

ROTH
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Final Project Report

RRR1201
2013 Grower Survey of
Cotton Farming
Practices
and
Regional Workshops to
Identify Research
Issues

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Purpose of the report

This is the final report for the Cotton Research and Development Corporation (CRDC) funded project RRR1201. The report comprises the individual reports for the project's two key components:

- A grower survey of cotton farming practices – conducted in winter 2013 with the final report provided to CRDC in March 2014 (Appendix A).

This has been provided to CRDC in a publication ready format ready for printing hard copies to mail out to survey respondents and web publishing.

In addition to the report, a series of Spotlight articles have been prepared to encourage responses to the survey and communicate findings.

- Regional grower workshops “Think Tanks” to identify issues for research and extension. Findings of these workshops were reported to CRDC in July 2013 (Appendix B).

Brief Summary

This project, undertaken from May 2012-March 2014 has used two processes to gather from cotton growers information about current cotton growing practices and views on research issues.

Cotton Practices Survey

The Cotton Growing Practices 2013 survey gathered valuable information about cotton farming practices that allows trends over time to be monitored by comparing with similar surveys conducted in 2011, 2007, 2006 and earlier. The 2013 survey focused on the 2012-13 cotton crop investigating mainly four core themes:

- Nutrition & Soils;
- Energy;
- Harvesting; and
- Human Resources.

The survey aimed to consolidate all CRDC funded surveys for 2013 into a single survey tool, to reduce the number of surveys growers are asked to complete for industry research. This process had challenges but has resulted in a consolidated data set and possibly improved efficiency in survey resourcing.

Survey responses covered 92,687 ha of irrigated cotton (23% of the total irrigated crop) and 9,853 ha of dryland cotton production (27% of the total dryland crop in 2012-13). 20% (165) of the farms registered with CRDC who grew cotton in 2012-13 returned surveys. While 362 people replied, many had not grown cotton in 2012-13. 38 (23%) of the responses included at least some dryland cotton production. At a regional level the rate of response ranged from 12% to 30%.

Findings in detail and summary have been prepared in a publishable report (Appendix A) and the full data set has been provided to CRDC.

Regional Workshops “Think Tanks”

Eleven ‘Think Tank’ workshops were convened to identify local issues for research and / or extension. These meetings involving 140 participants (73 growers, 37 agronomists and 33 other industry members) were arranged in collaboration with Regional Deliver Officers for Central Queensland (as part of their local project), Darling Downs, Macintyre, St George, Gwydir, Lower Namoi, Breeza, Boggabri, Macquarie, Southern and Wincott.

Notes of the regional Think Tank meetings were circulated back to all participants, generally within a week of the meeting. Issues from all Think Tanks were collated, coded against the CRDC Strategic Plan and provided to CRDC in a detailed spreadsheet.

A “Snapshot of Cotton Practices” was prepared, drawing together data from Grower, CCA and Environmental Audit surveys and other sources. This was used during the Think Tank workshops and refined with CRDC and posted to all growers with the 2013 Survey.

A wide range of issues were raised at the Think Tanks with key ones explored in more detail. Some of the most often mentioned issues included:

- **Nutrition** - including the efficient timing and application of fertilisers to minimise losses and optimize efficiency. Interactions between nutrition, plant growth, root development, soil condition, field history, water, testing of requirements.
- **Managing stressed crops** – heat stresses, water shortages and/or waterlogging. Optimising the economics of recovery strategies, reassessing yield targets.

- **Crop growth management** – better understanding the impact of growth regulators in different seasonal conditions at different growth stages. Understanding the interaction of plant growth management with nutrition and water.
- **Agronomy matched to irrigation** systems and decisions
- Continue to seek ways to **reduce losses from water storages**
- **Managing herbicide resistance** and **volunteer RoundupReady Cotton**
- **Alternatives to pupae busting** and **alternative refuge options**, particularly in dryland. Planting window.
- **Understanding the factors driving high yielding cotton** fields or patches in a field.
- **Extension and packaging** of older and current research.
- **Local trials.**

Greater details, with specific questions are detailed in the following report and the spreadsheet.

Recommendations

Recommendations relating to grower surveys and benchmarking

1. Monitoring framework

There would be value in having a strategic depiction of the data required for monitoring achievements against the CRDC Strategic Plan 2013-18. A separate project has commenced to identify these needs and help to guide future data gathering activities and investments. This will help guide the content of future surveys.

2. Future Surveys

External data sets provide very limited information about cotton growing practices. It is recommended that CRDC continue to gather detailed information about cotton growing practices. From surveys, the “hard data” eg fertiliser rates, tends to be more useful than attitudinal data for comparison over time.

Surveys are the simplest means to gather this information at this point in time. Surveys of both growers and consultants are recommended in order to gain both perspectives. However, it is recommended not to duplicate questions across both survey tools unless a specific comparison of grower vs consultant opinion is needed.

3. Survey themes

Survey questions should be guided by the monitoring framework in order to maintain focus on the long term core data sets rather than shorter term issues. Themes are a logical means to structure the surveys and most will not need to be repeated for several years. Themes for a 2014 survey may include eg water and crop protection (excluding issues gathered from the CCA). With very little dryland cotton in 2013-14 it would be sensible to focus on irrigated cotton, with perhaps a dedicated dryland survey in the future.

4. Researcher engagement in consolidating surveys

Whilst there is considerable merit in the concept of a consolidated survey, there can be challenges if other researchers are not supportive of the idea and have factored separate surveys into their projects. If a consolidated, single survey is to be pursued it will need to be championed by CRDC and research contracts agreed accordingly.

5. Survey length

The 2013 survey which combined a number of issues was particularly lengthy with some particularly complex questions. In future years survey length should be reduced and thus hopefully increasing the response rate – this can be done by exploring less issues.

6. Farm data sets

Some issues are very difficult to explore meaningfully through a broad survey tool. For examples, questions around canopy management and defoliation are highly influenced by crop growth and conditions at the time. A more in-depth process is recommended to explore these issues. One potential option may be to explore whether the CSD trial sites may provide a useful set of detailed crop management information for investigating these complex issues and interactions.

Recommendations arising from the Think Tanks

The following recommendations are drawn based on our interpretation and consideration of the issues raised in Think Tanks. They are by no means the full list of activities that CRDC could implement to address these issues.

7. Communication of Think Tank findings

A number of research and extension personnel have asked about the findings of the Think Tanks. It is our recommendation that these findings are communicated to researchers, the D&D team and Cotton Australia. We suggest that the full detail of comments from each region be circulated as this provides the local insight that may help researchers in targeting their messages to industry issues.

Option 1 – Short term communication

Release the spreadsheet collated by this project as a “raw report” to research, extension and Cotton Australia staff. Some minor editing may be required to correct alignment with Strategies, etc. This is possible as it would not be endorsed as a CRDC view.

Option 2 – Longer term

CRDC respond to the issues raised in the Think Tanks by adding to the spreadsheet some detail of current investments and where there is an identified R,D or E need. This would be the ideal longer term communication as the understanding of current research relating to issues raised would be of great value for D&D planning.

Option 2 would clearly take a considerable time to collate and we therefore recommend that Option 1 be implemented in the short term with Option 2 for the longer term.

In addition, a summary could be communicated via Spotlight.

Furthermore, as many of issues relating to varieties were raised it is recommended that this be communicated to CSD and the CSIRO Plant Breeding Unit.

8. Review of Think Tank findings with Cotton Australia panels

It would be of potential value for the Cotton Australia panels to review the Think Tank issues. The next step may be for the panels to work with CRDC to develop a consolidated, well informed perspective on the research and extension needs in relation to the issues raised and improve their clarity. Whilst we aimed to use a strategic focus, RD&E issue will vary over time and depending on the people involved in workshops. A cross industry discussion of the issues by the panels will help to deepen the insight to the issues and their relative priority. The think tank notes are really the start of a journey rather than an end point.

9. Consider the Think Tank issues in review of the Preliminary Research Proposals and fill gaps

For key issues raised from the Think Tanks which do require research or extension effort, consider these in reviewing the Preliminary Research Proposals. Request that relevant PRPs be adapted to match the industry need or commission new work to fill gaps.

It is recommended that CRDC engage participation of a grower or agronomist from the regional Think Tanks in these discussions to help shape the new projects.

10. D&D team convene small group meetings annually to review local RD&E issues

It is recommended that the Think Tank process be repeated on an annual basis in each region. This is most effectively done in small group discussions but would ideally involve different participants in future years in a series of small groups so that a wider range of views can be explored. This would ideally build on the findings from the 2013 Think Tanks and CRDC response.

These meetings could be convened by the Regional Delivery Officers as a part of their local planning activities / local reference groups. The process of engagement is as valuable as the content, in particular if effective feedback loops are in place.

It may be worth having some meetings specifically focused on dryland cotton.

It is recommended that the issues from each region be collated using a common framework to help in identifying issues for national campaigns.

11. Develop extension strategies at a local and/or national level to address the technical issues and the preferred extension methods raised at the Think Tanks

A number of suggestions from the Think Tanks were made for extension activities to address specific needs (eg A book of case studies of the on-farm nutrition management strategies used by 10-12 growers). There were also broader comments about the types of extension methods that are considered useful. Many of these referred back to activities that had been valued in the past (eg Trial books, local trials, CottonTales, single issue field days). There was also mention of there being many newcomers to the industry (growers & agronomists) and the potential need to revisit some of the older campaigns (eg SOILpak delivery) for this audience.

It is recommended to review the full detail of issues and methods identified in the Think Tanks and consider this in the development of a CottonInfo extension strategy. There are new technologies and now a new team to advance ideas raised.

Technical Recommendations

These are just a few ideas on advancing some of the issues raised. There were many more specific issues raised, and they too are just as worthy of consideration.

12. Convene a Nitrogen X Soils Forum and Develop a Strategic Nutrition Initiative

Nutrition and the interactions with soils and the farming system is a highly topical issue in most regions. The interest is not so much in rates but in the more complex interactions and the most efficient methods for fertiliser placement and timing.

A strategic research initiative for Cotton Nutrition is recommended to expand the scientific and industry knowledge on efficient nutrition management. This would align with CRDC's Strategies in Productive Resources Efficiencies.

As a critical planning step, a Nutrition X Soils forum is recommended to be convened by CRDC, modeled on the style of CRDC's former Farming Systems forums. It is also recommended to review the research on fertiliser placement conducted over several decades in other farming systems such as sugar/grains to identify relevance for cotton systems.

13. Increase industry and scientific knowledge of the interaction between cotton physiology, crop management and climatic conditions

A number of the issues raised relate to cotton plant physiology and growth/development, its interaction with environmental factors and the ability to manipulate plant growth to optimize fibre yield and quality. It is recommended to underpin information on growth regulators and plant stress with a solid understanding of how cotton plant physiology and growth/development translates into yield and fibre quality.

It may be justified to establish either a research initiative and/or a technical lead in the D&D team focused on cotton plant physiology and plant growth to optimize fibre yield & quality under variable seasonal conditions.

Three areas of activity are suggested in the shorter term:

- a. **Technical review of current knowledge on the management and impact of growth regulators in cotton**, including farm case studies. Whilst research will likely argue that this work has been done, there are clearly many questions amongst growers/agronomists and considerable financial expenditure occurring on growth regulators and their application.
- b. Compile a series of **economic case studies on the management of stressed crops**, supported by an overview drawn from the science.

Case studies with 10-15 growers could review the practices that they used to recover a crop that had been stressed by heat waves conditions, running out of water, waterlogging or flooding. Key questions to consider are: what were the strategies used? How did they decide on these strategies? Do they believe they were successful? What would they do differently? An economic analysis of the strategies would be valuable to help determine whether the decision to increase inputs or reduce inputs would be the most profitable.

This is recommended to be done in 2013 to draw on the recent experiences with both extreme heat, water shortages and flooding.

- c. **Deliver regional training opportunities to build understanding of cotton plant physiology, growth/development and management** eg local trials, Physiology Masterclass.

14. Continue the extension campaign on herbicide resistance

There appears to be strong awareness of the threat of herbicide resistance and in some cases its presence. There seems to be need for a campaign to increase vigilance in farm hygiene and weed management strategies to prevent spread and further development of resistant weeds. Cotton industry extension campaigns need to be strongly aligned with efforts of other sectors (eg GRDC).

15. Research and extension effort to investigate the management options for Volunteer RoundUp Ready cotton

This is a major concern that requires cotton industry leadership. As noted in one Think Tank: "GRDC is doing a lot on herbicide resistance but volunteer cotton is our own problem – we need to deal with that one as an industry".

16. Implement regionally based, nationally coordinated trials to address key issues raised

There is a strong desire for research conducted locally – ie away from ACRI. This may partly relate to a lack of awareness of the research that is underway and partly due to real differences in soils, climate and/or systems. Local trials or learning sites will help to engage growers with research.

Appendix A

Cotton Growing Practices 2013 **Findings of CRDC's survey of cotton growers**



Cotton Growing Practices 2013



Findings of CRDC's survey of cotton growers



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Summary

The Cotton Growing Practices 2013 survey conducted for the Cotton Research and Development Corporation (CRDC) focused on Nutrition & Soils; Energy; Harvesting and Human Resources for the 2012-13 cotton crop. The season was typified by hot, dry conditions and record yields to produce the second largest Australian cotton crop on record (4.4 million bales from 405,000 irrigated hectares and 36,880ha of dryland) with the highest yet average yield of 10.2 bales/ha.

The Cotton Growing Practices survey gathers valuable information about cotton farming practices so that trends over time can be monitored when compared with similar surveys conducted in 2011, 2007, 2006 and earlier. This survey aimed to consolidate all CRDC funded surveys for 2013 into a single survey tool, to reduce the number of surveys growers are asked to complete for industry research. The information gathered feeds directly into research projects and is also used to evaluate research outcomes, plan new projects, identify priority issues and tell the cotton industry's 'story'.

Survey responses covered 92,687 ha of irrigated cotton (23% of the total irrigated crop) and 9,853 ha of dryland cotton production (27% of the total dryland crop in 2012-13). 20% (165) of the farms registered with CRDC who grew cotton in 2012-13 returned surveys. The survey was mailed to all 1000 cotton growers registered with the CRDC in July 2013. While 362 replied, many had not grown cotton in 2012-13, reducing the population to 837. 38 (23%) of the responses included at least some dryland cotton production. At a regional level the rate of response ranged from 12% to 30%. 62% of respondents have been involved with the cotton industry for 20 years or more.

