Crop Models and Decision Support – Future Developments and Applications

Michael Bange[1], Sandra Deutscher[1], Chris Plummer[1], David Larsen[2], Darren Linsley[1], Dirk Richards[1], Stewart Whiteside[1]

CSIRO Plant Industry, Cotton Research Unit, Narrabri, NSW[1]

NSW Agriculture, Narrabri, NSW[2]

Australian Cotton Cooperative Research Centre

Introduction

Managing sustainable cotton production is becoming more difficult with the ever-increasing demand on limited resources. In addition cotton growers are facing increased pressures to manage resources more cost effectively and to be more accountable for the impact that their decisions make on the surrounding environment. Computer based decision support systems and simulation models are being developed to provide cotton growers with the best information and tools available from research to assist with their management decisions. A primary aim of the decision support and modelling teams in the cotton industry is to utilise sound and up to date technology, and integrate this technology across different electronic platforms and mechanisms, and finally delivering it to the industry for adoption 'Science into Practice' (Fig.1).

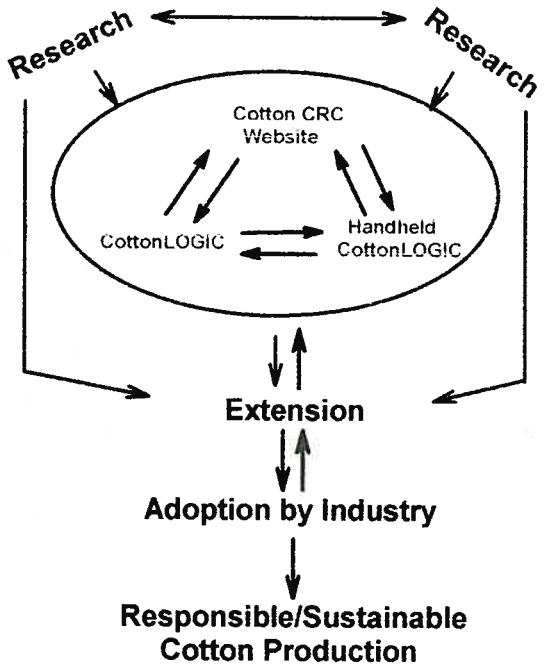

Figure 1. Putting 'Science into Practice' through computerised decision support.

We in the cotton industry are in an enviable position with an agricultural industry rich with successes and failures in computerised decision support, therefore we can call on a number of approaches to assist acceptance, development and evaluation of its products and activities. One principle approach is to use multifaceted skills and knowledge, coordinated effectively with expertise and input of others when available.

The first part of this paper will discuss the operation and means by which the decision support team, which now includes a number of people working on the crop simulation models to deliver decision support tools. The second part of the paper will address the significance of decision support and models to the cotton industry. Finally, the paper will present future activities being undertaken, involving both the decision support team and those associated with modelling.

While essentially there are a large range of tools being developed by the group in Narrabri for different research and industry needs, this paper will discuss the present development and future opportunities of the following:

- CottonLOGIC;
- Handheld CottonLOGIC for in field use;
- The Australian Cotton CRC website (WWW); and
- The OZCOT crop simulation model.

In the context of this paper 'decision support' will refer to the development, operation and application of CottonLOGIC (in all its forms), the WWW and the crop simulation model.

Development of Computerised Decision Support Systems

In an endeavour to achieve a focus on developing and delivering decision support, it is important to define a consistent and equitable strategy based on simple philosophical and moral principles to meet the needs of all stakeholders relevant to the cotton industry, and to the development of decision support. Points which try to encompass the philosophy by which the decision support team attempts to function are as follows:

1. Aim to develop effective, useful and user friendly computerised decision support systems backed by good science.
2. Promote responsible crop management based on the best and most appropriate science that is accepted by industry (ala Best Management Practice).
3. Responsibility for the science used in the software is inherently shared by all researchers involved, and not entirely by developers of decision support.
4. Selection of priority areas for effort is based on appropriate constructive feedback and industry input.
5. No group or region within the industry will be favoured nor ignored.
6. Approach each task pragmatically, and only after careful planning and responsible considerations commit to software development.

