Is it Time to Revisit Dark Fibre Risk Analysis?

Background

Due to the efforts of studs and commercial wool growers to reduce objectionable fibre contamination, through animal selection, culling and clip preparation, Australian wool is conspicuously free of coloured fibres compared to wool of many other countries, and commands a premium because of this [7].

Coloured fibres may be either naturally pigmented fibres (black fibres) or fibres stained by urine. Pigmented fibres will always occur in some sheep, no matter how well bred, because the genes that produce them cannot be totally eliminated by traditional breeding techniques. Apart from the occasional 'black sheep' the expression of pigmented fibres may occur via small patches of such fibres on white sheep [11]. These often become more prevalent on older sheep [4].

Alternatively, pigmented fibres in wool may occur through contamination from coloured sheep running within a white mob [5] or by poor shed hygiene.

Historically, urine stain has been seen as the most significant source of coloured fibres in Australian wool [2]. Urine stained fibres almost always occur because of unsatisfactory crutching or the failure to crutch at all. Removal of urine stained fibres during skirting and classing is extremely difficult.

Spinners or weavers may specify levels of around 10-20 pigmented fibres per 100 grams of wool top (even less for some uses) before discounts (or claims) apply [7]. In the original greasy wool this corresponds to as few as 3-4 staples of stained or coloured fibres per bale. Given that the sources of coloured fibres are normally patchy, it is difficult if not impossible to provide a reliable test of sale lots of greasy wool for such low levels of contamination. The major difficulty is obtaining an appropriate sample.

In the early 1980's CSIRO developed an instrument, the Dark Fibre Detector, which can be used for routinely monitoring levels of dark fibre contamination in wool tops [1]. In principle this instrument can and has been used for examination of scoured and carded samples of greasy wool, but the sampling difficulties preclude its routine use for testing for contamination from pigmented fibres. Furthermore it is a very tedious labour intensive procedure, which means for routine testing of greasy wool it is very expensive.

The CSIRO Dark Fibre Detector (left) uses balanced illumination from above and below a thinly spread sample constrained between two glass plates to make objectionable fibres more visible. The SiroCLEAR™ technology (right) is an on-line optical sensing device that detects and removes contamination from undyed yarns.

CSIRO subsequently developed additional technology, SiroCLEAR™, an optical sensing device for examining yarns when they are wound from a bobbin onto a cone. It offers processors dramatic cost reductions in coloured contaminant detection and removal from undyed yarn in winding, and is capable of removing rust stains, black fibres, dirty fibres, vegetable material, strands of baling twine, and packing material residues.

The Dark Fibre Detector can therefore alert a processor that there is a problem. The SiroCLEAR provides a spinner with a system for ameliorating a problem. Neither is useful in preventing the problem in the first place.

Due to the inherent difficulties in testing greasy wool for contamination of sale lots by objectionable fibres, Australia has taken the approach of attempting to minimise this by emphasising on-farm management techniques rather than relying upon a presale test. These techniques were incorporated in the former Australian Wool Corporation's 'Code of Practice for Wool Preparation', and are maintained in the Australian Wool Exchange's (AWEX) rules.

Over the past 4 years there has been an increasingly vigorous debate within the Australian Wool Industry about the risk of contamination of sale lots of merino wool by 'objectionable fibres' arising from the introduction of exotic sheep breeds such as Damara, Dorper, Karukul, and Awassi. Farmers were encouraged to introduce these sheep during the 1980's [3] and some did so throughout the 1990's [15] because they believed that they could improve the economic performance of their businesses.

Research has shown that contamination of merino wool by exotic sheep or their crossbred offspring can occur via three mechanisms [9,10,11,12,14,16,17,18]:

- contact of the ewes with the exotic rams during mating;
- contact of the ewes with their offspring following such matings; and
- penning coloured sheep and white sheep together close to shearing.

Contamination is unlikely if merinos are allowed to graze in paddocks previously grazed by exotic sheep, or in paddocks adjacent to exotic sheep [15].

AWEX has introduced variations to clip preparation and marketing procedures that reinforce the risk of wool contamination in such situations. AWEX's Woolclasser Development Program, currently nearing completion, has very actively promoted these changes to all of Australia's registered classers. Indeed, AWEX requires identification of potentially affected lots in all auction sale catalogues, via the addition of a Y suffix to the description of the wool.

There is evidence to suggest that such contamination can be effectively managed [9,10,11,13,14,17] on-farm. However, there is also evidence that such attempts at management are not always successful [16,18].

Furthermore, there have already been examples of commercial sale lots of wool being contaminated and causing substantial problems to processors.

It has been shown that contamination from exotic sheep, by the pathways indicated above, results in the contamination being relatively uniformly distributed over the contaminated fleeces. Further, it has been demonstrated that a Test Method based on the CSIRO Dark Fibre Detector can be used to screen for the presence or absence of such contamination with a detection level that is sufficient to meet commercial requirements [16]. ➤

Contamination of merino wool by exotic sheep can occur by contact with the rams during mating, contact with the lambs and by running the breeds together.