Findings are presented in this report and the full data set is available from CRDC. Some interesting findings are summarized below.

2012-13 season

- Irrigated cotton on average accounted for 16% of the land area of farms where it was grown while dryland cotton accounted for 2%.
- Irrigated cotton in 2012-13 yielded close to growers' targets in NSW but fell short in Queensland.
- Dryland cotton exceeded target yields in most regions.
- The highest reported yield from an individual field was 16.2 bales/ha in the Upper Namoi.
- 43% of irrigator respondents and 24% of dryland respondents received quality discounts, ranging from \$0.11/bale to \$75/bale with micronaire and colour being the most costly.

Nutrition

- Rates of applied Nitrogen (N), Phosphorus (P), Potassium (K), Zinc (Zn), Sulphur (S) and trace elements have been gathered for irrigated and dryland cotton crops and are compared with application rates recorded since 1997.
- Fertiliser rates and costs are highly varied, with a wide range at the same yield levels. Nutritional inputs cost between \$300 and \$600/ha for 75% of irrigator respondents and between \$100 and \$200/ha for 60% of dryland respondents.
- Average rates of nutrient application per hectare of irrigated cotton were 243kg N, 31kg P, 24kg K, 3kg Zn and 14kg S.
- Average rates of nutrient application per hectare of dryland cotton were 84kg N, 13kg P, 10kg K, 1.8kg Zn and 5.5kg S.
- Phosphorus was applied on 76% of irrigated and 62% of dryland respondents' farms.
- Potassium was applied on 43% of irrigated and 23% of dryland respondents' farms.
- 70% of respondents varied fertiliser application rates across fields / management units in the 2012-13 season and 16% varied fertiliser rates within a field.
- 13% of irrigated farms and 20% of dryland farms had a nitrogen use efficiency (yield per unit nitrogen) within the optimum range recommended by research.

- On average 67% of nitrogen was applied pre-season for irrigated cotton, which is similar to that reported for the 2010-11 season. There was a large variation between farms.
- Application methods and timing are varied. 55% of farms apply nitrogen in bands, 40% water run N, 24% use gas, 24% apply a granular side dressing direct drilled into the hill, 18% apply a granular top dressing followed by flood irrigation, 16% apply foliar nitrogen and 8% of farms indicated they apply N through fertigation.
- 39% of respondents used manures or composts in their nutrition program.
- Barriers to improving fertiliser efficiency include weather, application risks and practicalities, product limitations, cost, agronomy factors, soils and knowledge.

Soil and petiole testing

- Soil testing tends to be carried out by many farms at the same frequency for all depths and analysis types.
- 52% of irrigator respondents have a soil surface test for Nitrate-N, pH, EC and Chloride done every season, 18% having it done on every field every season. One third of respondents soil test some fields every season on irrigated cotton.
- 13% of respondents had a petiole nitrogen test conducted on every field every season on irrigated cotton.

Soils, crop rotations and other agronomy

- Almost all respondents (99%) thought that soil health was generally increasing or steady.
- Irrigated farms grew cotton on 15-100% of their irrigation country in 2012-13 (avg 58%).
- Dryland cotton was grown on 7-54% of the farms' dryland cropping area in 2012-13 (avg 23%).
- 75% of respondents produced on average two or less cotton crops before breaking with an alternate crop or fallow. 49% usually had at least one back-to-back cotton crop. 13% grow 5 or more consecutive cotton crops.
- Wheat was the most common rotation with cotton (used in the past 3 years by 78% of respondents). Other rotation crops used in the past 3 years, in declining order of use are chickpea sorghum, barley, maize, mungbean, faba beans, canola, soybean, vetch, sunflower, French white millet, canary seed and lab lab.
- Row configuration for irrigated cotton was at 1m spacing for 84% of respondents. In dryland cotton 12% used 1 m rows, 27% 1 m single skip, 30% 1m double skip and 15% 1.5m.
- The number of machinery passes varied a lot (1-10 passes). There were on average 5.3 workings for back to back cotton and 4.1 for cotton following a rotation or fallow.
- Substantial soil compaction is observed after wet seasons and harvesting (both picker types).
- 55% of respondents vary management based on high variation detected in yield maps.
- 54% of respondents usually manage for an early finish to the season.

Crop protection stewardship

- 76% of respondents thought the long term value of complying with the Bollgard®II resistance management plan (RMP) is worth the effort and cost, 11% do not agree.
- 79% consider it important to have a choice of refuge options.
- 63% of Bollgard®II crops are checked twice a week.
- 69% consider field failure to Bollgard®II will occur within 10 years (19% within 5 years) if the current RMP continues and no other *Bt* technologies become available.
- Herbicide resistant weeds were reported by 37 farms in irrigation and 31 farms in dryland.
- 13% of respondents indicated herbicide spray drift had affected their 2012-13 cotton crop.
- 49% of respondents believe CottonMap has helped to reduce herbicide spray drift.

Energy

- Diesel accounted for 86% of energy usage, electricity for 11%.
- 11% of respondents had measured or benchmarked their total energy usage in the past 5 years, 16% had done this for individual operations and 24% of irrigator respondents had a pump efficiency investigation done.
- Solar energy, the most used alternative energy source, was mainly house or workshop use.
- Price, availability and ease of use were the most important factors in decisions about alternative energy. Environmental benefits and risks were important to a high proportion.

Harvesting

- Round module pickers (JD7760) were used on 69% of respondent's farms and 82% of their cotton area in 2013.
- Where round module pickers were used, 53% of respondents used contract harvesters, 40% purchased or leased their own and 7 % used a combination of both.
- 36% of the 37 respondents who owned a round module picker had more than one.
- The major motivations for the initial decision to use a JD7760 were the ability to pick crops more quickly, a decrease in labour and decrease in workforce health and safety risks.

Human Resources

- 73% of respondents indicated that they have a capable workforce.
- As a broad average, respondents employed 6.6 people per farm (1.6 employees/100 cotton ha). Of these, on average 2.4 employees first joined the farm in 2012 and 1.8 employees were new to cotton.
- The average vacancy rate at January 2013 was 0.4 positions per farm.
- 30% of staff are 'Entry' level, 34% 'Experienced', 17% 'Senior experienced' and 19% at 'Manager' level.
- Permanent staff are primarily full time (63%), 3% of these are 457 visa holders.
- 28% are casuals and 8% part time permanent.
- 65% of casual staff employed at January 2013 were 417 visa holders.
- 74% of all casual staff are at entry level, 82% of the 417 visa holders are at entry level.

Safety

- 62% of respondents completed inductions for some or all new workers (51% for all).
- 24% completed inductions before each season with contractors.
- 28% had a formal system for workers/contractors to report hazards.
- 26% had a documented health and safety plan.

Use of contractors

- 98% of farms in the survey used contractors for at least some operations.
- 15% used contractors for ground preparation, 7% for planting and 15% for fertiliser application.
- 48% used contract harvesters and 34% had all of their harvesting done by contractors.
- 43% used ground rig contractors for spray application (16% for all of this work).
- 85% had modules transported by contractors.

Information and research

- 73% of respondents consider that cotton industry research and development is effectively communicated to them.
- 84% use a smart phone or tablet for accessing information about their farming system.
- 50% of respondents use the cotton industry's myBMP site at least slightly.
- Social media use is low (2% high-moderate use, 14% slight use).
- 61% considered that cotton specific mobile apps could be helpful, a number of suggestions are reported.
- The Australian Cottongrower, Cotton Pest Management Guide, CRDC's Spotlight and technical fact sheets rated most highly as preferred mechanisms to receive cotton R&D information.
- 77% believe the cotton industry has effective collaborative structures for prioritizing R&D.
- 91% consider that R&D drives continuous improvement of the Australian cotton industry.

Cotton productivity and profitability

- 86% of respondents believe that cotton is profitable and consistently their crop of choice.
- 31% believe they can continue to farm productively for 50 years with current practices.
- 32% indicated they will not be able to farm profitably into the future if recent trends in input costs and cotton prices continue.
- 78% agreed that in most seasons their farm generates a viable profit.
- Water and weather were the most frequently identified limitations to productivity and profitability, followed by farm characteristics, labour, costs, finance and varieties.
- The most mentioned drivers of productivity and profitability were yield and price followed by water, costs and nutrition.
- Above average yields were most commonly attributed to weather, agronomic inputs (water, irrigation timing and efficiency, nutrition, varieties) and management (timing, attention to detail, management and profit).

Aspirations

- Many respondents intend to improve their farm business (70%) and infrastructure (66%).
- Close to half intend to grow their farm assets and/or cotton enterprise.
- One third intend to transition the farm ownership to family members.
- 11% will move out of farming to retire or for other reasons.

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Background

Information about farming practices used in cotton production, yields obtained and fibre quality are of enormous value in planning research and extension efforts, in industry activities and in telling the industry's 'story'. Without regular surveys there is relatively limited information about current practices used on-farm or changes over time. Survey findings are used to evaluate research and development uptake and identify areas for further research to help improve cotton production.

The Cotton Growing Practices 2013 survey was conducted in late winter 2013, focusing on the 2012-13 cotton crop. The hot, dry 2012-13 season produced the second biggest Australian cotton crop on record with the highest yet average yield of 10.2 bales/ha¹. 4.384 million bales were produced from 405,000 ha of irrigated cotton. Dry conditions restricted the dryland plantings to 36,880 ha producing 132,300 bales.

Survey design

The survey was designed to be a single, coordinated survey of cotton growers conducted by CRDC and its research partners in 2013. Where possible it has been aligned with historical surveys so that trends can be monitored. By consolidating CRDC funded surveys CRDC aimed to reduce the number of surveys growers are asked to complete. A call was made to all CRDC funded researchers and other industry research leaders asking them to identify any questions they would like asked to aid their research or extension effort. This identified that surveys were planned by the NCEA (Harvesting by John McLean-Bennett and Energy by Gary Sandell). It gathered questions from The University of Melbourne (Workforce by Jennifer Moffatt) and several other researchers.

As a result, the survey was developed to focus on the major themes of:

- Nutrition & soils
- Energy
- Harvesting
- Human resources.

The survey was printed and mailed out to 1000 cotton growers listed on the CRDC's industry contacts list. Together with the survey growers received:

- an introductory letter from CRDC;
- a snapshot booklet of findings from previous surveys;
- a quick response form for people who would not be returning the survey (eg people who did not grow cotton in 2012-13, were not growers or did not want to respond) and for updating contact details; and
- a stamped, addressed return envelope.

Additional copies of the survey were provided to Regional Delivery Officers (RDOs) and an online response option was promoted via Cotton Australia's "Cotton Matters" newsletter and some RDO's regional newsletters. The survey was also promoted through a series of articles in CRDC's Spotlight magazine.

After an initial response window, a team of regional people experienced with their local cotton industry were engaged to call growers to encourage additional responses.

¹ Australian Cotton Yearbok 2013

Survey response

Survey responses cover approximately 23% of the 2012-13 irrigated cotton production area and 27% of the dryland cotton area (based on the survey responses that recorded crop area and the total crop area reported in the 2013 Cotton Yearbook).

At least 20% of farms registered with CRDC that grew cotton in 2012-13 completed surveys. Replies were received from 362 people (36% of the 1000 surveys mailed out). Of these, 165 returned the survey and 153 completed the majority of it. 34 declined to complete the survey. The population size can be reduced to 837 by excluding 163 people (46% of the replies) from the sample as: 55 replied that they did not grow cotton in 2012-13, 3 had their crop destroyed, 70 were not cotton growers, 17 were returned to sender and 18 of the initial list were duplicates for the same farm. Of the remaining population it is impossible to know what proportion were active cotton growers in 2012-13. If the 46% rate of non-active growers in the replies is extrapolated to the whole population then the sample would be reduced to 537 growers and thus the response rate would be 31%. However, the response rate from non-growers was likely higher (a simple, single page form). It can be estimated that the 165 surveys received represents between 20% and 31% of those on the CRDC's mailing list who grew cotton in 2012-13. 160 people amended their contact details and 45 asked to be removed from the list.

38 of the replies were from dryland growers, with 15 of these having grown both irrigated and dryland cotton in 2012-13. A much larger number of dryland growers returned the response form to say they did not grow cotton in the 2012-13 season. The distribution of the survey responses at a regional level is depicted in Table 1 while Table 2 shows the area of cotton surveyed. When compared with the total Australian cotton production estimate (Cotton Yearbook 2013), the surveyed area represents 23% of the total irrigated crop and 27% of the total dryland crop. Regions have been aggregated where appropriate into climatic zones for regional reporting. Particular caution should be taken in considering results from Central Queensland as it is a small sample and mainly from the Dawson Callide, with only 3 replies from Emerald. A detailed survey of Emerald growers was done in 2012.

Table 1 Regional distribution of surveyed growers and response

Response Total	Number of growers on mailing list	Active population (Excludes those who indicated they didn't grow cotton 2012-13)	Number of responses	% response
Burdekin	8	8	-	
Central Queensland	105	90	11	12 %
Darling Downs	231	195	33	17 %
Border Rivers	75	53	14	26 %
St George / Dirranbandi	44	39	10	26 %
Gwydir	119	101	18	18 %
Lower Namoi	145	120	22	18 %
Upper Namoi	89	70	15	21 %
Macquarie	119	90	27	30 %
Bourke	6	6	1	17 %
Southern NSW	61	54	14	26 %

Table 2 Area of cotton planted 2012-13 represented in the survey

	IRRIGATED				DRYLAND			
	No. of farms	Field ha	Green ha	Ha not picked	No. of farms	Field ha	Green ha	Ha not picked
Central Qld	11	2,453	2,431	65	0	0	0	0
Darling Downs	21	5,418	4,820	8	18	5,177	3,251	116
Southern Qld	21	24,356	24,346	617	4	640	458	0
Northern NSW	48	34,445	34,265	860	14	3,636	2,312	1,976
Macquarie	27	14,346	14,164	340	2	400	346	80
Southern NSW	14	11,669	11,596	15	0	0	0	0
All regions	142	92,687	91,622	1,905	38	9,853	6,368	2,172

Demographics of respondents

Cotton in the farm landscape

On average across respondents from all regions cotton production in 2012-13 accounted for 18% of the farm land area (16% irrigated, 2% dryland) (Figure 1). There is some variation across regions as depicted, in Southern NSW, farms have a larger proportion of the farm developed for irrigation.

