Impact of objective fibre measurement on wool production, marketing, manufacture and research

Contract Presentation

Reasons and strategy for the introduction of objective measurement of wool

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Research on objective measurement (OM) of wool began at WRONZ in the late 1960s. This initiative was taken for a variety of reasons which still apply today. The New Zealand wool clip had been traditionally classed for sale into a multitude of types, yet mill usage patterns clearly showed many subjective classifications were based on aspects of style or yield which meant little during wool processing. The concept of rationalisation of marketing has expanded in various directions since and in many ways remains the principal driving force behind the whole project.

This review of the strategy for OM would be incomplete without some reference to a sub-set of derived strategies each independently capable of yielding a major benefit in its own right. They are:

(a) full sale by description of greasy wool at auction;
(b) marketing of aggregated scourments produced in New Zealand; and
(c) formulation of blended aggregates by computer methods to give consistent processing and products at least cost.

The main purpose of this seminar will firstly be to refresh perceptions of the strategy underlying OM and to review current or foreseeable progress toward its realisation. This strategy has a critical influence on the selected range of fibre measurements and the means of making them. The second purpose is the important and interesting one of analysing benefits and opportunities which can be anticipated as OM is more fully exploited. Of particular interest to participants at this meeting will be the scope for adaptation of benchmark standard OM tests to facilitate individual flock or national clip improvement. The panel discussion later is intended to open the debate on these issues.

Bearing in mind these later discussions, a principal purpose of this paper will be to underline some constraints imposed by the general strategy of implementation of OM. Tests designed for large-volume test house use are unlikely to be ideal for application in other spheres such as animal selection for breeding without some adaptation.

The Textile Institute Conference at Lincoln in 1983 (The Textile Institute (New Zealand Section), 1983) brought together IWS, CSIRO, and New Zealand experts in most aspects of OM and it is worth restating the main points made then because they gave a global view which remains substantially valid today. Mr Buchanan of the New Zealand Wool Board stressed the need to sell our raw material, wool, with some assurance of consistency and quality in order to remain competitive with synthetic fibres. He expanded on the rapid changes in market destination of our wool, its processing routes and consumer products, and the perceived need for wool to go upmarket to survive in the long term.

Dr Andrews of CSIRO categorised the ultimate benefits of OM, presenting a similar list to WRONZ of contributions on this point. They were:

Elimination of show floors.
Centralised selling.
Continuous selling.
Reduced costs to buyers.
Rational clip preparation.
Greater marketing efficiency.
Lower processing cost.

Another paper today will expand on the first 5 items and the only additional point made now refers to the very important consequential developments that are in progress in packaging and sampling wool. These not only alter transport routes from farm to manufacturer but also change the way the wool trade operates. More efficient wool-flow patterns may in fact yield the largest direct benefits to wool producers.

The last 2 items on the list are more obscure because they implicitly assume that the costs of OM are readily recoverable both in the selling process itself and further downstream as a result of more predictable manufacturing.

One needs to bear in mind that proceeding from the current package of tests which made 'sale by sample' a reality to full OM specifications will involve additional measurements of uncertain but possibly high cost. Any aspect of the description of wool can be measured, but this crucial factor of cost, even with the economies of scale afforded by a large number of lots, has been the central issue for WRONZ. What is the minimum set of economic tests needed to accommodate meaningful specification of the bulk of the clip? Other consequential costs of OM include the need to hold reference samples and the implicit obligations to settle claims or meet some guarantee.

Taking this point further, there is no ultimate proof yet that completing the range of tests of adequate reliability and precision for realistic practical use in total specification will not escalate total costs of the system so as to counteract all or most of the direct savings inherent in presale testing.

Present Measurements

Each measurement that has come into test-house use and international recognition has evolved from statistical analysis starting with adequate foolproof sampling, subsampling, preparation, and test procedure. One notes that many years after initial introduction such old hardies as yield and regain tests are periodically reviewed and adapted to reduce the scope for errors and claims. So great are these problems of simple indexation of the properties of a complex material, which is often highly variable within a single lot, that each test has demanded individual attention to the basics of presenting reliable test samples. The fundamental list of tests required for New Zealand wools has itself been a subject of searching analysis by WRONZ, and comprises the following:

(1) Yield

A range of tests is actually needed, based on washing wool to a clean state and analysing it. Derived information includes wool base, ash yield, and vegetable matter (VM) and extractable residuals. Core sampling is needed for an adequate result.

(2) Fibre diameter

The longstanding airflow method is not fully satisfactory for New Zealand wools because of anomalies in measuring lambswool and medullated wools. The imaging system FIDIVAN (WRONZ) did not proceed beyond the laboratory prototype and the later FFDA developed by CSIRO has not found favour much beyond scientific use. A new development fostered by the Australian Wool Testing Authority based on modern image analysis now looks most promising and owing to WRONZ participation in this project it may be available for assessment by WRONZ later this year. While variability of fibre diameter within a lot or a blend remains a somewhat obscure factor in the processing or performance of most New Zealand wools, it is noteworthy that in keeping with all versions of imaging equipment the AWTA development would yield data on this parameter.

