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Cotton wax in Australian cotton

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A longstanding issue facing the cotton industry is the effect that wax levels can have on everything from spinning ability, yarn properties and ultimately, to dye uptake.


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Cotton wax is essential for the efficient processing of cotton fibre into spun yarn. It provides a lubricating layer that reduces fibre-to-metal friction and therefore fibre breakage during mechanical processing. The downside is that this layer also acts as an impermeable barrier to the entry of water and dye molecules into the fibre. For successful, even dyeing, this barrier must be removed by scouring and/or bleaching.

The percentage of wax on commercial cottons generally varies between 0.3 per cent and 1.0 per cent of the weight of fibre.

The chemical composition of the wax is complex and contains a number of lipid classes including wax alkanes, fatty acids, fatty alcohols, plant steroids and mono, di and triglycerides. Most of the wax is on the surface of the fibre and impregnated in the primary wall, although some remains in the secondary wall of the fibre even after extensive extraction.

TABLE 1: Wax Contents of Sicala 40 (CSD trials 2000/01)

Region	Percent Wax	Micronaire
Hillston	0.33	4.6
Tandou	0.57	4.4
Trangie	0.92	4.4
Mt. Foster	0.94	4.4
Brookstead	0.55	3.8
Hebel	0.54	4.6
Moree	0.61	4.3
Walgett	0.56	4.3
Collarenebri	0.70	4.5
Boggabilla	1.03	4.4
Dirranbandi	0.63	4.4
Dalby	0.99	4.4
St. George	0.58	4.4

During the early 1990s, the Cotton Research and Development Corporation (CRDC) commissioned fibre-to-fabric trials to examine the effect of plant variety upon spinning ability, yarn properties and dye uptake variability.

While the trials found that variation in dye uptake was due predominantly to a combination of fibre maturity and fineness (linear density), which are largely environmental effects, it was strongly suspected that the cotton wax on some varieties had an effect upon dye uptake. This was because the wax on some varieties was more difficult to remove than others.

The issue of the wax content of Australian cottons has been raised in more recent times by local and international dyers and finishers, and from spinners of Australian cotton who sell yarn into knitting markets. It's a particularly vexing issue, especially as it relates to how the wax levels of Australian cotton plants contribute to dye uptake variability — most notably in fabrics that undergo limited preparation before dyeing.

The costs to dyers and finishers can be counted in terms of product claims — for example, fabric returned from a customer due to uneven dyeing, and/or the cost of implementing costly scour procedures before bleaching to ensure wax is removed and consistent dye uptake is achieved.

Wax and variety survey

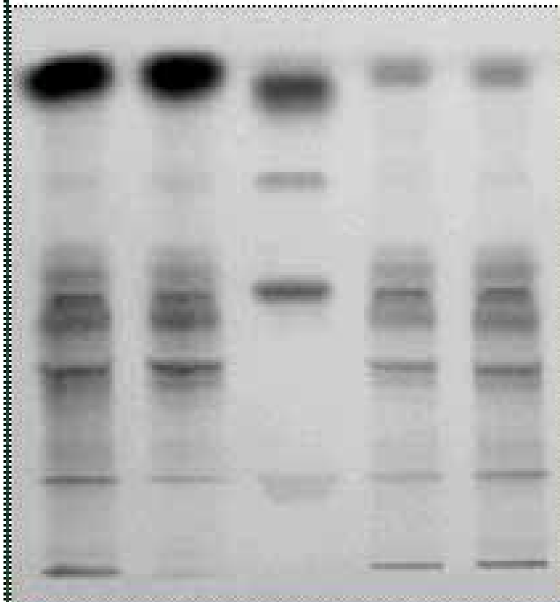
In a survey sponsored by the CRDC and CSIRO Textile and Fibre Technology (CTFT) and conducted over the past year by CTFT, wax extracts of cotton fibre samples gathered from the Cotton Seed Distributors' 2000–01 variety trials were examined. Both the amount and type of waxes present on the cottons were examined during the survey.

The percentage (on weight of fibre) of extractable wax results for Sicala 40 grown across 13 different sites together with micronaire values are shown in Table 1. The data illustrates the wide range of wax contents that can be found on one particular variety.

Statistically, the differences in wax contents between most of the regions are significant and point to environmental effects as being very important in governing the amount of wax deposited. The influence of the environment on micronaire also means there is often a relationship between extractable wax and micronaire. Although not evident in this subset of the surveyed samples, it is usual to expect that micronaire varies inversely with the extractable wax.

In general, wax extracts from samples like those in Table 1 had very similar compositions. Only

FIGURE 1: HPTLC of cotton wax extracted from two samples of Sicala 40 cotton. The dark stains at the top of lanes 1 & 2 (Brookstead) indicate the higher concentration of hydrocarbon waxes. Lanes 4 & 5 (Walgett) show a typical chromatogram of cotton wax and lane 3 shows a chromatogram of lipid standards



subtle changes were observed between the samples. These results are consistent with previous work showing the presence of the same lipid classes in similar proportions in waxes from a variety of cotton cultivars, growths and species.

The exception to this generalisation was that the wax from some low micronaire cottons had much higher concentrations of hydrocarbon wax. These particular waxes are large, long chain molecules (more than 16 carbon atoms) that are hydrophobic and so may not be readily removed during normal textile scouring/washing processes.

Figure 1 shows a high performance thin layer chromatogram (HPTLC) of the wax from the Brookstead sample (micronaire value of 3.8) together with a typical wax from the same cotton variety grown at Walgett (micronaire value of 4.3). The higher concentration of the hydrocarbon wax is readily apparent although other components in the two samples are comparable.

By this relationship between low micronaire and higher concentrations of hydrocarbon wax did not occur for all low micronaire (below 3.8) cottons examined in this study. This relationship only came about when cotton plants (trial plots) had suffered heat or water stress during growth and consequently also had a low micronaire value. It was under these conditions that a higher proportion of hydrocarbon wax was seen compared to that in cotton grown under normal conditions.

Further work is required to confirm and fully explain the interesting effect seen in the Brookstead sample and to assess the textile processing consequences of the high concentrations of hydrocarbon waxes.

The authors are researchers within the Cotton Textile Research Unit of CSIRO Texture and Fibre Technology. For more information on this and other research taking place go to: http://www.tft.csiro.au or www.tft.csiro.au or contact Dr Stuart Gordon on (03) 5246 4000.

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