On those farms that reported they have irrigation, irrigated cotton accounted for on average 23% of the land area with a range from 1% to 100%. On farms producing dryland cotton, the area of dryland cotton accounted for an average of 18% of the land area (Range 5%-53%).

Figure 1 Land use mix, average across all cotton growing farms surveyed 2012-13

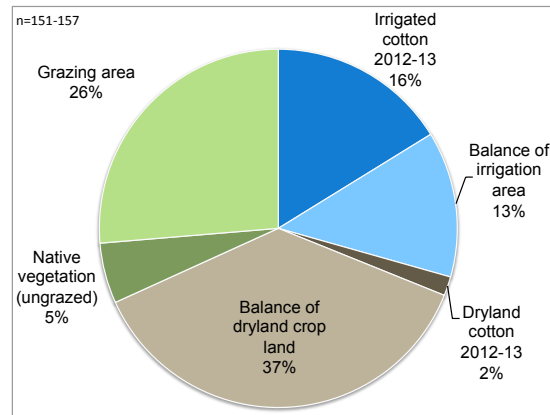
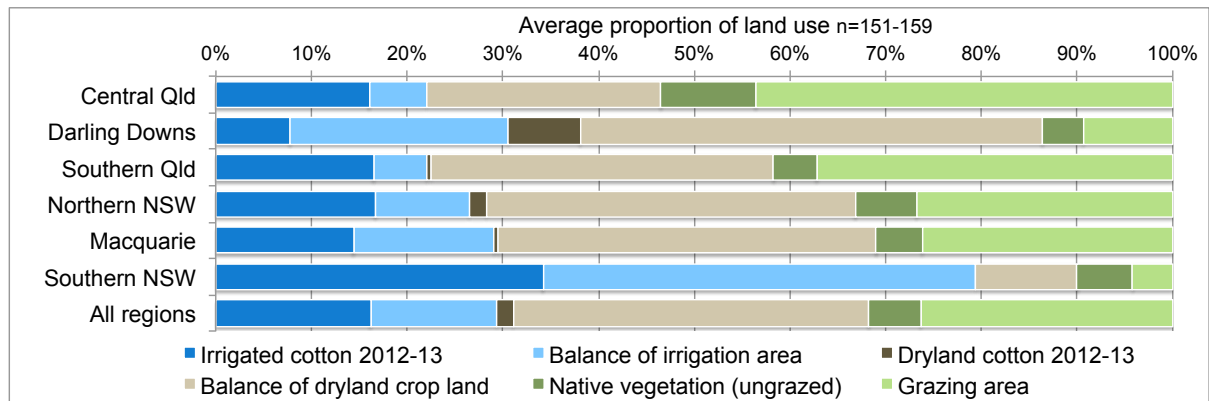


Figure 2 Average proportion of land use types on cotton growing farms surveyed, by region 2012-13



Note: Responses from Central Qld are predominately in the Dawson-Callide region. Farms in the Emerald Irrigation Area typically have the majority of the farm used for cotton production and would differ from what is presented here.

People

62% of respondents have been involved with the cotton industry for more than 20 years (Figure 3). The majority of respondents were aged between 35 and 64 (Figure 4). Note, that the one respondent over 80 years of age completed only the first page of the survey.

Figure 3 Years involved with the cotton industry

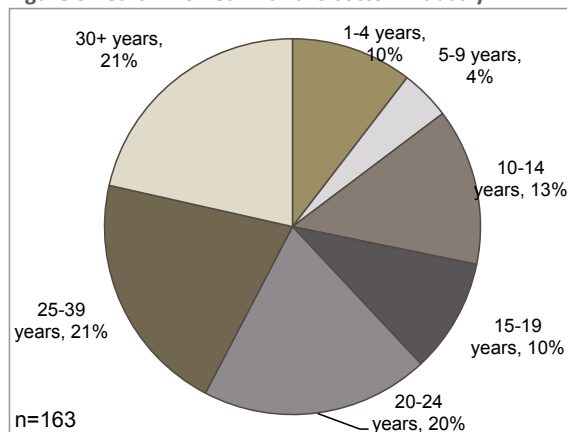
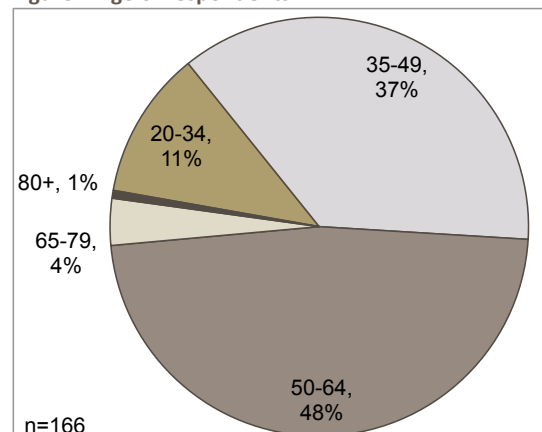


Figure 4 Age of respondents

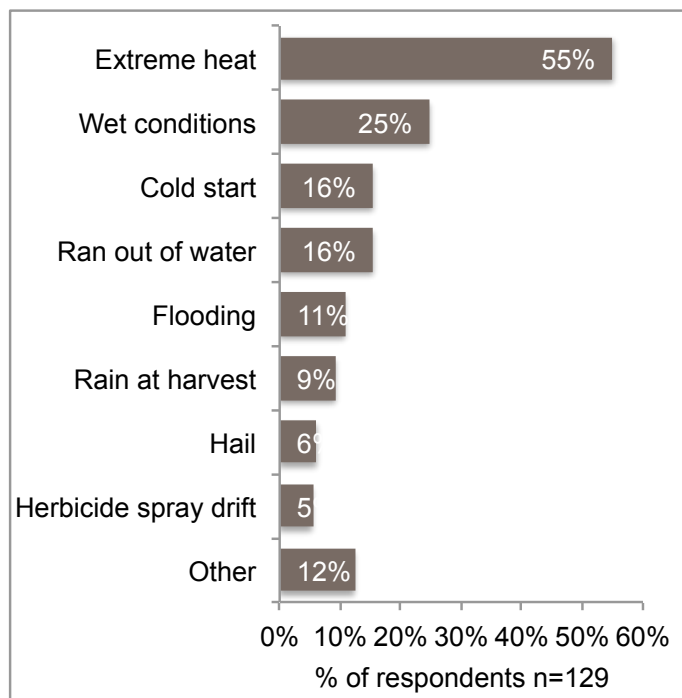


Findings

2012-13 Season

The 2012-13 season was typified by a dry, hot summer with some very high temperatures recorded in most regions. There was significant rainfall in January and March in many regions with some experiencing January flood events. A number of respondents indicated that these seasonal conditions impacted substantially on the yields achieved (Figure 5).

Figure 5 Issues substantially impacting on yield



Were there any issues that substantially impacted on the yield or quality of your 2012-13 cotton crop?

“Other” issues were: Crop didn't defoliate well, Ginning, Replant, No Irrigation planted because of zero water, Hard start, Dry Start, Poor Establishment, Planting rain wasn't until early December first flower not till February, Bastard of a year! Seed Quality, Breakdown of bores, Wire worm, Nitrogen, Early fruit set, Hardforming soil structure damage, Management.

Irrigated cotton yields

Yield results are depicted in Figure 6. Irrigated cotton farm average yields achieved close to target yields in NSW in 2012-13 but fell short in Queensland regions. In all regions there were some high performing individual fields. The highest reported yield was 16.2 bales/ha from a field in the Upper Namoi.

Dryland cotton yields

Figure 7 illustrates that in most regions dryland cotton exceeded target yields. These averages are boosted by some particularly high yielding fields in each region. The highest yielding dryland cotton crop was 10.4 bales/ha from a field on the Darling Downs. Nine farms (24% of dryland respondents) reported an area of dryland cotton that was planted but not harvested.

Solid bars in these figures show the average yield across the region, the average of the target yields that respondent growers are aiming to achieve, the average of each farms' highest yielding field and the highest yield from an individual field from across the region.

The dotted line/transparent red bar shows the average quality discounts and the single line above this depicts the highest quality discount received.

Figure 6 Yields and quality discounts of irrigated cotton 2012-13

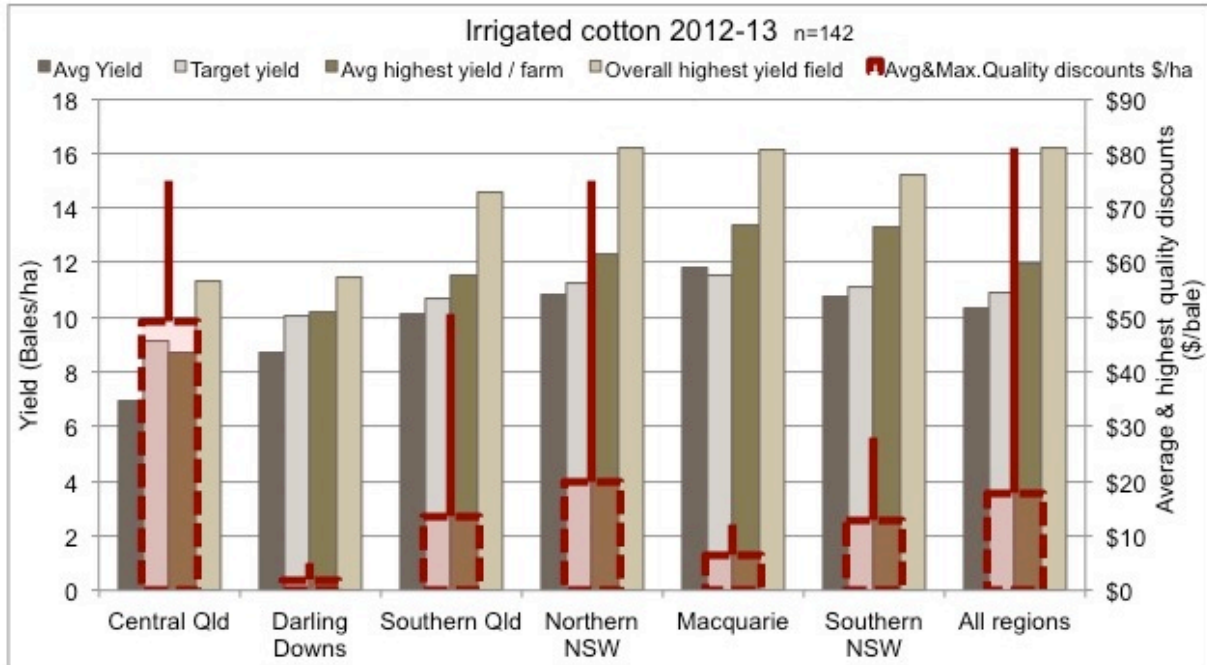
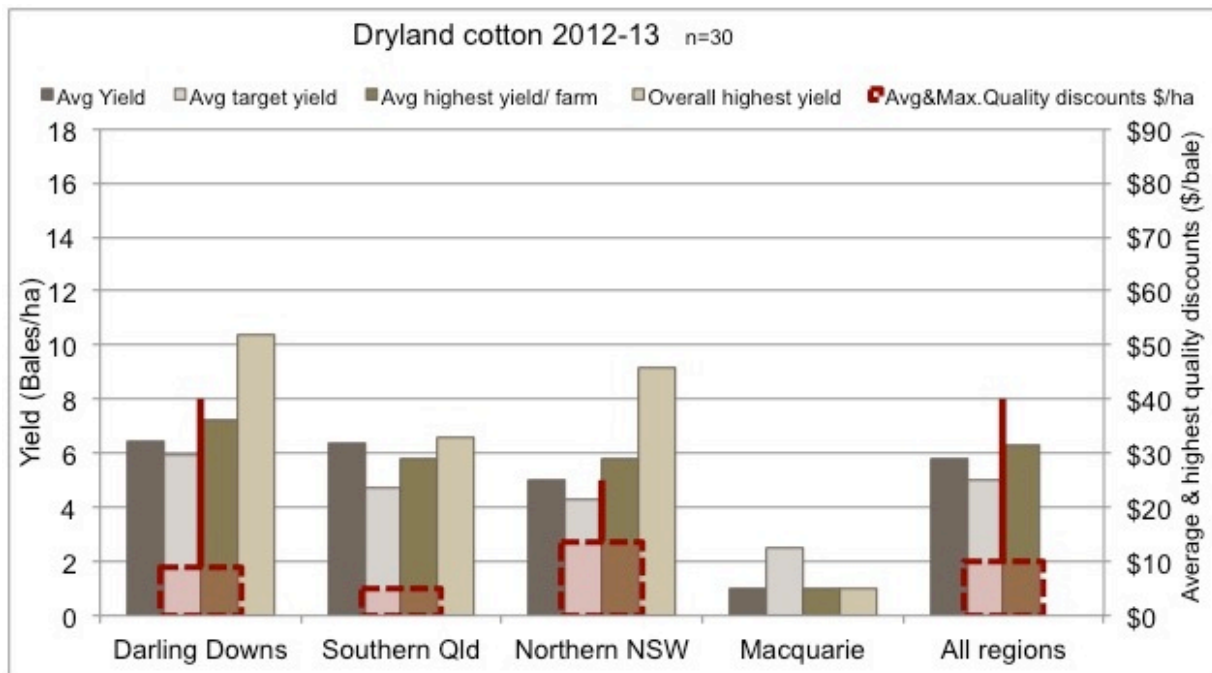


Figure 7 Yields and quality discounts of dryland cotton 2012-13



Quality

57 irrigated growers (40% of respondents) indicated they received quality discounts ranging from 11c/bale to \$75/bale. Nine dryland growers (24%) received quality discounts ranging from 50c/bale to \$40/bale.

35% of respondents received no quality discounts.

The average cost where quality discounts were received (ie excluding zero or non-response) was \$17.80/bale for irrigated cotton and \$10/bale for dryland cotton. Of the two discounts of \$70 or more/bale, one was linked to colour (this Central Queensland crop had rain at harvest after extreme heat in the growing season) and the other to micronaire in a Northern NSW crop that ran short on water with extreme heat conditions.