(3) Length

The measurement of fibre length is the principal obstacle to a transition from sale by sample to full OM specification. Sampling to yield a set of representative staples followed by staple length/strength testing has proceeded furthest in Australia using ATLAS (CSIRO), with PERSEUS (UNSW) and a South African version made by SAWTRI also contenders for practical use. These instruments were designed basically for Merino wools and the specific problem of relating top to staple length/strength parameters has been attempted by the development of algorithms. Appropriate computer software is being refined to convert nominal length and measured strength and position of break to a hauteur-barbe prediction of value to topmakers.

These instruments are in the course of appraisal for a range of New Zealand wool types. In order to convert the results to an understandable form, these lots are being similarly measured for staple length (WRONZ staplemeter) and length-after-carding on a prototype card-gill-Almeter system established by WRONZ in the NZWTA Christchurch laboratory. Within Australia some delays are anticipated in moving from CSIRO-designed ATLAS machines to a fully commercial version. A further potential problem is the ultimate practical cost of a test which may need adjustment to something over A$40 per lot.

Considerable uncertainties still surround the value of a length/strength measurement of New Zealand wool types. The present raw data obtained from a restricted range of wools certainly do not mean much without mathematical processing into a form more significant to wool processors. Auxiliary trials by WRONZ referred to earlier will be crucial in this

regard, and a decision on how to proceed with length/strength measurement awaits completion of the current round of trials.

Very recent results suggest that the WRONZ proposal to expedite scoured wool specification by means of a card-gill-Almeter sequence will be technically feasible, based on results which indicate that parallel lines of equipment can be tuned to give consistent results.

The capital and labour costs inherent in this test suggest a test cost of the order of NZ$60 which is likely to be acceptable for the larger size of typical scourments compared to greasy wool auction lots.

(4) Colour

Considerable progress has been made this season in the application of colour measurement on a routine basis by test-houses. It is still not clear, however, whether the present colour test will gain acceptance by IWTO, partly because the Australians have alternative ideas on precleaning techniques. Wider use of colour tests is also likely to expose other problems, notably a lack of understanding of the basic reflectance data they produce. Colour tests also look set to highlight inadequacies in commercial scouring, and possibly examples of unusual instability of wool colour during processing. The premiums for better colour may already have generated more use of bleaches during scouring but exacerbate problems of reyellowing during processing or exposure of the final product to sunlight. It seems pointless to cast doubts on the test for these consequences, which emanate from a quite substantial existing technical problem for wool, namely colour stability. The concept of colour space is not difficult for technical dyehouse staff, but other terms derivable from reflectance parameters, e.g., brightness and yellowness, will always be a little tricky for those who have not thought much about colour physics.

(5) Bulk

The practical importance of bulk has been discussed for many years and it may be variously associated with many features of wool products. The degree of softness and resilience of fine wool knitwear may be contrasted with the robust crisp high-volume yarns from bulky carpet wool blends. Much development work has gone towards defining satisfactory methods of homogenising a wool sample and determining a volume packing factor. A prototype test-house version will be appraised shortly.

(6) Medullation

Medullation is made visible by the immersion of fibres in a liquid of similar refractive index. The labour-intensive method of counting a sample in a projection microscope and a more sophisticated and faster optical method based on the above principle (WRONZ Medullameter) are the main sources of present data. A potential bonus of the AWTA image analyser for fibre diameter measurement is an indication that it could provide an adequate medulla content estimate at no extra cost. This would be important in view of the great variation in significance of medullation to manufacturers from nil to quite high in some instances.

Other Measurements and Methods

Additional information may be valuable in some cases. CSIRO are interested in an economical method of determining the very small but often very important level of incidence of dark fibres. The identification and ranking of wools of high lustre would be useful to some manufacturers.

Perhaps of more general significance is the evaluation of new physical instruments which may replace existing standard equipment. Near-infrared reflectance can provide a directly calculated estimate of wool base, regain, residual grease, and VM on scoured wool. After detailed research WRONZ has produced a test method based on subsampling by a minicoring machine, involving some modification of standard NIR equipment. The extension of this technique to all greasy wools as well looks most difficult but not impossible.

Image analysis is a fast developing technology which has succeeded both at CSIRO and WRONZ in providing staple length estimates. Software refinement could yield further data on tippiness, cotting, position of break (when visible by fibre thinning) and general staple conformation. No clear view can be taken at this point of the future place of image analysis in wool specification, other than the AWTA IMAN development aimed primarily at fibre diameter measurement.

The Application of OM to Farm Management and Breeding

It is worth highlighting some features of OM by way of introduction to the panel discussion of this topic. OM methods are strictly organised to solve difficult sampling and subsampling problems to yield mean values. They are aimed at large numbers of tests of verifiable precision at the lowest cost. The capital cost of equipment is often secondary to minimum labour cost and human intervention. The precision sought is based on useful manufacturing distinctions, not on within- or between-animal variations. Nevertheless the test-house equipment itself, or a simplified version of it, will clearly often be useful in a directly relevant manner for breeding research or flock improvement.

However, there is usually another dimension to instrumental wool appraisal on the farm or in flock-research projects, namely the economics of changing a farm procedure such as classing or formulating a breed-improvement plan. Considerable exasperation is a common result of analysis of wool price stratification according to selected OM variables. The