7. Make activities and decisions transparent to superiors, industry and funding bodies.
8. Produce quality outcomes, thoroughly tried and tested.
9. Decision support systems are just that, they do not make the decisions, but provide information to assist in the decision-making processes. Promote the decision support systems as tools. (e.g. Promote IPM, and CottonLOGIC helps achieve this)

Successful development and delivery of decision support for adoption by industry encompasses many different processes from the conception of an idea through to delivery and support. Some of the important functions and activities of the decision support team are outlined in Table 1.

Table 1: Team functions and examples of activities of the decision support team.

Team Function	Example of activities
Software development	Software engineering, coding, and testing
Education and training	CottonLOGIC workshops, field days
Support	Phone support at the Cotton CRC's Technology Resource Centre (TRC)
Industry Feedback	Workshops, TRC, Industry Steering Committee
Packaging and Distribution	CottonLOGIC packages, and mailouts through the TRC
Promotion	Attendance at trade shows, local shows with the TRC
Scientific Review	Attendance at Scientific Conferences, Peer Review
Field Validation	Regional specific field trials using CottonLOGIC, working with the Industry Development Officers
Project Evaluation	Surveys, Independent feedback from Consultant
Administration	Personnel management, sourcing funding

Significance of Decision Support and Modelling to Industry

CottonLOGIC

The development of any computerised decision support package relies on constructive feedback from its stakeholders. Based on different forms of feedback and assessment it has shown that CottonLOGIC is highly valued and accepted in the industry as a tool to assist with crop management.

Apart from the day to day informal feedback that the decision support team obtains, the group also uses other mechanisms to ascertain importance and industry needs for decision support development. In the past year the group has conducted one phone survey, one workshop survey as well as employing the services of an independent consultant specialising in decision support. While the information gathered has highlighted deficiencies, it has also however, demonstrated overwhelming support for computerised

decision support to help assist the industry. The different forms of feedback and assessment are now discussed.

While anecdotal, there is evidence to suggest that the demand for CottonLOGIC has increased based on the increase in the numbers of copies of software (be it entomoLOGIC or CottonLOGIC) being distributed to the industry. The number of registered copies has significantly increased from 205 in 1995 to 1035 in June 2000 (Fig. 2).

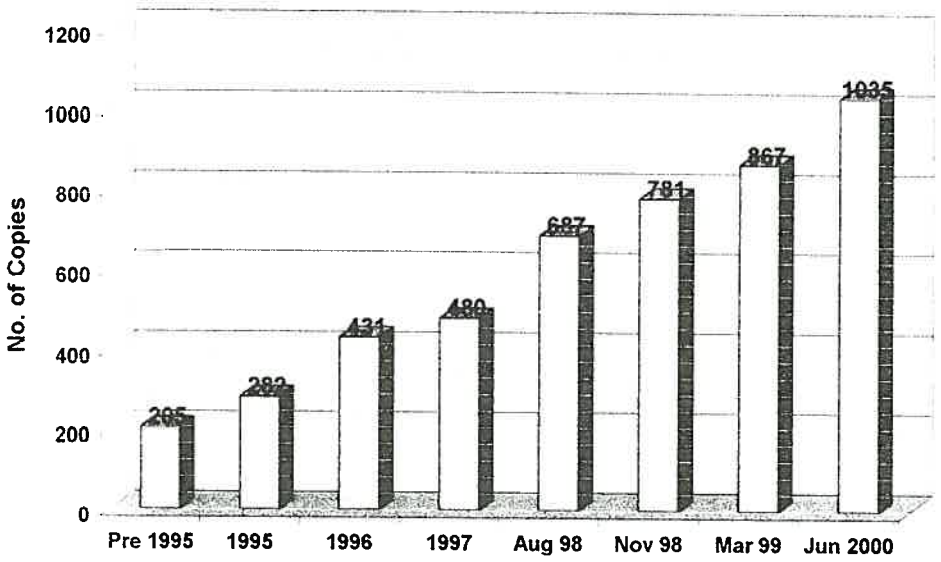

Figure 2: Graph showing the number of registered copies of CottonLOGIC distributed.