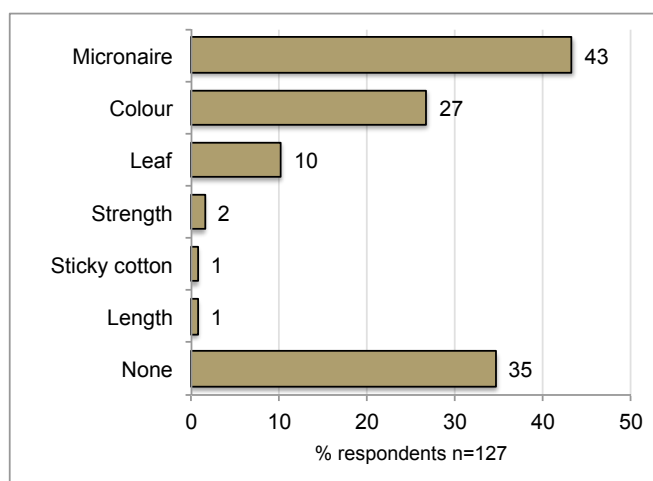
As in 2011-12, quality discounts were significant in Central Queensland (Figure 6). The most common quality discounts experienced in each region were:

- Central Queensland: Colour & leaf
- Darling Downs: Colour & micronaire
- Southern Queensland: Colour & micronaire
- Northern NSW: Micronaire, colour
- Macquarie: Micronaire, leaf, colour
- Southern NSW: Micronaire, colour.

43% of respondents reported that micronaire problems caused costly quality discounts for them in the 2012-13 season (Figure 8). These micronaire discounts occurred in all regions other than Central Queensland. Whilst we cannot distinguish if this was high or low micronaire, it is known that high micronaire is most often a problem when there is very hot weather in the growing season (as in 2012-13).

Colour was a costly discount for 27% of farms. Colour problems occurred across all regions but was most prevalent in Central Queensland where 64% farms indicated that colour was a problem.

Figure 8 Most costly quality discounts received by growers



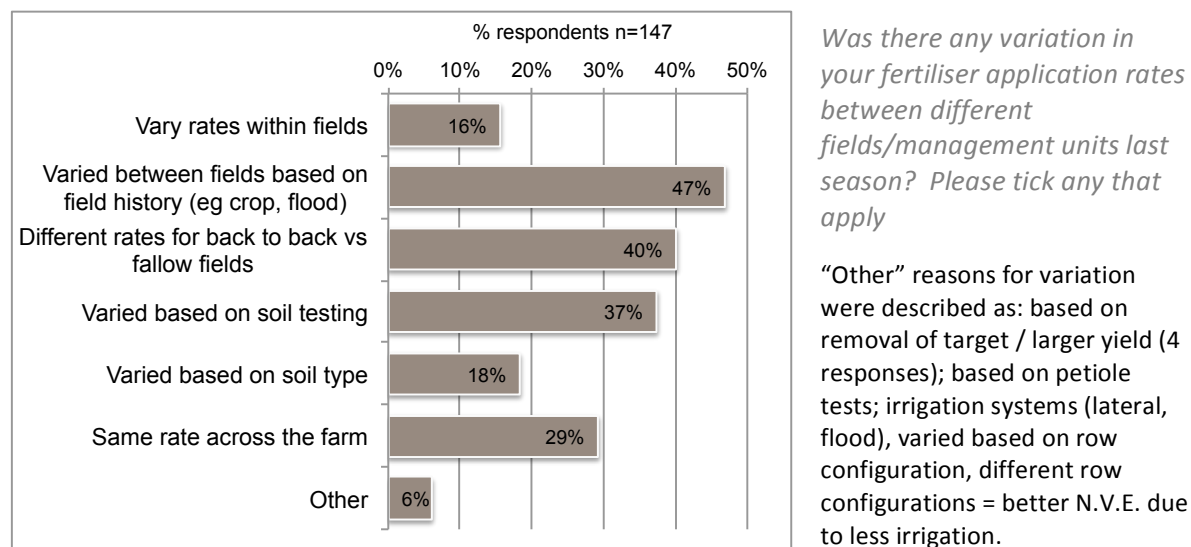
Which quality discounts (if any) were the most costly for you this year? (or are likely to be if you don't have results yet) Please tick all that were a substantial cost

Nutrition

Fertiliser rates

Fertiliser nutrient rates were recorded as the 'typical rates' applied across each farm (Table 3). Fertiliser application rates were varied across fields / management units in the 2012-13 season on 70% of respondents' farms, with field history being the most common basis for variation (Figure 9). 16% vary fertiliser rates within a field and 29% use the same rate across the farm.

Figure 9 Variation in fertiliser rates between fields or management units



Rates were supplied by grower respondents as either nutrient rates or as fertiliser product rates. Where fertiliser rates were provided these were converted to nutrient rates for that farm. There was often confusion between the two and a number of follow up calls were made to clarify nutrient rates vs fertiliser rates.

Table 3 reports the nutrient rates used in 2012-13, as averages across those farms using each type of nutrient (ie zero values are excluded from the averaging calculation) and the proportion of farms applying each type of nutrient. Table 4 compares nutrient rates in 2012-13 with previous years, showing that most nutrients have, as expected, increased over 16 years but have remained relatively stable over the past two seasons.

Figure 10s 10 to 12 show the rates of N, P and K applied to irrigated cotton on individual farms vs the farm average yield on those farms, with each region presented differently. Figure 13 shows rates of N, P and K for dryland cotton vs yield. These figures show the variation between farms and regions is considerable.

There is a high variation in potassium (K) application: while over half of the farms apply no K, others apply high rates. Several factors may influence this including: soil type, field history or K may be applied on some years only on some farms.

Nutrient rates were gathered based on previously used categories of application (Table 4). Several people also used liquid fertilisers as well – while used in relatively low rates per hectare (especially at planting) they are clearly important in some growers' nutrition strategies.

Table 3 Nutrient rates applied to cotton crops in 2012-13

Applied Fertiliser (nutrient rates)	Irrigated				Dryland			
	Avg.	Min	Max	% farms	Avg.	Min	Max	% farms
Preseason nitrogen – solid fertiliser (kg N/ha)	135	9	250	75	89	60	140	54
Preseason nitrogen – gas fertiliser (kg N/ha)	169	70	230	34	70	10	120	27
In season nitrogen – solid fertiliser (kg N/ha)	100	6	310	53	33	3	75	12
In season nitrogen – gas fertiliser (kg N/ha)	88	2	150	8	-	-	-	0
In season nitrogen – water applied (kg N/ha)	61	4	150	41	-	-	-	-
Total applied Nitrogen	243	93	370	100	84	2	140	85
Preseason phosphorus – fertiliser (kg P/ha)	31	0.1	180	70	14	4	30	50
In season phosphorus – fertiliser (kg P/ha)	15	1.6	40	11	8	4	20	15
Total applied Phosphorus	31	1.7	180	76	13	1	30	62
Preseason potassium – fertiliser (kg K/ha)	26	0.2	80	34	10	0.7	30	23
In season potassium – fertiliser (kg K/ha)	12	1	50	11	-	-	-	0
Total applied Potassium	24	1	80	43	10	0.7	30	23
Zinc fertiliser (kg Zn/ha)	3.0	0.25	30	59	1.8	0.1	5	54
Sulphur (kg S/ha) *	14	1.5	180	40	5.5	.7	13	42
Trace elements (kg/ha)	9.1	4.4	15	3	-	-	-	-

NB zero values are excluded from calculations – each average is the average for those farms using this type of application
In-season 'solid' N includes liquid & foliar fertilisers. A few high rates of sulphur are from large applications of gypsum.

Table 4 Trends in fertiliser rates on cotton over 16 years

FERTILISER	1997	2001*	2006*	2007*	2011 [^] Irrigated	2013 Irrigated	2011 [^] Dryland	2013 Dryland
Pre season nitrogen - solid fertiliser (kg N/ha)		80	87	101	142	135	89	89
Pre season nitrogen - gas fertiliser (kg N/ha)		78	71	60	155	169	84	70
In season nitrogen – solid fertiliser (kg N/ha)		17	29	60	99	100	45	33
In season nitrogen – gas fertiliser (kg N/ha)		8	14	18	83	88	40	-
In season N water applied (kgN/ha)					57	61	5	-
TOTAL applied N kg/ha	125	176			217	243	96	84
Pre season phosphorus fertiliser (kg P/ha)		23	30	35	42	31	14	14
In season phosphorus fertiliser (kg P/ha)		2	3	2	20	15	13	8
TOTAL applied P kg/ha					40	31	16	13
Pre season potassium fertiliser (kg K/ha)		8	16	24	33	26	7	10
In season potassium fertiliser (kg K/ha)		0	2	4	15	12	2	-
TOTAL applied K kg/ha					28	24	7	10
Zinc fertiliser (kg Zn/ha)		5	5	5	4.4	3	3.7	1.8
Sulphur (kg S/ha)					6.3	14	2.4	5.5
Trace elements					21	9	4	-

* Roth G (2009) Economic, environmental and social sustainability indicators of the Australian Cotton industry. Cotton CRC.

[^] GHD Hassall (2011) Cotton Grower Practices Survey. Cotton CRC and CRDC.

