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Ph: 02 6270 6562, Fax: 02 6273 4825
Ph: 02 9351 2947 Fax: 02 9351 3706
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LEADING EDGE

Leading Edge, supported by the Society for Engineering in Agriculture and the Australian Centre for Precision Agriculture, provides a local and worldwide window on engineering and PA research.

Fuzzy lint meets fuzzy logic – gin stand secrets to be revealed

By Gary Alcorn

Former CSIRO wool-combing researcher Kevin Bagshaw is switching fibres to discover what really happens at the critical saw/rib/cotton seed interfaces in an operating gin stand.

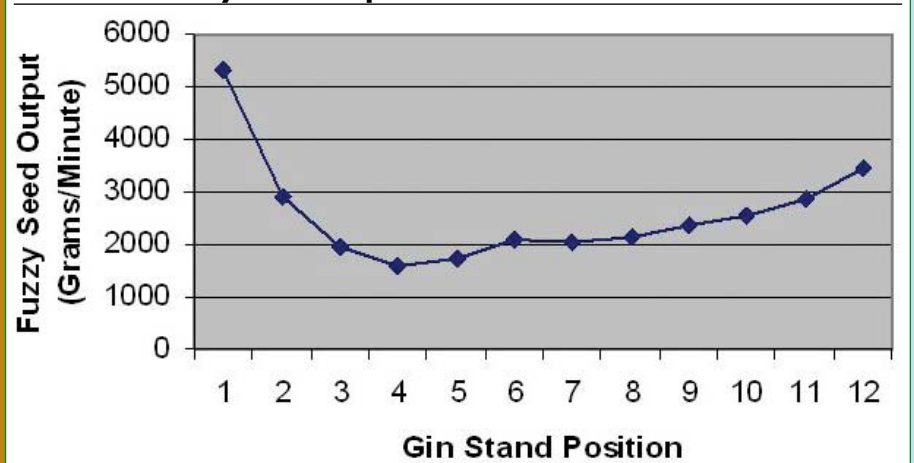
He intends to study this vital operation just millimetres from the action using a range of techniques, including high-speed cameras located in purposely manufactured toughened glass ribs to:

- Explain the movement of fuzzy seed in the seed roll; and,
- Why the fuzzy seed output across the gin breast is higher on one side than other sections of the stand (see Figure 1).

In a world-first Kevin's team will use image mapping to detect and measure the volume of lint stripped from each seed and relate this to the variation in yield output across commercial cotton gin stands.

The modern gin stand is capable of producing 15 bales of lint per hour yet it takes an average 20 teeth on a saw to remove enough cotton to make one cotton bud end.

FIGURE 1: Fuzzy seed output distribution



"My aim is to increase return to growers by improving fibre quality and quantity of fibre recovered while reducing seed damage and residual lint loss," Kevin said.

"A reduction of one per cent in residual lint would mean another $6 million back to the grower industry in the next season alone and ginners will also achieve higher production rates," he said.

A very enthusiastic Kevin Bagshaw is conducting this research for his Masters degree in Science Engineering funded by Cotton Catchment Communities CRC and CSIRO.

His supervisors are Dr Stuart Gordon, Principal Research Scientist at CSIRO Materials Science and Engineering and Assoc Prof Mark Porter, Head of Agricultural, Civil and Environmental Engineering at USQ Faculty of Engineering and Surveying.

As Stuart explains, "Australian cotton breeders are progressing towards the production of new premium Upland cotton varieties that have long, fine fibre but without the yield penalty.

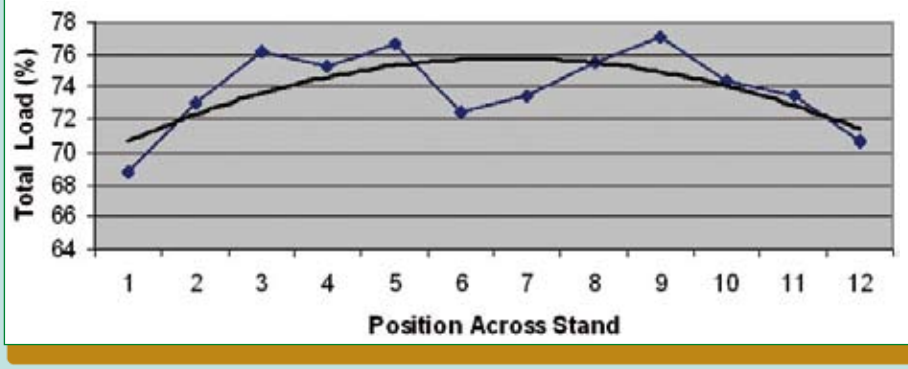
"But high yielding long, fine cotton is subject to more damage in the ginning system by virtue of the increased density (number of seeds) of the seed roll that forms over the gin saw.

