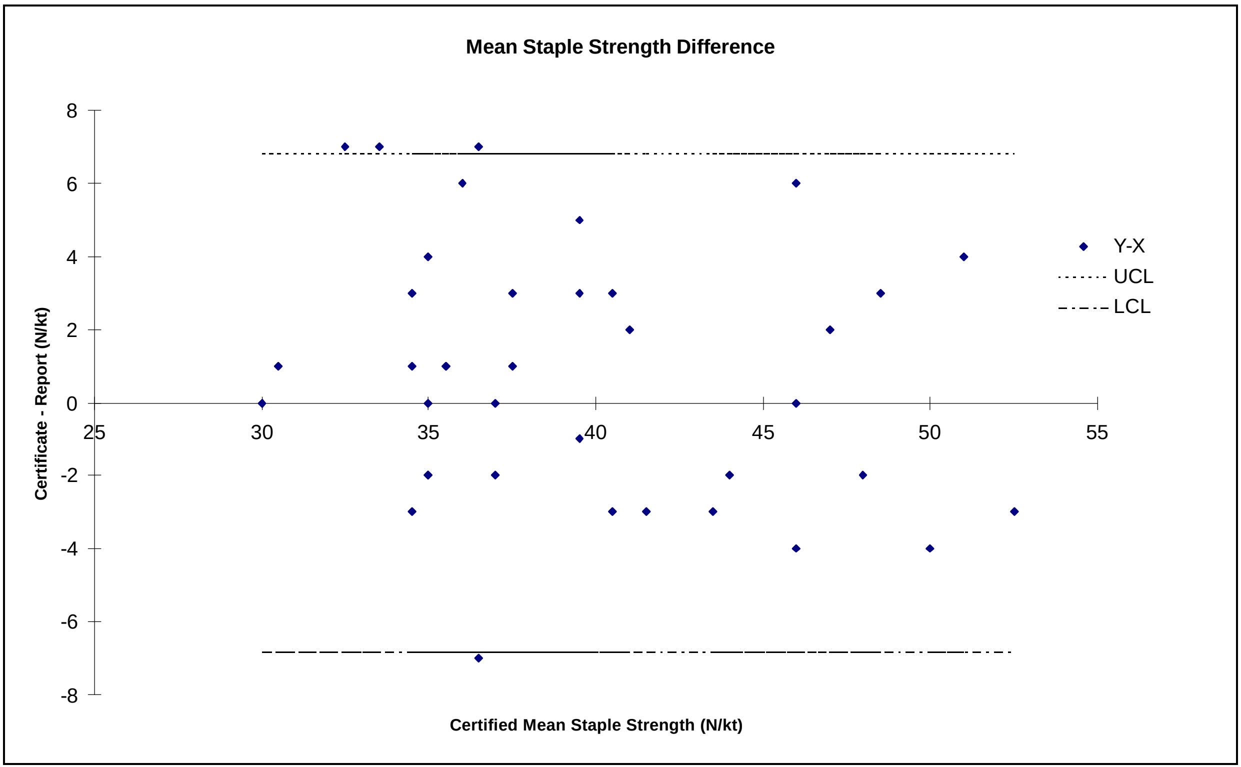


Summary of Regression Statistical data for CV of Staple Length

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.693	0.985	0.117	0.131	NS
Difference versus Average	0.021	-0.018	0.140	-0.130	NS

FIGURE C6





Summary of Regression Statistical data for Mean Staple Strength

Regression Type	R	Estimated Slope	Standard Error of Slope	t-value for the slope	Statistical Significance
Geometric Mean	0.850	0.902	0.078	1.252	NS
Difference versus Average	0.192	-0.111	0.093	-1.191	NS