Australian Cotton Cooperative Research Centre

Annual, Progress & Final Reports

Part 1 - Summary Details

Please use your TAB key to complete part 1 & 2.

COTTON CRC Project Number: 4.1.00 (SX20)

Annual Report:	☐	Due 29th May
Progress Report:	☐	Due 22nd November
Final Report:	☒	Due within 3 months of project completion

Project Title: Scientific Exchange Dr Tom Sinclair (USDA/University of Florida)

Project Commencement Date: **01/07/03** Project Completion Date:**30/06/04**

Research Program: 4. Education, Transfer of Technology

Part 2 – Contact Details

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Other Staff & Collaborators – Please list

Signature of Research Provider Representative: _____

Part 6 – Final Report Format

The points below are to be used as a guideline when completing your final report.

1. *Outline the background to the project.*

Scientific Exchange USA Scientist Dr Tom Sinclair (USDA/University of Florida) to Narrabri

Following the International Crop Science Congress last year we were presented with a unique opportunity to host internationally respected crop physiologist Dr Tom Sinclair in Narrabri. This proposal supported a 10 day visit to Narrabri by Dr Sinclair following the Crop Science congress to:

- Meet with researchers currently working on crop water relationships (evapotranspiration) and discuss the range of different approaches taken. This is especially important exposure since we have young researchers starting work in these areas.
- Meet with other researchers working in crop physiology/agronomy and modeling to discuss research outcomes and approaches taken in the areas of water use efficiency and simulation modeling of crop growth.
- Invite Dr Sinclair to represent his Crop Science Congress talk at Narrabri 'Increasing yield potential of legume crops – similarities and contrasts with cereals'.

In addition he will also be involved in various other discussion groups as they are deemed appropriate.

Improving our understanding of the soil water balance is a key initiative of the Cotton CRC. Accurate estimates of evapotranspiration are a key element of deriving water balances for cropping and catchment scale estimates of water use. Currently one of our best methods of estimating evapotranspiration in cotton crops is through the use of the cotton simulation model OZCOT. There are number of ways that OZCOT can estimate evapotranspiration and there are limitations to the approaches taken. Currently there is some debate on the most appropriate method to meet the current and future needs of simulation modeling. Dr Sinclair can add some insight to this problem.

Dr Sinclair has a long distinguished career in crop water relations and approaches to simulation modeling. He has seen the development and use (appropriately/inappropriately) of simulation modeling over many years. In fact he was invited to write a definitive review in the Journal Crop Science. Dr Sinclair has strong views on particular approaches to research in many areas in which we in the CRC undertake. Other areas of relevant research to the CRC that Dr Sinclair has been involved with include waterlogging, temperature and yield component physiology. His visit would provide a unique opportunity to access some of this knowledge.

2. List the project objectives and the extent to which these have been achieved.

Dr Sinclair visited the Australian Cotton Research Institute (ACRI) between 20 and 30 October 2004. During his visit he presented two seminars on topics that related to research into crop physiology, they were:

- 'Crop Transformations and the challenge to increase yield potential'. During this seminar Dr Sinclair outlined his views on the limitations of the field of biotechnology and its potential to increase crop yields. This work had been published in a review in Trends in Plant Science.
- 'Increasing crop yield under water limited conditions'. During this seminar Dr Sinclair discussed his research on improving understanding and simulation of crops' water use. His also presented some of his recent work exploring the differences in crop transpiration between species and the consequences of these differences on crop yield and water use efficiency in different climates.

In addition to these seminars Dr Sinclair met with many of the researchers at ACRI to discuss their research. Some of the outcomes of the discussions with individual researchers are presented below:

David Johnston (OZCOT programmer) – David was able to discuss with Dr Sinclair some of the modelling approaches that he has developed for modelling soybeans and legumes in general. He provided David with code that captures some of the essential elements of his modelling efforts relating to soil water balance, soil nitrogen, LAI and linear harvest index. David was challenged to consider how cotton might be modelled along similar (simple) lines. These may be very useful considerations in the process of developing a new cotton model using some of APSRU approaches. APSRU has used Dr Sinclair's approaches to modelling for (at least) their legume model.

Greg Constable: Despite Dr Sinclair's admitted and obvious lack of knowledge on cotton physiology, his discussions on theory and methodology for some of his work was very good and worth noting. His views on the purpose of and place of genetically modified crops were good as to get a balanced view. Greg did have concerns on Dr Sinclair's opinions on impact of temperature on crop responses (see below).

Peter Reid/Warwick Stiller: Peter and Warwick outlined their breeding aims and areas of work. They discussed the limitations of biotechnology and its overemphasis in recent years to the detriment of conventional breeders, physiologists etc. Dr Sinclair's ideas on stress tolerance were also discussed. Some of the views that Dr Sinclair expressed that were noted as further food for thought were:

- In terms of plant growth etc the extremes of temperature don't matter it is the average that is important (we would disagree).
- Respiration is not an important cost to plant production (we would disagree).
- He was dubious about the value of carbon isotope discrimination in selection for water stress tolerance (this may be true for cotton, but maybe not other crops).

Rose Roche: Rose discussed with Dr Sinclair her work on population studies in cotton exploring the differences in crop physiology between conventionally spaced cotton and ultra-narrow row. Dr Sinclair challenged Rose to consider that the differences in early leaf area development between the two systems may simply be due to difference in water availability by the crop and its impact on leaf area

development. He highlighted that this may be the case with cotton since leaf area development appears to be more sensitive than other species in relation to water availability. As a consequence of these discussions Rose has increased the emphasis in her current field studies on monitoring early water use to explore the issue.

Simone Heimoana/Lewis Wilson: Simone and Lewis discussed their work on the impact of Aphids on cotton crop growth, particularly in relation to the impacts of aphid damage on leaf photosynthesis. Tom provided some useful suggestions on research approaches to explore the reasons for reductions in leaf photosynthesis. As a consequence of the discussions Simone has purchased a leaf refractometer that measures leaf sugars in an attempt to better understand leaf function following aphid damage.

James Neilson: James discussed with Dr Sinclair cotton plant water relations, both in terms of cotton plant performance under water limiting conditions and the usefulness of various measurements of cotton plant water relations including, hydraulic conductivity of the plant and the rate of leaf area expansion under moisture stress. These discussions were very useful and have raised a number of questions and possible research opportunities. Tom has expressed interest in exploring these concepts in cotton in collaboration with research conducted in Australia. James will be visiting Dr Sinclair later in 2005 to initiate these research opportunities.

Other time was spent with Michael Bange, Dirk Richards Stephen Yeates discussing simulation approaches for water use. Dr Sinclair also met with Nilantha Hulugalle (approaches on root measurements), and with Ian Rose (soybean breeding programme).

Overall the visit by Dr Sinclair was extremely beneficial in providing a fresh source of ideas and opinions towards our crop physiology research at ACRI. His seminars were outstanding and generated excellent discussion. The one on one interaction with researchers was beneficial in generating a range of new ideas. Finally, having seized the opportunity to invite Dr Sinclair while he was visiting for a conference, the cost for the Cotton CRC and CSIRO was low and of good value.