A simple phone survey was conducted at the end of March 1999 to assess to level of use of CottonLOGIC and determine what the software was used for. A total of 153 people were successfully surveyed (81 growers and 72 others which included consultants and agronomists). The sample size was approximately 19.1 % of the total number of registered copies (excluding extension and research personnel) at that point in time. One major issue was to address the level of use of the software for decision making in the context of tactical pest management or determining nitrogen fertiliser rates, compared with using the software for record keeping.

Details of survey and results follow:

- Overall 57% of those surveyed said that they used the package.
- Overall 35% of those surveyed used the package for crop management while 22% used the package solely for farm record keeping.
- 25% of growers surveyed used the package for management decisions; 54% hadn't used it at all.
- 46% of consultants/agronomists use the package for management decisions; 30% don't use it at all.

Survey participants were also given the opportunity to make any comments relating to further development of the package. A detailed list of issues highlighted by the relevant groups was presented in Australian CottonGrower Magazine (Bange et al., 1999).

In the past year emphasis was also placed on assessing the training given by the decision support group. Significant effort has occurred in redesigning and improving the workshops to cater for the greater numbers attending, and to suit a range of learning styles of the participants. Evaluation was conducted by allowing the participants at last year's workshops to answer some simple questions relating to the delivery and importance of the workshops. Of the total of 250 participants that attended the workshops, 100% of the responses thought that the workshop was useful while 98.7% said that they would attend the workshops in the future. In addition 80% of responses said that they would not like to see any changes in the present workshop format.

Most importantly in the past year the decision support group has employed the services of an independent consultant systems Mr Peter Van Beek specialising in assessing the importance and impact of decision support. Mr Van Beek has conducted numerous (30+) interviews with a range of different stakeholders in the industry. A comprehensive report of the major findings was completed and presented to the group. The report was extremely positive, highlighting the importance of CottonLOGIC and decision support to the industry both directly and indirectly. The assessment also played a significant role in identifying the problems and deficiencies in decision support development and provides a basis on which to improve. Some quotes taken from the report are below:

'The science behind CottonLOGIC was seen as one of its valuable aspects'.
'The use of CottonLOGIC had effected relationships with consultants and other stakeholders'.
'One saw CottonLOGIC as a back-up and verification, and would be upset if it was not regularly updated'.
'Consultants would survive without CottonLOGIC, but not having it would be a disaster for the industry, as it is important in disseminating information'
'The new versions come out too late to try changes, familiarise, and train staff in the applications'.

A decision support team workshop has been held to discuss the findings and structure a work-plan to address some of the issues. The results of the workshop will be presented to the industry's decision support steering committee for further discussion.

Crop Simulation Models

Research on the application of crop simulation models such as OZCOT involves both the Agricultural Production Systems Research Unit (APSRU) based in Toowoomba working closely together with researchers from Narrabri. The focus of the research is now on identifying the appropriate means of delivering this technology to industry as well as addressing and identifying appropriate needs for irrigated cotton growers. This has come about after a highly successful project that used this technology with

dryland grain and cotton growers. The success of the past research was again established using similar evaluation methods described above for CottonLOGIC.

As well as establishing credibility through formal project evaluation, significant industry demand (especially from dryland grain and cotton growers) has resulted and has brought about contributions from the GRDC and CRDC to explore the appropriate means of delivering modelling technology. Recently the 'FARMSCAPE' accreditation process was launched to train and accredit four agribusiness companies to allow them access to this technology. In addition to the agribusiness companies key personnel in both the cotton and grains industry will be accredited. Mr Dirk Richards is now being accredited in the cotton industry and will use his skills to train the industry extension personnel in the correct use and function of cropping systems models. It is envisaged that a user-friendly version of OZCOT will be made available to assist the cotton industry's access to this technology.