Figure 10 Nitrogen rates used on irrigated cotton farms vs yield

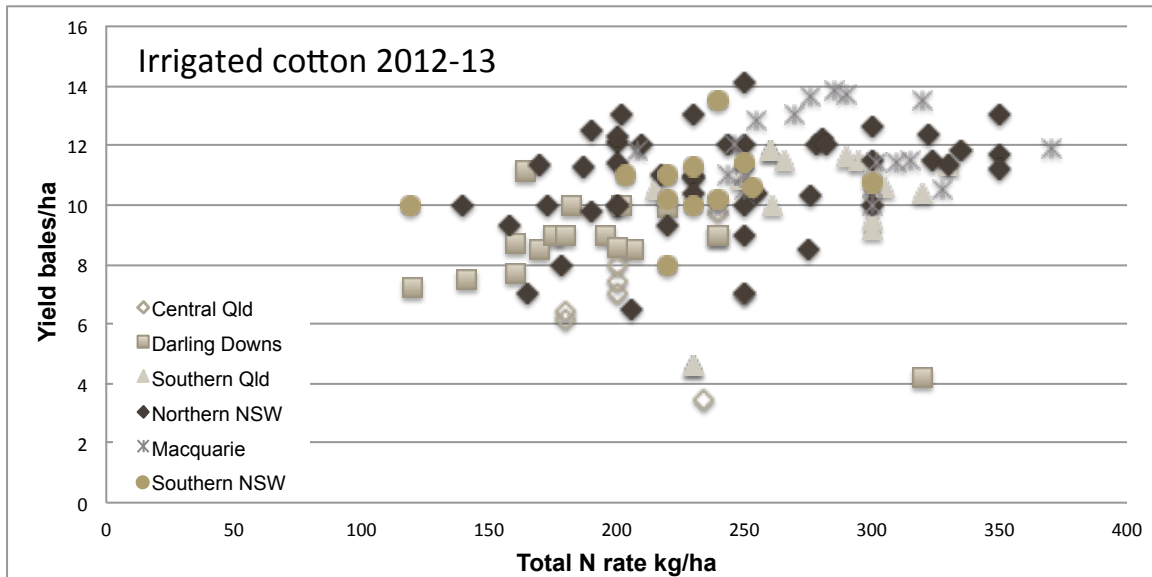


Figure 11 Phosphorus rates used on irrigated cotton vs yield

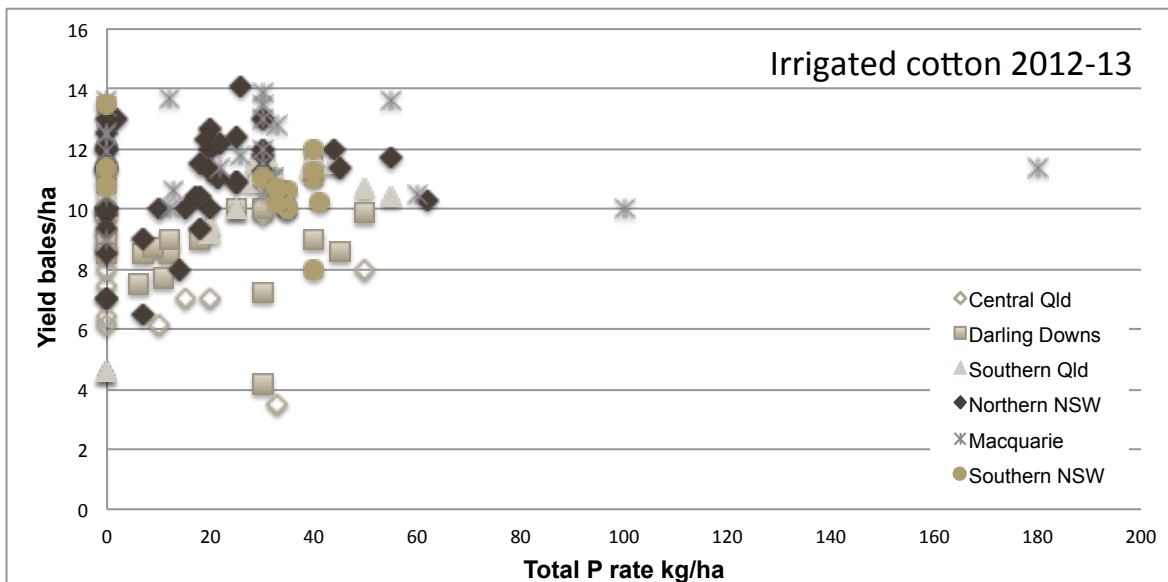


Figure 12 Potassium rates used on irrigated cotton vs yield

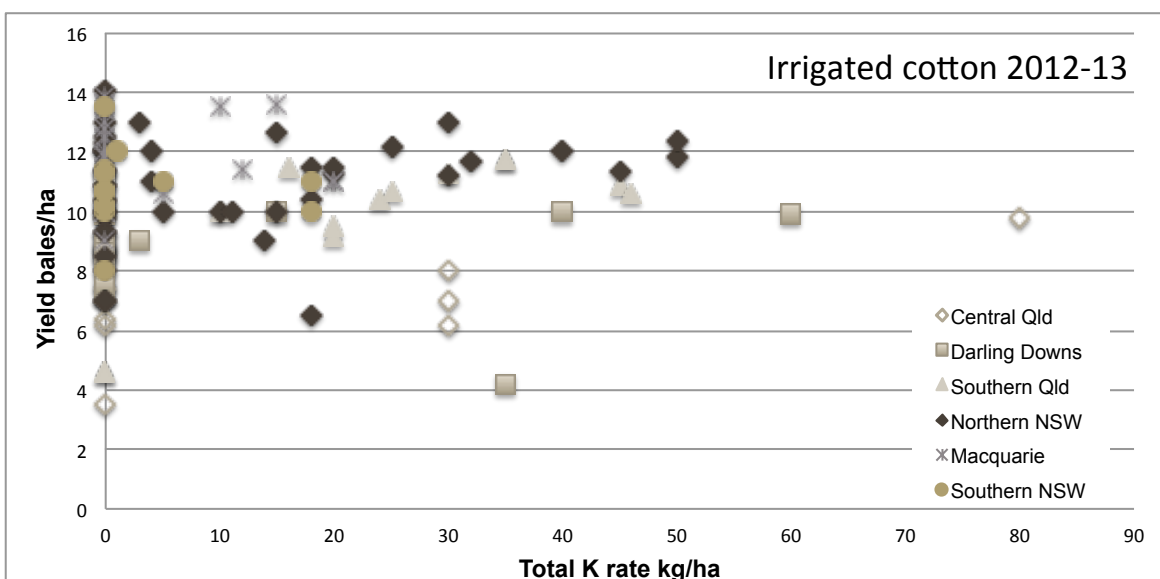
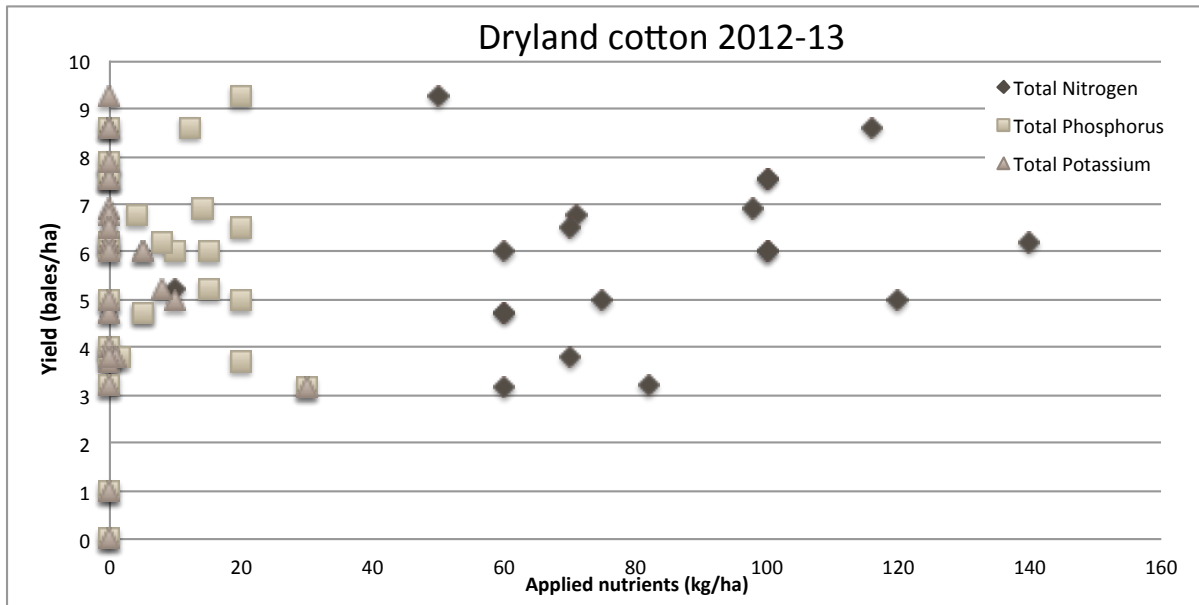


Figure 13 NPK fertiliser rates used on dryland cotton vs yield



Nitrogen fertiliser use efficiency

Calculation of the nitrogen fertiliser use efficiency (NFUE: kg lint/ha divided by the kgN/ha) reveals that only 13% of respondent farms are achieving NFUE on irrigated cotton within the optimal range of 12.5 to 16 kg lint/kg N recommended by Dr Ian Rochester’s (CSIRO) research (Table 5).

There is quite a degree of regional variation (eg 27% of irrigated farms in Northern NSW have NFUE in this optimal range), which appears to be linked to yield variations. In the majority of irrigated cotton farms, the NFUE is lower than optimal (ie they are applying more N than necessary for the amount removed in harvest).

Note that this measure does not take into account the background level of nitrogen or any N applied in manures and composts, it is only based on the reported fertiliser application rates to the cotton crop and harvested yields. This may contribute to the high NFUE in dryland crops – eg if N has been over applied to the previous crop with a subsequent low rate on cotton.

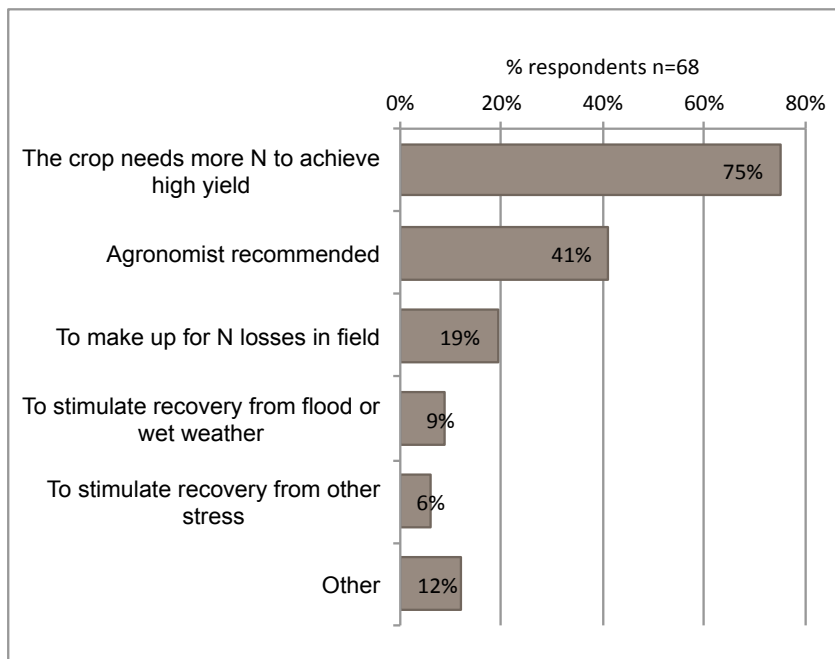
Table 5 Calculated nitrogen fertiliser use efficiency

Region	Irrigated		Dryland	
	Average kg lint/kg N	% of farms in optimum range # (12.5 to 16 kg lint/kg N)	Average kg lint/kg N	% of farms in optimum range (12.5 to 16 kg lint/kg N)
Central Qld	7.5	0 %	-	-
Darling Downs	10.7	12 %	17.4	17 %
Southern Qld	8.3	0 %	17.8	33 %
Northern NSW	10.6	27 %	35.7	20 %
Macquarie	9.7	5 %	-	-
Southern NSW	11.1	0 %	-	-
All regions	10.0	13 %	22.0	20 %

optimum range based on work by Dr Ian Rochester

Close to half (46%) of irrigator respondents recorded total Nitrogen rates of 250 kg/ha or higher on irrigated cotton. The main reasons given for this were the crop's needs for high yield and agronomist (Figure 14). This pattern is similar in all regions with the exception of the Gwydir where agronomist recommendation was rarely identified as a reason for the higher rate. Other reasons given were: Back to back cotton, leaf analysis and "To ensure crop is green at the finish. I will pick up leftover N in subsequent crops."

Figure 14 Reasons for N rates higher than 250 kg/ha



If your total applied Nitrogen rate is higher than 250 kg N/ha, what are your primary reasons for this?

Gypsum

Findings about gypsum applications in 2012-13 can be summarised as:

- 16 farms (12%) applied gypsum to irrigated cotton.
- Between 36 and 934ha were treated on these farms.
- The area treated on each farm equated to between 4 and 83% of the area of the farm developed for irrigation.
- Rates applied ranged from 1 to 5 tonnes/hectare, on average 2.2 tonnes/ha.
- No dryland cotton received applications of gypsum.

What area of your irrigated and/or dryland cotton did you apply gypsum to in 2012-13 and at what rate?

Fertiliser costs

75% of irrigated cotton respondents spent between \$300 and \$600 per hectare on nutritional inputs for their 2012-13 cotton crop (Figure 15). On dryland crops, 95% of respondent farms spent less than \$300 per hectare (Figure 16).

Across all respondents there was a wide range of fertiliser costs for the same levels of yield (Figure 17). Higher rates are broadly linked to higher yields but it is interesting to note the wide range of fertiliser spend for the same yield. For example, fertiliser inputs for crops yielding over 12 bales/ha ranged from \$200-250/ha through to more than \$750/ha.

Most of the irrigated crops with costs below \$250 received nitrogen fertiliser at rates between 140 and 240 kgN/ha and no other fertilisers. There was no clear pattern of timing of application for the low fertiliser cost farms, with most having split N applications. The irrigated farm with fertiliser cost below \$50/ha was using a complete sewerage program. Farms with fertiliser costs over \$600/ha had N rates between 200 and 370kg/ha and most were also applying other nutrients.

It is possible that some respondents may have included application in their cost estimates.

Figure 15 Fertiliser costs on irrigated cotton: proportion of farms in each cost bracket

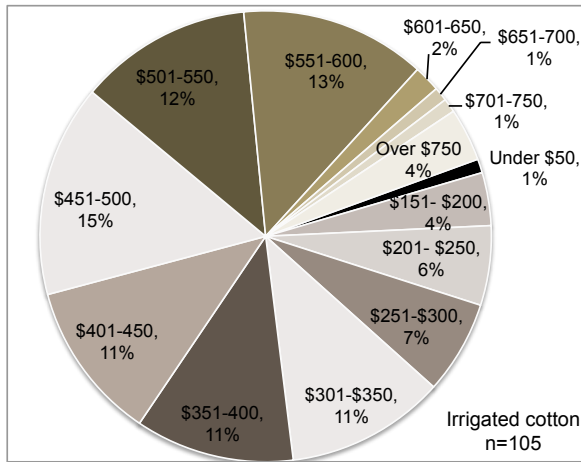
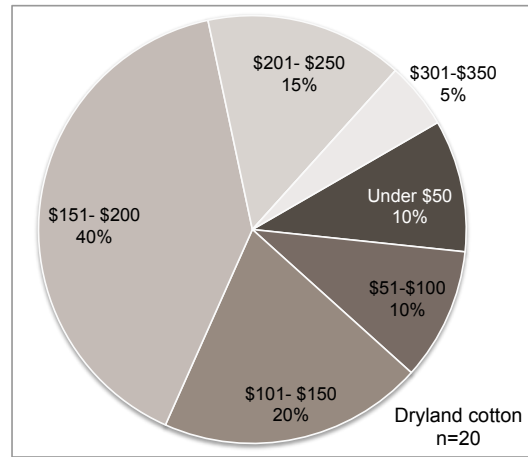
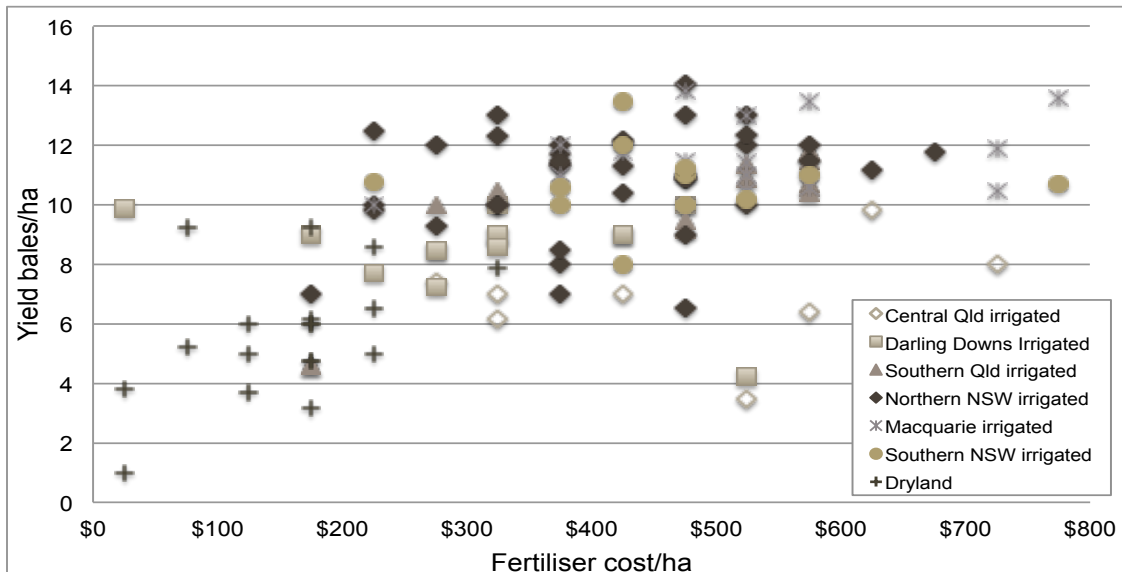


Figure 16 Fertiliser costs on dryland cotton: proportion of farms in each cost bracket



What was the approximate cost per hectare of nutritional inputs for your 2012-13 irrigated and/or dryland cotton crops?

Figure 17 Fertiliser cost vs yield on individual farms



Fertiliser application methods and timing

Analysis of the rates of nitrogen applied pre-season vs in-crop reveals:

- The proportion of N applied pre-season is highly variable (Figure 18).
- On average 67% of nitrogen was applied pre-season for irrigated cotton.
- 15% of irrigated farms applied all nitrogen pre-season and 26% applied more than 80% of nitrogen pre-season.
- Two irrigated farms applied all nitrogen in-crop.
- 17% of irrigated cotton farms applied less than half the nitrogen pre-season.
- Almost all nitrogen on dryland crops was applied pre-season.

There had been some speculation that a higher proportion of fertiliser would have been applied pre-season in the dry winter of 2012 as compared to the wet winter of 2010 which had restricted pre-season application. However, the average of 68% nitrogen being applied pre-season in 2012-13 is only slightly higher than the average of 60% in 2010-11.