However, although this equipment is relatively inexpensive (AUD8000) the Test Method is highly labour intensive, requiring approximately 5 man-hours per test, which means that each test will cost AUD150 (+GST). If every lot were to be routinely monitored then the cost would be much higher, due the physical space required. Despite this, as an interim measure AWTA Ltd will, from the beginning of March 2003, provide a simplified screening service based on the Dark Fibre Detector, so that growers have a testing option if they require it. Meanwhile, the Company is employing its own resources and also collaborating with other researchers in an effort to develop a more cost effective test.

Nevertheless this does not adequately address the entire problem. This test (or any later development) will not be capable of detecting urine stain, or pigmented fibres that are naturally grown by merino sheep, with a commercially acceptable reliability. The industry therefore requires a more holistic approach. Ideally this will incorporate:

- on-farm management systems to minimise the risk of contamination from any source;
- systems for quantifying the level of risk of contamination given that the appropriate management system is followed;
- a low cost presale test for potential contamination arising from contact with exotic sheep;
- technology to quantify contamination of tops; and
- technology to remove any contamination from yarns.

Fortunately much of what is required is already in place, able to be put in place relatively quickly, or made available after some development effort.

On-farm management systems for minimising contamination from urine stain or pigmented fibres grown by merino sheep are already well established, with a demonstrated track record of success. On-farm systems for managing contamination by exotic sheep are not as well established, and some additional work is required to fully develop these. SARDI, the NSW Department of Agriculture and the Queensland DPI already have considerable expertise in this area and are already working actively to improve these systems.

A system for quantifying dark fibre risk was developed by CSIRO during the 1980's [6,8] (see also **Features**). This did not incorporate risks associated with contamination from exotic sheep, but once practicable on-farm management systems are delineated this should prove to be a relatively simple task. The system does rely on wool growers providing correct information about their animal husbandry and wool management practices, but it is not simply a Vendor Declaration system, as has been reported in some of the Australian media. It is more than that.

The Federation of Australian Wool Exporters (FAWO) has taken on board a recommendation from AWTA Ltd that implementation of a Dark Fibre Risk analysis system, which does require industry co-operation, should be pursued. FAWO have made an application for funding from AWI to employ a professional for a fixed period to extend the risk analysis system to include contamination from exotic breeds and to define the information collection systems that will be required. This is likely to be approved.

AWTA Ltd will be implementing a presale screening service for contamination from exotic sheep based on the CSIRO Dark Fibre Detector. A promising adaptation of this technology to decrease the cost of the test for pigmented and urine stained fibres, as well as medullated fibres, has been identified and is being further developed. This development could provide the basis for regular less expensive randomised testing to provide confirmation that on-farm management systems and dark fibre risk assessment systems are functioning effectively.

The CSIRO Dark Fibre Detector technology already provides a capability for topmakers and combers to quantify contamination in their tops. Any developments on the raw wool side will ultimately provide benefits here as well.

Technology to remove contamination from yarns, SiroCLEAR, already exists and can be used by topmakers, combers and spinners for further quality control.

The extent to which the processors need to rely on measurements on tops and yarns will ultimately be dictated by the levels of contamination that occur in the greasy wool supplied to them. The key element in reducing their risk is a reliable Dark Fibre Risk Assessment system. Australia has an opportunity to even more definitively differentiate the quality of its wool from that of its competitors by implementing such a system.

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ODDments

Making Shearing Easier

We all know that shearing is tough work. But, speaking of research, the following is an abstract of a paper published recently in the journal Applied Ergonomics (vol 33, page 523):

Tom Roberts, Shearing the Rams, 1890.

"Some occupational health and safety hazards associated with sheep shearing are related to shearing shed design. One aspect is the floor of the catching pen, from which sheep are caught and dragged to the shearing workstation. Floors can be constructed from various materials, and may be level or gently sloping. An experiment was conducted using eight experienced shearers as participants to measure the force exerted by a shearer when dragging a sheep. Results showed that significant changes in mean dragging force occurred with changes in both surface texture and slope. The mean dragging forces for different floor textures and slopes ranged from 359 N (36.6 kg) to 423N (43.2 kg), and were close to the maximum acceptable limits for pulling forces for the most capable of males. The best floor tested was a floor sloped at 1:10 constructed of timber battens oriented parallel to the path of the drag, which resulted in a mean dragging force 63.6N (15%) lower than the worst combination."

It has now been scientifically proven that it is easier to drag sheep downhill along a smooth surface.

A full copy of this paper, which, in addition to its 7 (Australian) authors, involved 5 live sheep, 8 shearers and 400 trials, can be purchased for USD30 via http://www.sciencedirect.com. ■