New small sample spinning technology at CSIRO Geelong

By Dr Robert Long – CSIRO

AT A GLANCE:

- CSIRO Geelong has recently acquired a new miniature ring spinning line capable of spinning small (10 to 1000g) batches of cotton fibre, which complements CSIRO’s full scale processing which requires a minimum of 50kg of cotton fibre.
- The new equipment replaces old technology that was manufactured in the 1960s.
- It will allow the spinning and detailed assessment of spun yarn and finished fabric from small sample plots, for research in areas such as physiology and agronomy, or to more easily and quickly assess larger numbers of new variety lines.
- Uniquely the spinning line includes a miniature combing machine, which allows premium combed yarns to be manufactured from small amounts of cotton fibre.
- The new equipment is easier to use, more consistent, allows a greater range of different yarn types to be manufactured, and the yarns produced are better than those manufactured by other miniature spinning systems. The new process is now extensively contributing to current research projects.

The CSIRO at Waurn Ponds Geelong recently acquired new cotton spinning equipment manufactured by Tianjin Jiacheng Mechantronic Equipment Co Ltd, China. This contributes to a timely upgrade to the spinning capability in the cotton processing mill facility now located within CSIRO premises at Deakin University, one of only a handful of such research facilities world-wide. As part of the acquisition, CSIRO hosted four engineers from the Tianjin based company in November 2015 (Photo 1), who commissioned the spinning line (Photo 2). The purchase of this equipment was made possible via investment from CSIRO and Deakin University.

The new cotton spinning line consists of:

- An opening machine, which provides preliminary cleaning;
- A carding machine (Photo 3), which comprehensively cleans and aligns fibre;
- A drawing machine (Photo 4), which allows the formation of an elongated sliver and allows slivers to be blended;
- A combing machine (Photo 5), which removes short fibres and neps and allows for greater fibre alignment; and,
- A roving machine (Photo 6) which converts sliver into a lighter twisted sliver called a roving, which is the fibre assembly required for ring spinning.

This new capability replaces miniature spinning equipment that was originally manufactured several decades ago (Photo 7) and was based on gear driven mechanics. It may be dated but it still plays an important role for processing research.

The new system is also specifically designed to process small amounts of cotton fibre (10 to 1000 g). Each machine offers...
easier user inputs through digital touch screen technology, and cylinder and roller speeds are more precisely controlled via variable speed technology, more akin to the latest full scale processing equipment.

A highlight of the new system is the inclusion of a combing machine, which enables fine count premium combed yarns to be manufactured. This is of significant relevance to the Australian cotton industry considering that most Australian cotton is exported to South East Asia, where a lot of it is used to spin fine count premium combed ring spun yarns. Until now, research on combed yarns has required full scale spinning protocols, limiting the scope of such experiments due to the larger amounts of cotton required (>50 kg).
Generally, small sample spinning enables field trials to be undertaken more cost effectively, allowing smaller plots of cotton to be propagated per experimental unit. This simultaneously offers the opportunity to spin yarn from more extensive field experiments such as replicated full factorial trials.

This new machinery is part of an established research spinning mill, which includes a full scale industrial ring spinning line, open-end spinning, gin lint cleaning, and setups for harvesting and contamination measurements. This CSIRO capability is crucial for the research that supports the Australian cotton industry, and also allows excellent training programs to be conducted for industry stakeholders.

Some of the project areas that have been looked at, include:
- Processing fibre from agronomic management improvement field experiments;
- Assessing fibre from new breeding lines;
- New spinning efficiency research;
- Understanding contamination effects

- Cotton fibre storage issues; and,
- Ginning improvement research.

Ultimately this end product based research is enabling the cotton industry to be more efficient and profitable, and assists cotton growers in obtaining optimal production while avoid discount penalties.

Initial operations and preliminary assessments of the new system have shown that it is a user friendly, consistent, and versatile spinning line. This is reflected in yarn evenness results which are 13 per cent more even than a previously used system, while the variability across multiple yarn strength tests was 25 per cent better (Table 1). The number of micro entanglements of fibre (neps) was reduced greatly, demonstrating the efficient carding process now in place. More comprehensive comparative research is soon to be undertaken assessing the differences between full scale processing, particularly combing, and the new small sample system.

<table>
<thead>
<tr>
<th>Spinning method</th>
<th>Yarn evenness (CV%)</th>
<th>CV% of yarn strength</th>
<th>Yarn neps</th>
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<tbody>
<tr>
<td>Hybrid method 1</td>
<td>21.16</td>
<td>12.91</td>
<td>905</td>
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<td>2016 new system</td>
<td>18.32</td>
<td>9.74</td>
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<td>% improvement</td>
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<td>85%</td>
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For more information about this new capability at CSIRO please contact Dr Robert Long: Robert.long@csiro.au