

# Cotton science delivering impact

■ By Dr Danny Llewellyn, CSIRO Canberra

**A** WINTERLY chill blowing down from the Snowy Mountains was not enough to deter the gathering of 150 cotton scientists from all over Australia attending the three day Association of Australian Cotton Scientists' 3rd Australian Cotton Research Conference in Canberra in early September.

The conference entitled "SiCott2017: Cotton Science Delivering Impact" was held in the Discovery Centre at CSIRO and attracted delegates from as far afield as Adelaide and Melbourne and from up north to Dalby in Queensland, with several travelling from the US cotton belt.

Huddling together to conserve warmth they delivered over 80 presentations on a diverse range of aspects of cotton science from genes, through to genomes up to whole plants, fields, farms and farming systems, and attended a number of functions where they could network and develop new interactions and collaborations. The major sponsor for the conference was the CRDC with additional sponsorship from CSD, CSIRO and Monsanto. Cotton Australia sponsored four undergraduate agriculture students to attend the meeting.

## Digital agriculture focus

The first day of the conference had a digital agriculture theme highlighting the growing use of digital imagery,



**Texas A&M's Agrilife Research and Extension Centre Director, Dr Juan Landivar Bowles delivered the opening keynote talk on using drones to assist with cotton crop management and breeding.**

sensor technologies and computational sciences in research underpinning breeding, crop management and crop physiology.

Having survived tropical storm 'Harvey' to come to the conference, Dr Juan Landivar Bowles from Texas A&M's Agrilife Research and Extension Centre in Corpus Christi kicked off the



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**Dr Gunasekhar Nachimuthu (right) receives his Early Career Researcher's Award from Mike Bange and Karen Kirkby.**

conference with a keynote talk on Texas A&M's program using UAVs or 'drones' to collect crop images from the air across a range of sensor technologies to determine the growth rates, flowering and boll production that contribute to the productivity of cotton (and other crops like sorghum) and how they use that data and growth simulation models to predict final yields.

As image capture is almost instantaneous, thousands of research plots can be examined with each drone flight and it is hoped that they can eventually be used to help the selection of the best performing lines in breeders' fields to accelerate their breeding objectives in a more cost effective manner.

The same technologies are also being used to assess a range of plant health and stress status parameters of cotton that could also be used as aids in crop management. Juan was followed by CSIRO's Ross Searle who launched the concept of an 'AgData Hackathon' for cotton and covered some of the technical challenges that it entails in combining data from disparate sources. The Hackathon will be a competition run by CSIRO and CRDC hopefully in time for the next grower conference at the Gold Coast.

It will bring together a number of multi-disciplinary teams of informatics and agronomy researchers to develop a useful analysis method, app or web tool for growers, consultants or researchers, utilising historical production, climate and management records (including the ever increasing sensor data collected by on-farm machinery) from a large enterprise cotton farm, with a cash prize for the winning team. While not meant to generate a commercial product, the hackathon is seen as an incubator and a way to showcase how digital technologies can be used to assist cotton growers in their decision making and to encourage new researchers into the industry.

The digital agriculture session was finished off with a number of presentations on the ways Australian researchers are using drones, and fixed and machinery mounted sensors to manage irrigation scheduling, variable rate irrigations, crop nutrition and yield predictions in cotton crops from Queensland down to Victoria.

The afternoon continued some of the water theme on irrigation scheduling and interactions between irrigation and nitrogen use efficiency on cotton farms. A highlight of the conference was the increasing research on southern cropping systems and the involvement of new players in cotton research, particularly those like Deakin University, now that there are cotton

crops closer to those centres and co-operators willing to benefit from allowing researchers onto their farms to run trials.

There was a concurrent session on weeds and weed control addressing those perennial issues of how to use herbicides like glyphosate without selecting for resistant weeds and highlight the need for continued vigilance in monitoring and that it is just as important to adopt IWM programs to maintain the longevity of GM herbicide traits as it is for the insect resistance traits.

The first day ended with a session on managing nitrogen inputs in irrigated crops and assessments of the value of denitrification inhibitors to give the crop a better chance of utilising the nitrogen applied. The take-home message was clearly that extra nitrogen needed to be optimised as there were diminishing economic returns in chasing very high yields, but the jury was still out on the value of denitrification inhibitors.

## **Pests and disease of cotton**

Day two covered those important issues of pest and disease management with keynote talks from Linda Smith (QDAF) highlighting the ongoing battle with fast evolving pathogens in monoculture cropping systems like cotton and from Mary Whitehouse (CSIRO) who gave a history of the devastating spiral of pesticide release and loss through resistance development that plagued the industry over the past three decades and how Bt-cotton halted that cycle and allowed greater adoption of IPM approaches.

In both cases, development of varieties with greater resistance to pests and diseases has been critical to keeping the industry sustainable, but there is little room for complacency and both speakers stressed the importance of on-going vigilance in monitoring and adherence to best management practise to prevent the emergence of new pests and diseases and to manage those we already have.

A number of speakers stressed the value of non-host rotation crops in managing particularly difficult diseases such as Verticillium wilt and black root rot, but that research is on-going. Kristen Knight (Monsanto) also introduced the new GM trait for Lygus control developed by Monsanto in the US. It is just starting to be evaluated in northern Australia, but little data is yet available on its efficacy against Australian sucking pests such as mirids and thrips (watch this space).

The rest of the morning covered a variety of aspects of cotton breeding and genetics and Iain Wilson presented data on the good progress being made by the CSIRO breeding team in identifying new sources of host resistance to Black Root Rot in diploid relatives of Upland cotton and more robust resistance to Verticillium wilt. But even with the use of modern DNA marker technologies, new varieties with these traits will not be available for several years yet. Breeding is a numbers game and the further afield breeders have to go to find new traits the longer it takes them to get back to the elite performing genotypes that our growers expect from them.