Figure 18 Proportion of nitrogen applied pre-season vs yield for irrigated cotton

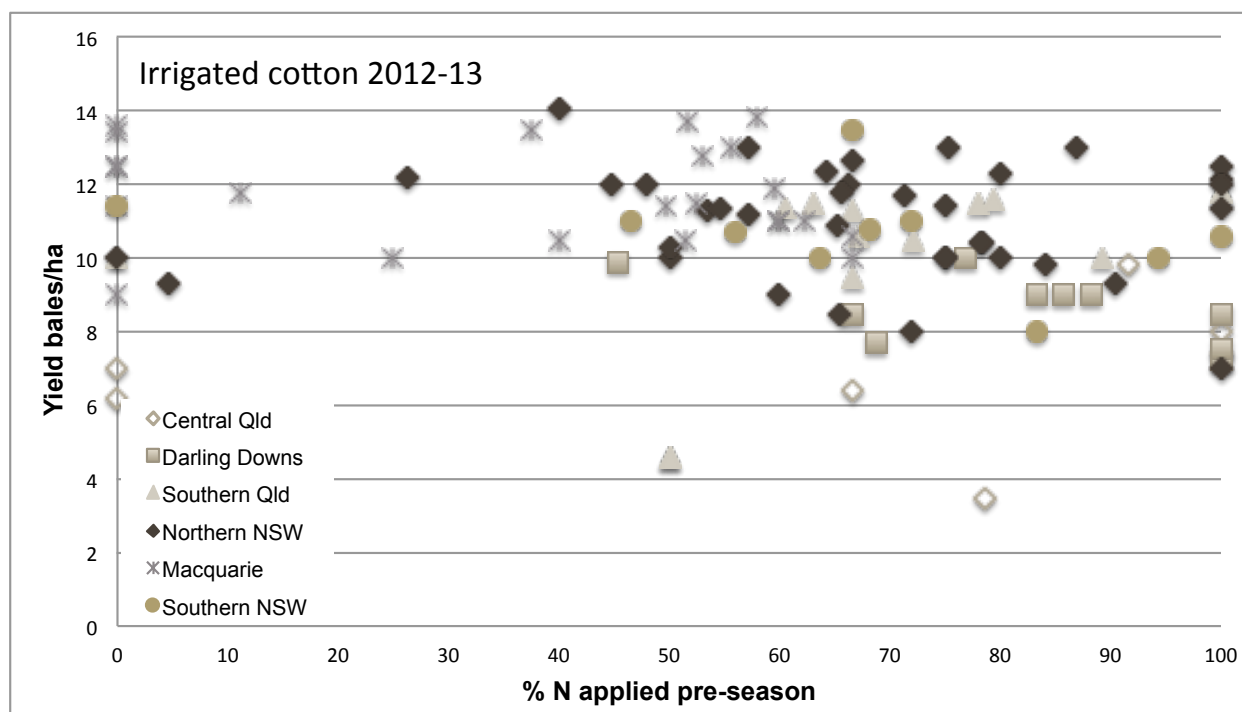


Figure 19 shows that the main factors influencing timing of fertiliser applications were optimising nutrient availability to the plant (40% of respondents), weather (36%), labour (33%) and split applications to reduce losses (32%)

Figure 19 Factors influencing timing of fertiliser application

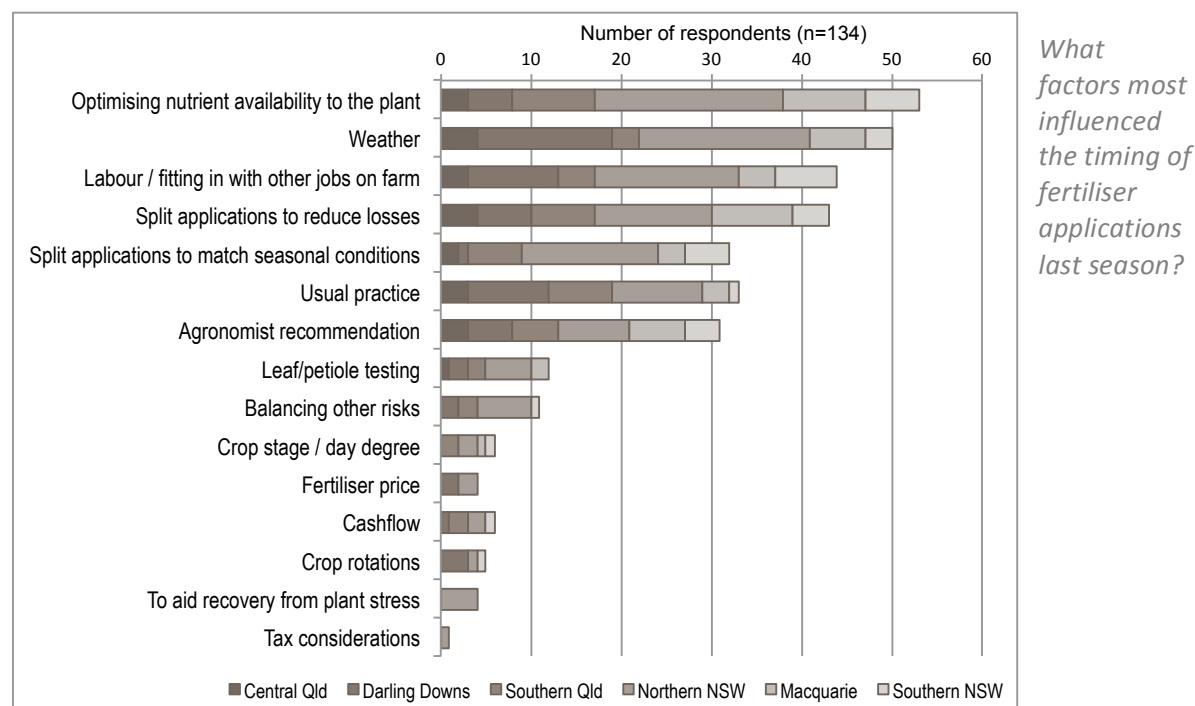


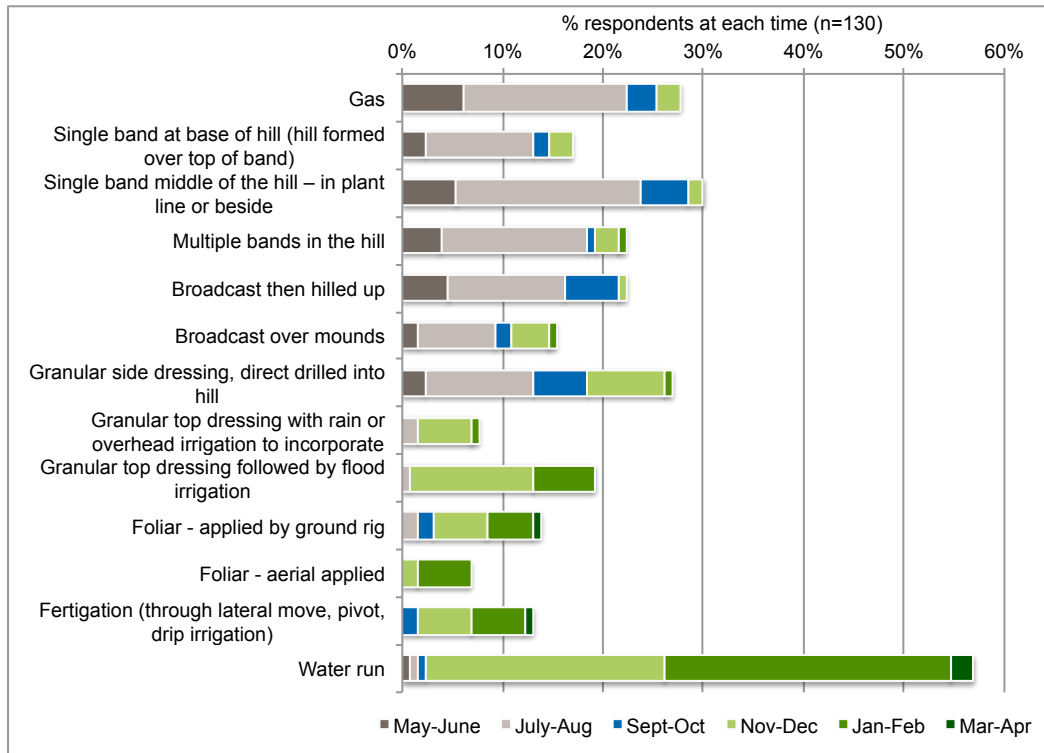
Figure 20 illustrates the timing and methods of nitrogen fertiliser application while Figure 21 shows the methods of applying P, K and other fertilisers. Note that several respondents indicated two timings of N application via a given method (eg Gas in May-June and in July-August) – we are unable to determine whether these are two separate applications or whether it is a single application applied at some time during that wider window). There are no clear regional trends in the application methods used.

These graphs show considerable variety in the methods of application, particularly for nitrogen. Several farms use two or more methods of applications, particularly for Nitrogen (eg gas, banded and/or waterrun). Conversely, other farms have used only gas in July-August.

Nitrogen application methods included:

- 55% of farms applied nitrogen in bands of some form.
- 41% of farms water run nitrogen at least once.
- 31% broadcast nitrogen.
- 24% of farms applied nitrogen as a gas. Of these all except one farm also applied Nitrogen in another form.
- 24% apply N as a granular side dressing direct drilled into hill.
- 5% apply N as a granular top dressing with rain or overhead irrigation to incorporate.
- 18% use a granular top dressing of Nitrogen followed by flood irrigation. It would be interesting to understand how this is done as their can be high risk of down furrow movement in some conditions.
- 16% of farms applied foliar nitrogen either by air or groundrig.
- 8% of farms used fertigation (through lateral move, pivot or drip irrigation) to apply nitrogen. This appears to be quite high. We did not ask about the irrigation type being used and so are unable to calculate the proportion of farms with overhead or drip irrigation who fertigate.

Figure 20 Timing and method of application of nitrogen fertilisers



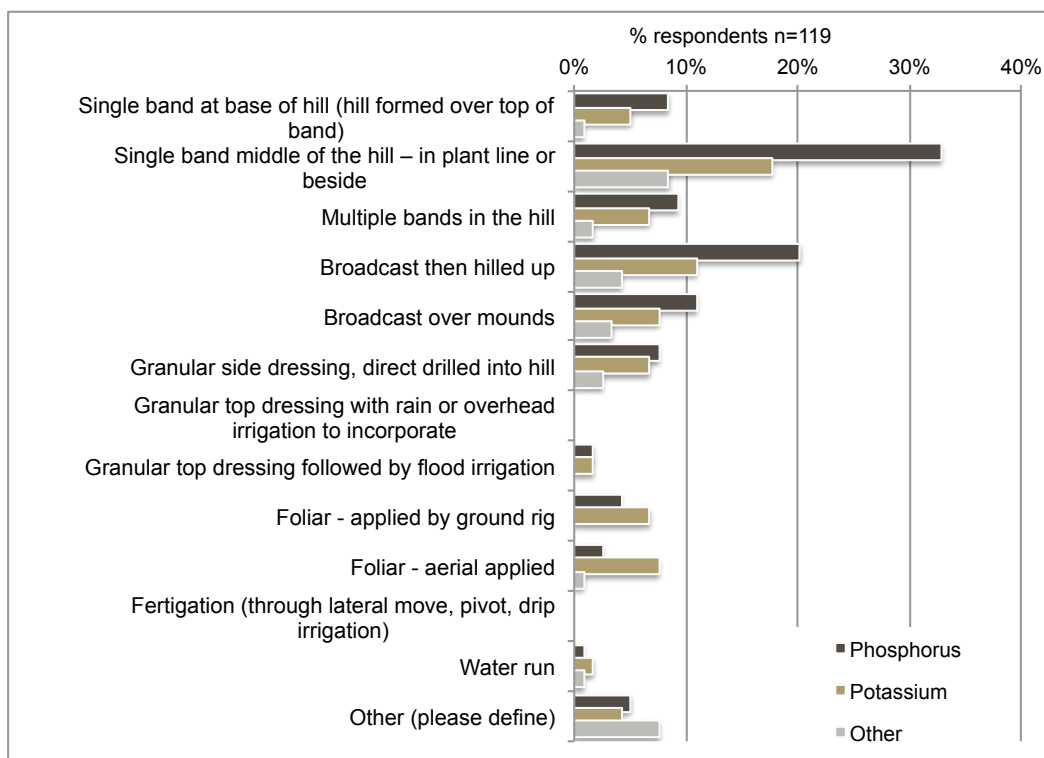
How and when did you apply nitrogen fertiliser for cotton crops in 2012-13?

NB each farm is counted for each time period where the fertiliser methods has been used. Thus the cumulative bars are the accumulation of all periods where a method has been used. eg in total 41% of farms water applied N, many of these did this more than once.

Phosphorus is most commonly applied in bands (45% of respondents with 32% applying P in a single band at the middle of the hill, in the plant line or beside). Broadcasting P is also popular with 28% broadcasting P either over mounds (10%) or followed by hilling up (21%).

Potassium is banded by 27% of respondents, most commonly as a single band in the middle of the hill (17% of respondents). 17% broadcast K over the mound (7%) or followed by hilling up (11%).

Figure 21 Method and timing of phosphorus, potassium & other fertilisers

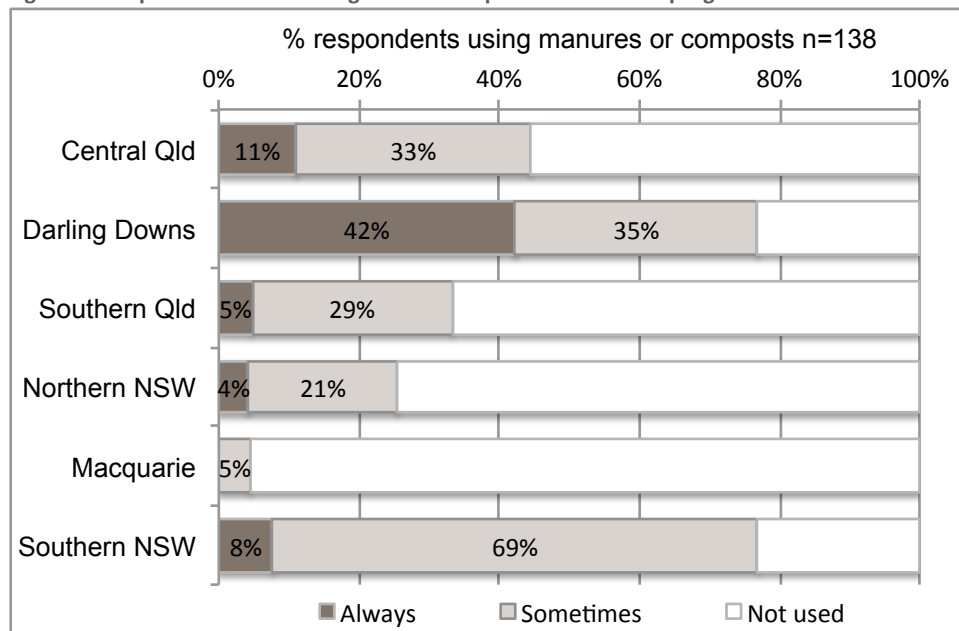


How did you apply phosphorus, potassium and other nutrients for cotton crops in 2012-13?