Future Developments in Decision Support

This section will present some present and future developments that are occurring from both the decision support and modelling teams at Narrabri, involving both CottonLOGIC, the WWW and OZCOT.

CottonLOGIC for Handheld devices

In attempting to resolve issues of some users, significant development has progressed in providing CottonLOGIC on a handheld device using the Palm® operating system. This will allow in-field recording and analysis of insect data and provide a report to the pest manager in the field as opposed to returning to a computer located in an office. The capacity to then down-load data in to a desktop version of the software will be possible for storage and further processing. While the concept was simple when first perceived, significant effort on certain issues has had to be resolved in order to enable this project to reach completion, they were:

1. Identify an appropriate device that will function adequately in the field.
2. Develop software that would be supported by hand-held devices into the future (Palm Pilot; Fig. 3)
3. Develop software to handle data from a central database and be passed and managed between a number of handheld devices (Fig. 3).
4. Taking the science and programming from the desktop version of CottonLOGIC and transfer to the development of the handheld.

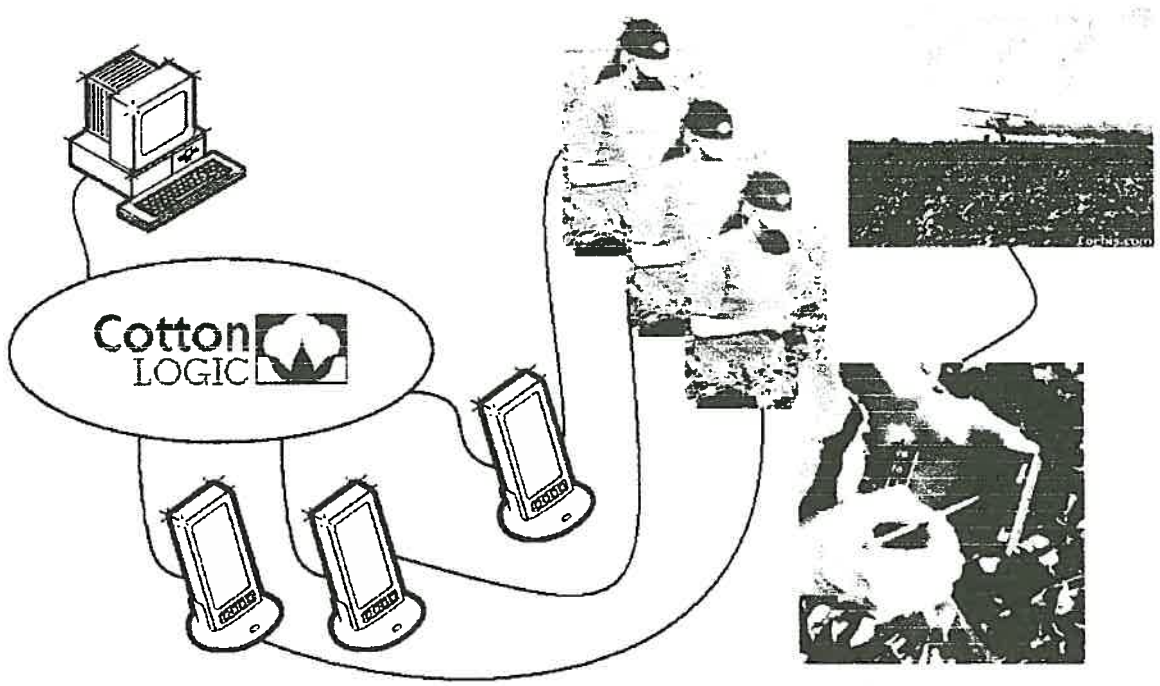

Figure 3: The Palm Pilot handheld device and a diagram describing the operation of use of the device with a desktop version of CottonLOGIC.