## **Looking to the future**

In an afternoon session a number of talks covered new research from the Australian National University on the potential to engineer better and more robust photosynthesis and carbon fixation in cotton and other crops in the face of the predicted extreme changes in the climate of Australian cropping regions. This is still very Blue Sky Research but the ANU group are world leaders in redesigning plant photosynthesis to be more efficient at higher temperatures.

Tom Wedgaertner (Cotton Incorporated), one of several visiting



Knowledge grows

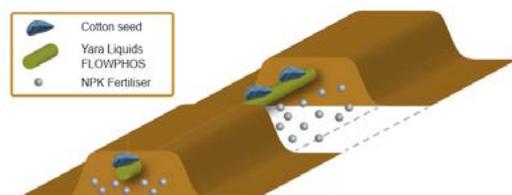


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**Dr Paul Grundy, new President of the AACs.**

US researchers who made the trip to Australia, reported on their GM cotton that has very low seed gossypol and its potential benefits as a food and feed beyond the normal range of animals able to ingest cotton seed. The potential applications are large but they are particularly focusing on the growing aquaculture industry that currently utilises wild caught fish as their source of high quality protein for farmed fish and crustaceans.

Surprisingly, low gossypol cotton seedmeal appears to be just as nutritious as fish meal and contains an unidentified feeding stimulant in some fish species tested! Finally, Nicole MacDonald, a sociologist from USQ offered up something just a little different, reporting on her PhD studies on investigating farm worker job satisfaction as a way of understanding attraction and retention of good workers to the industry.

She surveyed the beliefs, values, and attitudes that cotton farm workers bring with them to their employment and showed that when their own values aligned more closely with their work tasks and industry values (eg. land conservation values) that they were more likely to have better career satisfaction and so stay with cotton. So future investments in Skills Development Programs need to focus on education about broader industry values and not just be purely task focused.

The final session for the second day looked at farming systems research and it was fitting to see the legacy of Ian 'Rocky' Rochester and his long-term crop rotation trials at ACRI emphasised in several talks as an acknowledgment of the important part that these experiments have played in understanding the impacts that different rotations can have on soil health, carbon sequestration and farm productivity.

The day was capped off with a Conference Dinner at the iconic National Museum of Australia overlooking Lake Burley Griffin. At the Dinner the Association's Early Career Scientist Encouragement Award was presented to Dr Guna Nachimuthu (NSW DPI) in acknowledgement of his contributions to soil science, the Service to Cotton Science Award to Dr Lewis Wilson (CSIRO) for his contributions to cotton IPM research and the Scientific Publication Award to Drs Grant Herron (NSW DPI) and Lewis Wilson for their recent publication on resistance management strategies to recover insecticide susceptibility in the cotton aphid in Australian cotton. Nilantha Hulugalle, Ian Rochester (posthumously), Jim Peacock, Geoff Baker, and

Stephen Allen were elected Lifetime Members of the Association in recognition of their distinguished careers in supporting Cotton Science in Australia.

### **Post-harvest research**

Day three had a post-harvest theme in the morning with a focus on the products of cotton, primarily the fibre, but also its oil as a potential feedstock for replacing those currently derived from petroleum products. Filomena Pettolino (CSIRO) delivered a keynote talk on her group's research in understanding the molecular and chemical structures of fibres and how new technologies might be used to genetically manipulate those fibres to have novel functional properties beyond existing uses for cotton. Stuart Gordon (CSIRO) reported on their use of the National Synchrotron facility to get right into the core of the structure of the cellulose making up cotton fibres so that we might have a better understanding of how its structure influences fibre properties.

Our industry has been quick to adopt round bales but Rene Van Der Sluijs (CSIRO) offered a cautionary note on the risk to our reputation that this might entail when the bale wrapping plastic finds its way into processed cotton. Small amounts of plastic in a bale can have drastic consequences in the final spun and woven fabric, but is often not visible until the fabric is dyed. The situation is likely to get worse as more players enter the market with lower quality but cheaper wrappings, so there is a need for some pre-emptive action to maintain Australia's reputation for low contamination cotton.

### **Cotton production in future climates**

The day ended with a keynote talk from David Tissue (Hawkesbury Institute for the Environment) on the multi-disciplinary research being undertaken to understand how cotton may respond to future climates with elevated levels of CO<sub>2</sub>, higher global temperatures and more extreme weather events.

While it is still early days in the research, some researchers had predicted that the higher CO<sub>2</sub> levels would increase plant productivity and compensate for the negative effects of elevated temperature. Experiments to date suggest that this may not be the case and that we will therefore need to manage the whole production cycle, including nitrogen nutrition, if we are to continue to maintain sustainable cotton production as climate change progresses.

Some exciting collaborations harnessing expertise in climate science and cotton physiology across research institutions (HIE, ANU, CSIRO) and across continents (USA) were presented that will ensure our industry is ready for those predicted changes in climate and that it will remain globally competitive.

During the conference Mike Bange stepped down as the inaugural President of the Association and he will be ably replaced by Paul Grundy (QDAF) who was elected as the new President. Paul will be supported by an executive consisting of Mike Bange, Warwick Stiller, Linda Smith, Allan Williams, and Mary Whitehouse. The next Research Conference will be held in 2019 at the University of New England, Armidale, NSW.

Cleave Rogan (Deputy Chair, CRDC) closed off the conference noting the high international standard of the research being undertaken in Australia and the obvious renewal happening in the research space as many of our older industry stalwarts move on and new blood is attracted to the industry to fill their places, ensuring that the research base of the industry is in safe hands for the future.

**The abstract and posters from the meeting are available from the association's website at [www.cottonresearch.org](http://www.cottonresearch.org)**