Manures & composts

39% of surveyed farms used manures or composts at least sometimes as part of their nutrition program. The use is much higher on the Darling Downs and in Southern NSW (Figure 22), likely due to closer proximity to feedlots and poultry farms.

Figure 22 Proportion of farms using manures as part of a nutrition program



Do you use manures or composts as part of your nutrition program?

The most commonly used are chicken and cattle manure. A few use cotton compost (gin trash) and one farm reported using pig manure.

Comments made about manures mainly described them as being used for their nutritional inputs of phosphorus, potassium, zinc and trace elements and by a few to improve waterholding capacity or to 'activate the biology'.

Some farms noted that they use manures as a part of their longer term nutritional program (eg "Feedlot manure used every 3-5 years at 9t/ha" or "5t Cattle & chook manure every second year, keep a mixed fertiliser plan") whilst others are more opportunistic ("Aged cow manure - we use as much as we can source at a fair price") or on a needs basis ("Cow manure on cut area after land forming").

Cotton compost was used by some for phosphorus and potassium.

What type of manures or composts and what role does this play in your nutrition program?

Soil, leaf and petiole testing

These questions sought to understand the nature of soil, leaf and petiole testing carried out by cotton growers. This involved the combination of the depth of testing, the frequency of testing and the types of tests.

The proportion of growers conducting each type of test at the various frequencies is shown for irrigated cotton in Figure 23 and for dryland cotton in Figure 34.

Note, the groupings of elements used (eg Nitrate, pH, EC Chloride) were advised by Dr Mike Bell (QDAFF) as they are those that are commonly offered as a set by laboratories. The differences in soil testing depth in the irrigated and dryland questions is based on the differing recommendations for each of these systems.

How often do you usually soil, leaf and /or petiole test for each of these nutrients/ conditions?

Some observations on the patterns of use of soil and plant testing:

- Most growers use the same frequency of soil testing for all depths and analyses. That is, when they do soil test, they carry out all tests rather than using a differing strategy for each depth or element for soil test.
- One third of respondents soil test some fields every season on irrigated cotton.
- 52% of irrigator respondents have a soil surface test for Nitrate-N, pH, EC, Chloride test done every season, 18% having it done on every field every season.
- 13% have a petiole nitrogen test conducted on every field every season on irrigated cotton.
- Some growers use only leaf and/or petiole testing, conducted every season.

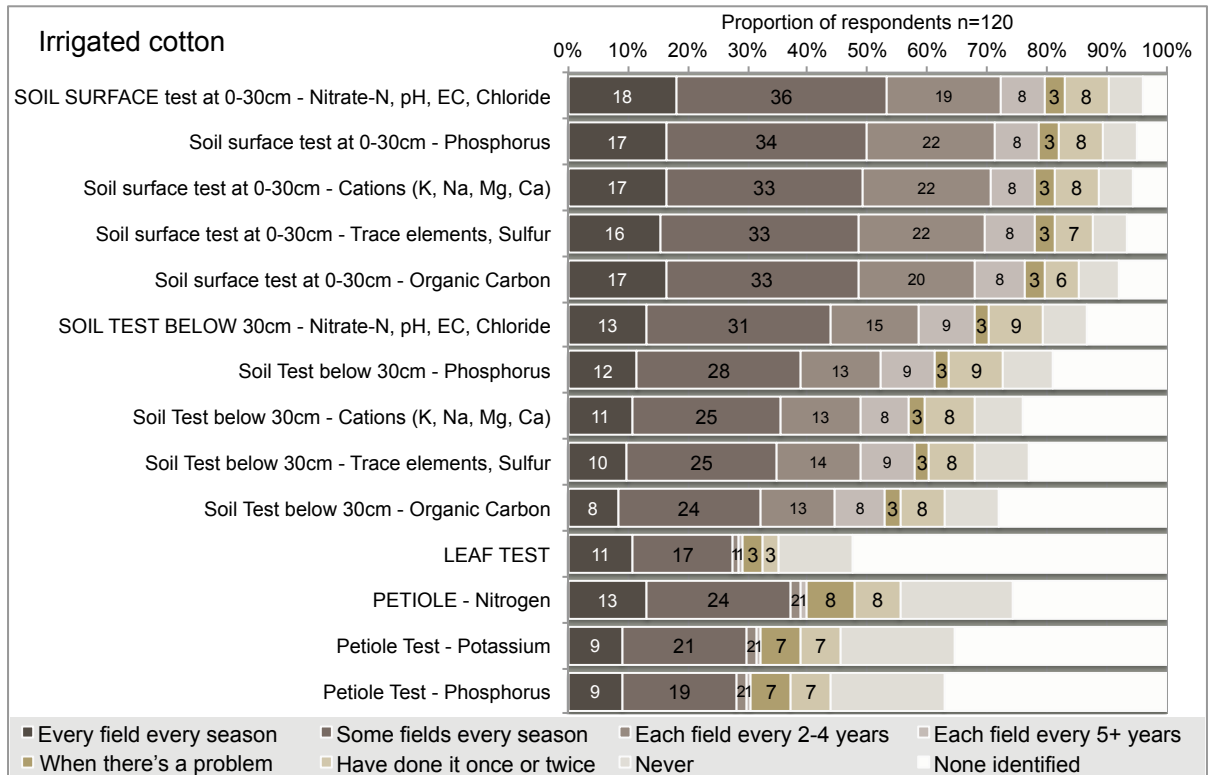
Barriers to improving fertiliser use efficiency

Growers were asked to identify the main barriers to improving their fertiliser use efficiency. The responses to this open ended question are presented in Table 6.

The identified barriers can be grouped as relating to:

- weather,
- application and practicalities,
- fertiliser and inhibitor products and availability,
- efficiency of application,
- costs,
- agronomy,
- soils, and
- knowledge.

Figure 23 Frequency of soil, leaf and petiole testing used by growers for irrigated fields



"None identified" categorises those growers who responded to the question but did not select a response to that testing process – we can likely assume this means that they do not do that form of analysis.

Figure 24 Frequency of soil, leaf and petiole testing used by growers for dryland fields

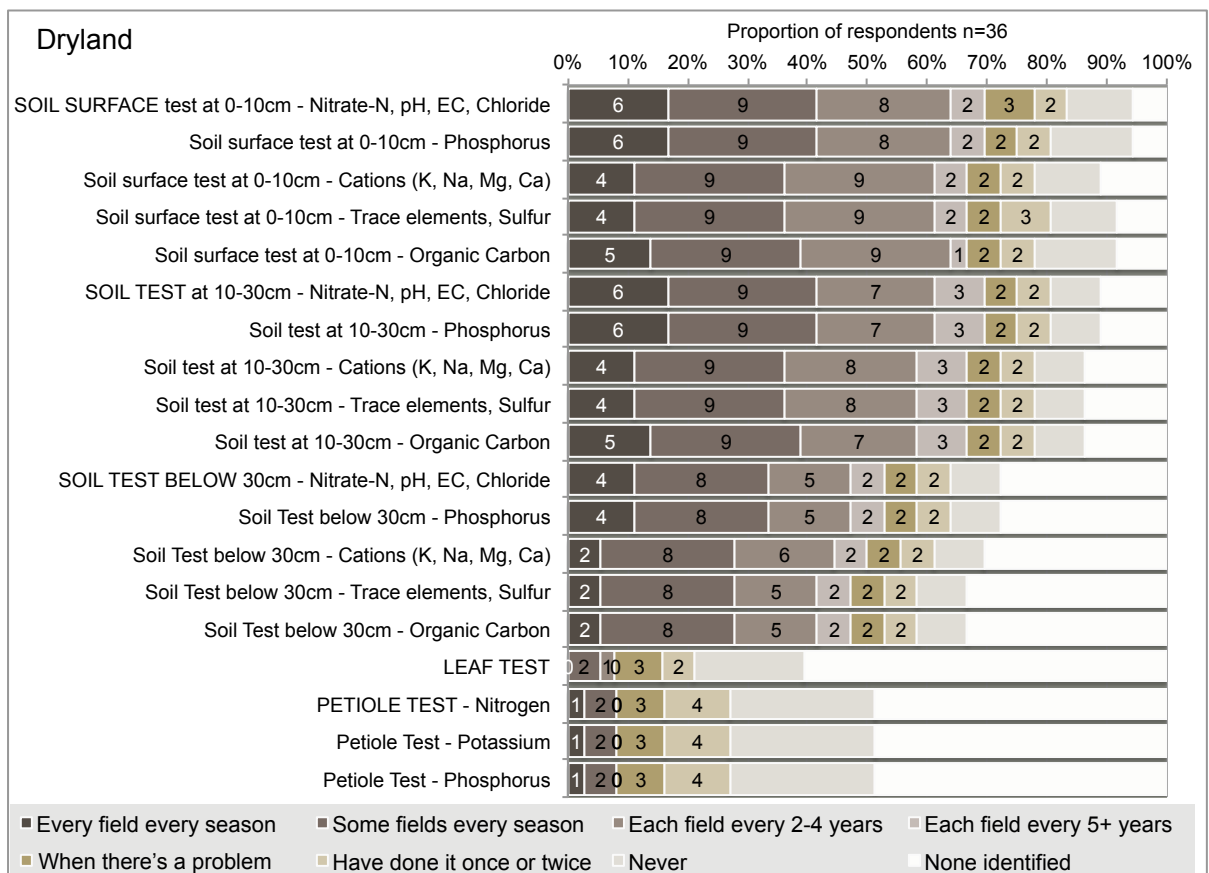


Table 6 Barriers to improving fertiliser efficiency

n= 87

Weather	Application & practicalities	Knowledge
<ul style="list-style-type: none"> • Weather and predictability • Time, Weather (x3) • Soil, Weather • Lack of rain • Often rain events • Moisture (X2) • Weather - High rainfall • Climate • Weather, Machinery • Flooding • Uncertainty of water supply • Season Length 	<ul style="list-style-type: none"> • Managing application & supply risks (X3) • Seasonal conditions and practical issues (x3) • Equipment is a limitation (X2) • Being able to apply small amounts more often • Good application • Application methods and timeliness • Ease of use & timing issues • Timely applications • Deep placement • Balancing the risk between wanting to apply it in crop when it needs it and actually being able to do this • Type of application matching plant yield to n requirement • Stop buying / developing farms 	<ul style="list-style-type: none"> • Industry hasn't come up with a better fertiliser plan • Not knowing how to be more efficient • Knowing yearly fertiliser requirements • Knowledge (x2) • Always trying to improve • Lack of knowledge • Not able to measure it. • Accurate knowledge of crop demands • lack of trial data and knowledge • How to measure it • Information (X2) • Trials are very time consuming • Better understanding • Knowledge - lack of
Products	Efficiency of application	Cost
<ul style="list-style-type: none"> • Lack of availability of Big N - use of Urea is insufficient • Lack of Nitram • Availability of products • Type of product - no nitram available • Lack of cost effective nitrogen loss inhibitors 	<ul style="list-style-type: none"> • Getting N into soil with minimal losses. • Leaching • Denitrification during wet periods. Gross margin from legume crops are poor on irrigated country eg: Soybeans, Mungbeans, Fababeans, Chickpeas • Don't know how to or if there is any evidence for split applications having a benefit 	<ul style="list-style-type: none"> • Cost (x2) • Cashflow and labour reliability • Cost of application • Freight logistics cost • Cost and water availability • Weather x labour =cost • Timing and cost of application
Agronomy	Soils	
<ul style="list-style-type: none"> • Variability of response and having N available if crop requires it • Trying to increase yields • Growing conditions • Yield Vs rates • Lack of fallow in high water availability years • Irrigation, slope of fields 	<ul style="list-style-type: none"> • Volatilization, Deep Drainage, Sodic Soils, Rainfall, Root Biomass • Soil Biology • Soil Health - Organic matter • Soils proneness to waterlogging events (esp; flood events) had much better efficiency during the drought • Reducing wheel track compaction and water logging. • Soil conditions • Varying results from soil/leaf tests 	

Understanding nitrogen pathways

Question 9 in the survey asked growers to rate their level of agreement to disagreement with a number of statements. Figure 25 illustrates responses to the statements relating to nitrogen. This perhaps indicates a potential to supply more information to improve many growers understanding of nitrogen use efficiency and emissions losses as:

- 45% of respondents believe that they have enough information to calculate nitrogen use efficiency.
- 62% have a good understanding of how to maximize nitrogen use efficiency (compared with 13% whose calculated nitrogen use efficiency fell inside the recommended optimum range).
- Less than a third of respondents (28%) indicated that they understand how to reduce nitrous oxide emissions from their system.