Development utilising the World Wide Web and OZCOT

Another platform for delivery of information and decision support that is showing ever-increasing support is the Internet (WWW). Substantial improvements in the web infrastructure, management, and appearance of the Cotton CRC web site have occurred. The Technology Resource Centre now operates a fully functional and interactive web site that provides information such as: current weather data from the cotton industries met stations; cotton industry publications; diary of events within the cotton industry; industry contacts; and providing the latest research information available within the industry.

Significant improvements in the last year have been implemented, they are: personal details can now be passed securely; development of a cotton degree-day calculator accessed through the Cotton CRC website that accesses the Bureau of Meterology's climate database and the Queensland Department of Natural Resources Patched Point Data Set (PPD) (through the SILO project); and greater links with the CottonLOGIC software have been established.

Greater links and developments with the SILO project are progressing some examples include:

- Access to more accurate accumulated day degree value accessed via the Internet through CottonLOGIC for use with NutriLOGIC and other simulation models.

- Obtaining numerical weather prediction 5 days in advance improve the Helicoverpa pest population forecast calculated in the CottonLOGIC. Information to be delivered via the Internet. Presently average temperatures generated from historical records are used in the models to generate the pest forecast.

It is hoped that one day that users would be able to directly access and download the information with the click of the button whilst running the CottonLOGIC software.

Another exciting opportunity that the interactions with the SILO project bring is being able to access climate records (PPD) and numerical forecast of weather easily. The decision support team and crop modellers are working with the SILO project linking the climate and weather data with the OZCOT model. Hopefully it will provide the industry with a tool for growers and consultants to monitor crop development, as well being able to predict crop growth in the short term (over the next few days) and for the remaining season (Fig. 4). It is envisaged that this information in the first instance be delivered over the Internet.

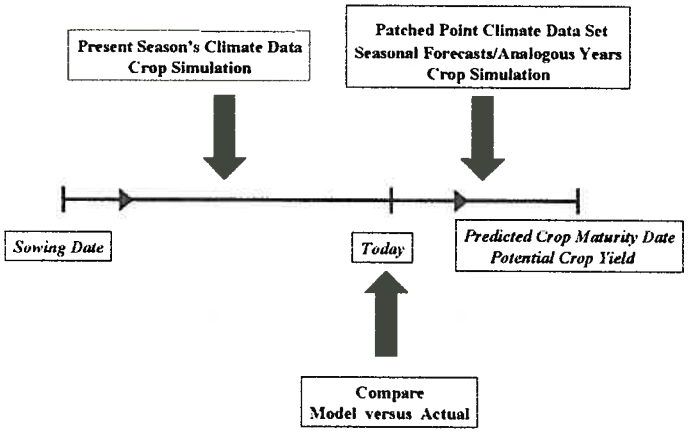

Figure 4: A diagrammatic representation of the use of OZCOT linked with the SILO project climate and weather databases.

Significant Issues facing the Decision Support Development Team

From the evaluation presented above and through continued development of decision support some important issues have been identified, they are:

- Enabling links with 3rd party software, that is to allow easy data transfer from CottonLOGIC to other farm management software packages.
- Investigate the requirements for a water budgeting system with the intent of inclusion into CottonLOGIC.
- Ensuring closer links with existing mechanisms for education, training and support in the industry.
- To enhance development of decision support a significant re-engineering of the CottonLOGIC software is required.

Conclusion

The development of computerised decision support is an ongoing process that is constantly responding to changing industry, biological, environmental and technical issues. The decision support and modelling teams will endeavour to respond to these changes and meet the needs of industry and wider community by assisting the cotton industry to become sustainable and environmentally responsible. For information and free copies of CottonLOGIC contact David Larsen, the coordinator the Australian Cotton CRC's Technology Resource Centre on (02) 679915534.

References

Bange, M., Deutscher, S., and Plummer, C. (1999). CottonLOGIC: Survey shows the way forward. 20(4). The Australian Cottongrower. pp.40-42.

Acknowledgments

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