DR STUART GORDON

Stuart is currently a Principal Research Scientist at CSIRO Materials Science and Engineering where he has worked for the past nine years leading research projects in cotton fibre metrology, ginning and short-staple processing.

Prior to joining CSIRO, he worked as a Technical Manager with Australia's then largest cotton spinning company, Rocklea Spinning Mills.

FIGURE 2: Seed cotton input distribution



"This study has two broad objectives: The first is to investigate and improve the efficiency with which long, fine fibre is separated at the gin saw while at the same time maintaining fibre and seed quality through this point.

"The second objective is to train a new ginning researcher for the future of the Australian cotton industry," Stuart said.

This research project is being conducted at CSIRO Geelong 1300 km from cotton ginning operations in northern NSW. Its location demonstrates the strong cooperation between industry and research.

Last season Kevin monitored the distribution of fuzzy-seed discharge from 11 commercial gin stands by dividing the 2400 mm gin breast into 12 x 200mm sections and then measuring the fuzzy-seed yield from each section.

"They all had higher output from the left-hand which was also the drive side," he said.

His initial research which revealed this universal 'loading up on the left-hand side' trend was not matched by input rates. But what is the input distribution?

New age software enabled colleague Graham Higgerson to analyse high speed images, which quantify actual input rates across 12 equal sections.

Furthermore the quality of both lint and seed vary considerably across the gin stand.

"What I'm saying is that a single sample from any one point across the stand is not representative of the neighbouring areas," Kevin said.

"This is a new finding. Eliminating this will increase the quality and marketability of Australian cotton," he said.

Figure 2 shows how seed cotton input distribution varies across the stand.

The question now is why does output distribution show a strong bias to the left-hand side?

Another major cost input in ginning is electrical power requirements. Gaining an understanding of the seed flow within the seed roll will enable researchers to improve the efficiency with which the gin removes lint from the seed.

Kevin's initial studies showed that there is significant variation in electrical loads related to seed-cotton throughput. More power usually means more processing throughput although the subsequent variation in seed flow throughput is non-linear and at high electrical loads seed damage and residual lint increase (see Figure 3).

This season miniature cameras mounted inside toughened glass gin ribs will enable the research team to observe and capture images of fibres separating or not separating from the seed.

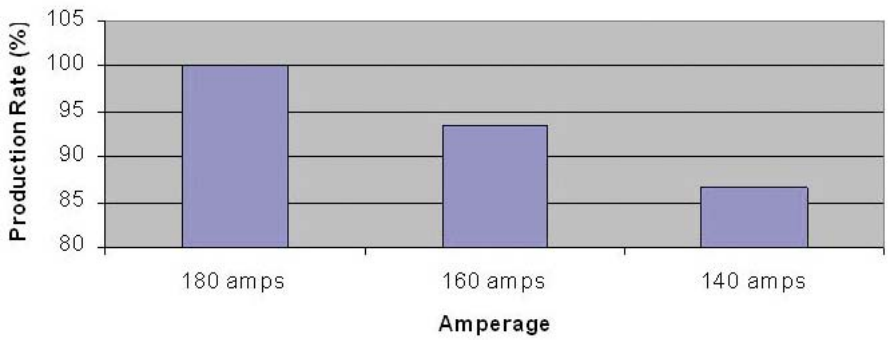
"This advancement will help plant breeders understand how fibre detaches from the seed and what it takes to detach the fibre from the seed roll.

"They will be able to rate various varieties and select for best yield," Kevin said.

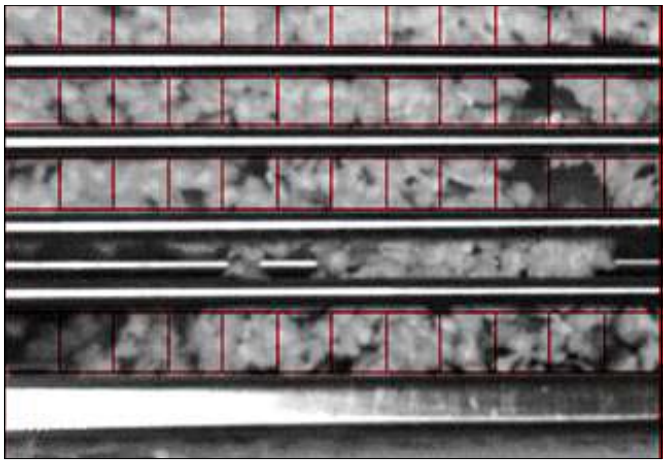
Some of the new techniques in this project are the subject of patent applications and cannot be published beforehand.

For further information download the PowerPoint presentation "Increasing the value of Australian cotton through improved ginning" at www.cottoncrc.org.au

FIGURE 3: Gin stand production rates



Saw blade rib detail.



Input analysis.