Figure 25 Perceptions on understanding and information for nitrogen management

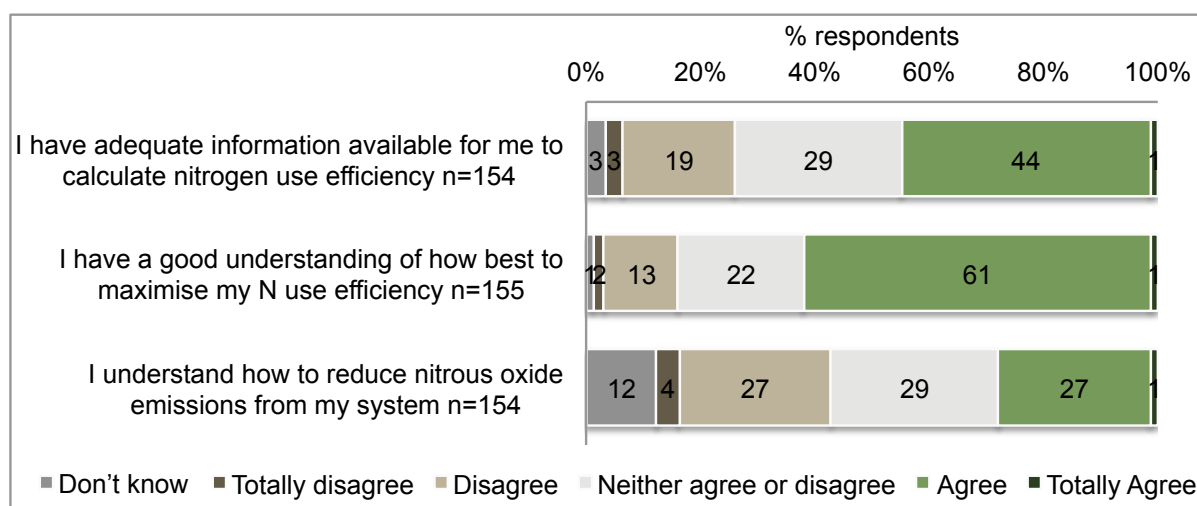


Table 7 illustrates that there are highly varied views about the proportion of nitrogen that is used by the crop, tied up in soil or lost. Respondents' estimates of the proportion of applied nitrogen that is used by the crop ranged from 35% to 100%. The majority of growers felt that between 60 and 90% of nitrogen fertiliser was used by the crop (average 69%). 89 growers responded to this question, some of the non-respondents indicating that they didn't know, and some who did respond noting that it was 'only a guess really'.

Table 7 Estimated proportions of nitrogen fertiliser thought to be used, stored or lost

n=89	% into the crop	% tied up in the soil at the end of the season	% lost to leaching or run-off	% lost into the air
Average	68%	12%	12%	8%
Range	35 – 100%	0 – 45%	0 – 30%	0 – 30%

Approximately what proportion of Nitrogen fertiliser you apply do you think goes to each use/loss.

Soil, land preparation & crop rotations

In response to the question “In general across your farm, do you consider the health of your soil is increasing, steady or declining?”:

- 71 respondents thought the health of the soil was increasing
- 69 thought it was steady and
- 1 respondent thought it was declining.

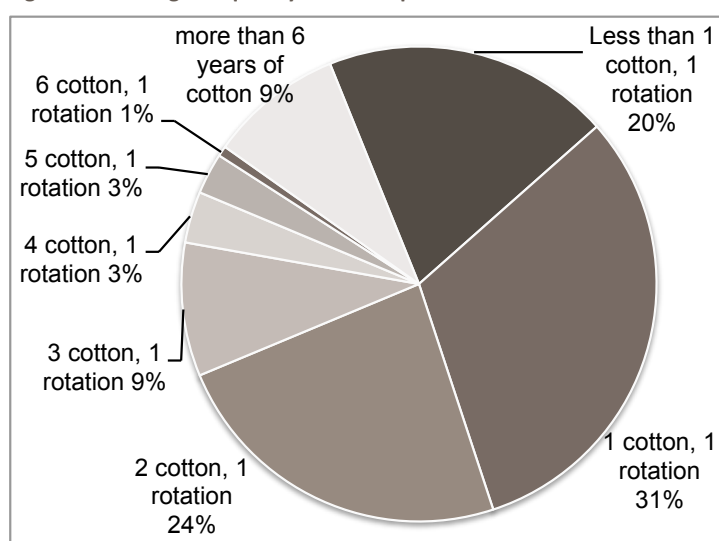
Rotations

Growers were asked to identify the average frequency of cotton production in any field on their farms. The proportion of growers using each frequency is presented in Figure 26. Comparison with historical responses to this same question since 1996 (Table 8) shows this fluctuates over time, likely influenced by commodity prices and seasonal conditions.

Findings about rotations and land use include:

- 75% of respondent growers will on average have 2 or less cotton crops before having an alternate crop or fallow break.
- Almost half (49%) of respondents usually grow at least one “back-to-back” cotton crop and 25% will have at least 2 cotton crops in a row.
- 13% will grow 5 or more cotton crops before a break.
- Irrigation farms used between 15% and 100% of their irrigation country for cotton production in 2012-13 with an average of 58%.
- Dryland cotton accounted for between 7% and 54% of the area developed for dryland cropping on each farm, with an average of 23% in 2012-13.

Figure 26 Average frequency of cotton production in a field on each farm



On average, what is your frequency of cotton production in a field?

Where rotation = a crop other than cotton or a fallow of 18 months or more

Less than 1 cotton, 1 rotation is where cotton is followed by two or more alternate crops or fallows.

Table 8 Percentage of farms growing cotton at each frequency in a rotation, from 1997 to 2013

Cotton production frequency	1997	2000	2006	2007	2013
Less than 1 cotton, 1 rotation	4%	9%	19%	3%	20%
1 cotton: 1 rotation	42%	22%	36%	28%	31%
2 cotton: 1 rotation	24%	17%	20%	10%	24%
3 cotton: 1 rotation	9%	15%	6%	6%	9%
4 cotton: 1 rotation	6%	6%	6%	7%	3%
5 cotton: 1 rotation	2%	6%	2%	8%	3%
6 cotton: 1 rotation	n/a	3%	2%	4%	1%
More than 6 cotton/rotation	12%	18%	8%	22%	9%

The crops grown in rotation with cotton in the past three years are listed in declining order of popularity in Table 9. It shows that most respondents (78%) had a wheat crop grown in rotation with cotton in the past 3 years and that 46% of growers thought that wheat was the crop having the most positive affect on the subsequent cotton crops.

The 11% of farms that did not grow any other crops in rotation with cotton were all irrigated cotton farms, located across several regions.

Table 9 Rotation crops grown and those seen to have most positive affect on subsequent cotton crops

	Proportion of farms growing it past 3 years	% that thought this had the most positive affect on subsequent cotton
Wheat	78%	46%
Chickpea	31%	12%
Sorghum	26%	4%
Barley	20%	5%
Maize; corn	19%	16%
Mungbean	12%	2%
Faba Beans	10%	11%
Canola	10%	0%
Soybean	3%	4%
Vetch	3%	4%
Sunflower	1%	0%
Other: French white millet; Canary seed; Lab lab.	8%	9%
None	11%	4%

In the past 3 years, which of the following crops did you grow in rotation with cotton?

Of these crops or fallow breaks, which did you think had the most positive affect on the subsequent cotton crop? Why?

Reasons cited for the positive affect of wheat crops on cotton included:

- Moisture: more moisture, wheat moisture retention.
- Soil structure: cereal crop cracks soil open, adds organic matter; Soil drying, cracking (stubble) fallow; wheat does a good job of breaking up the clods making the soil more friable, wheat was good for breaking out compaction and leaching out salts
- Stubble: Crop residue, Stubble cover, Different type of crop stubble, Ground cover, “We were left with more stubble so soil softer and held more moisture and I believe we had more organisms in the soil as a result”
- Other: VAM host, Disease break, weed control; Research suggests it is better; easiest to go back to cotton.

Chick peas, faba beans and maize were the next most commonly mentioned crops in having positive impacts on subsequent cotton crops with reasons being:

- Maize / corn / feed corn: improved soil structure; Plant vigour and health seems better, soil cover, microbial activity, different weed spectrum, shallow roots, high organic matter “I need management herbicide rotation”, “Its a rotation from cotton and I feel cotton responds better to a short fallow”.
- Chickpeas and Faba beans: Organic Nitrogen that's stable in the soil, legumes for soil improvement, soil tilth and some N, softer soil, improved soil structure and fertility. “Faba beans are very good for soil health on older type fields”

Positive affects were also reported from less common break crops including:

- Vetch: Vetch then wheat, soil tilth, N response, organic carbon
- Mungbean – “positive affect, no idea why!”
- Soybeans due to buildup soil nutrients and tilth; less moisture extracted.
- French white millet – “best cover for moisture used”
- Canary seed - Disease and soil health
- Sunflowers “definitely improve deep soil friability (breaks deep compaction)”
- No break crop – mulch, “I haven’t seen much difference”.

There was concern about a possible negative impact from canola:

- “We think Canola may have reduced Cotton Yield – VAM?”

Row spacing

Irrigated cotton was primarily (84% of responding farms) solid planted at 1m rows (Table 10).

69% of dryland cotton was planted at 1 m rows but there was more variation in the planting configuration. The most common were 1m double skip (30% of responding farms) and 1m single skip (27%). 1.5m and 2m plantings and even wider were also used. There does not appear to be a regional pattern in the row configurations used for dryland cotton.

What row spacing did you use for cotton in 2012-13?

Table 10 Proportion of farms using each type of planting configurations for cotton in 2012-13

	Less than 75cm	75 cm or 30”	90cm or 36”	1 m	1 m single skip	1m double skip	1.5 m	2 m	More than 2 m
Irrigated cotton	0	1%	6%	84%	3%	0	4%	2%	0
Dryland cotton	0	0	0	12%	27%	30%	15%	9%	6%

Machinery operations and its impacts

Machinery operations undertaken for cotton crops are listed in Table 11. Note that some who responded to this question only gave figures for either the cotton after rotation/fallow or cotton follows cotton situation. It may be that they do not have the other as part of their system.

There is considerable variation in the number of machinery passes carried out on each farm, ranging from 1 to 10 passes. Overall there is more cultivation for back-to-back cotton (5.3 passes on average) than for cotton following a rotation (4.1 passes on average).

On average, how many of each of the following types of tillage passes did you do for your last cotton crop (from July 2012 to June 2013)?

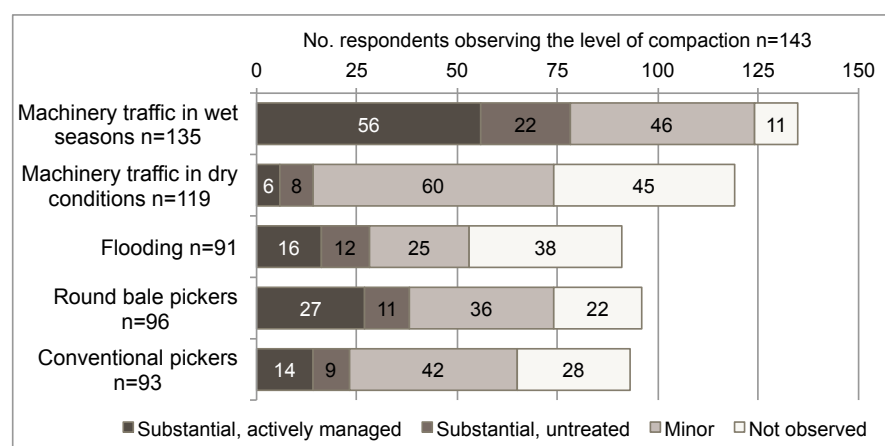
Table 11 Number of tillage passes used in cotton production

Number of passes		Light operations eg harrowing, root cut, plant, interrow cultivation	Medium operations eg pupae busting, discing	Heavy operations eg deep ripping, listering	Total
Where cotton followed cotton n=99	Average number of passes	2.7	1.6	1	5.3
	Maximum	7	5	4	10
	% of farms doing some of these operations	90%	90%	72%	100%
Where cotton followed rotation or fallow n=89	Average number of passes	2.1	1.3	0.7	4.1
	Maximum	5	7	6	10
	% of farms doing some of these operations	60%	53%	36%	100%

Soil compaction continues to be an issue requiring management in cotton production (Figure 27). Note in this graph there are a number of people who responded to the question but not to some of the sub-questions. This may be because the issue was not experienced on their farm (eg flooding, round bale pickers).

Machinery traffic in wet seasons has resulted in some degree of observed soil compaction on 92% of respondent farms with 41% actively managing this compaction. Machinery use in dry conditions was observed by 62% of respondents to result in some soil compaction, mostly at a minor level (50%). Compaction has been observed following both round module pickers (70%) and conventional pickers (69%). The severity of the compaction is considered substantial by more respondents following round module pickers (39%) than it is for conventional pickers (25%).

Figure 27 Soil compaction observed as a result of activities

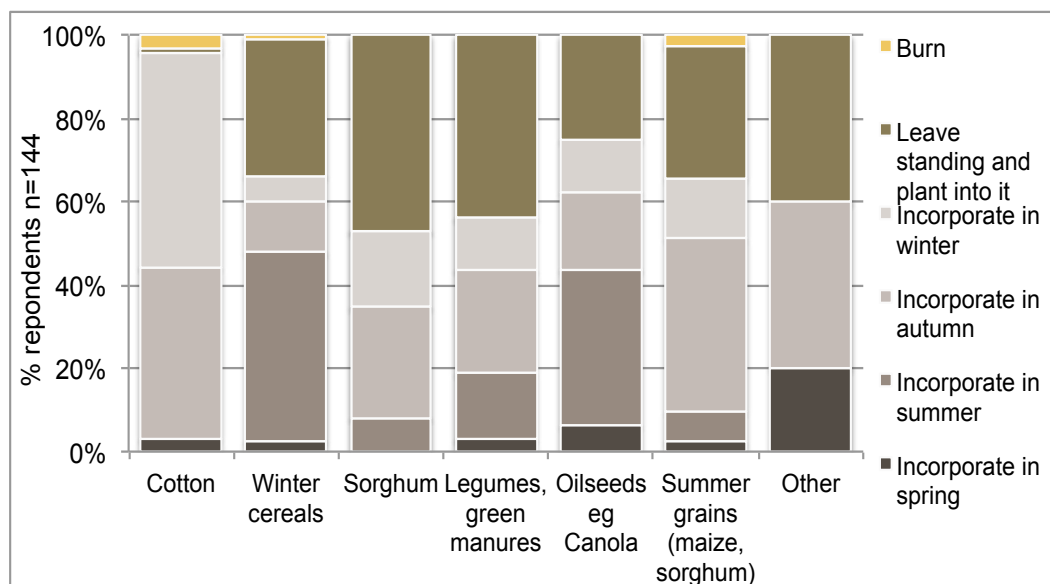


Have you observed soil compaction as a result of any of the following activities on your farm over the past two years?

Crop residues

The majority of respondents incorporate residues from the prior crop before planting cotton (Figure 28). Planting directly into standing crop residues is used by some in winter cereals (26% of respondents), sorghum (16%) and legumes (10%). Burning of crop residues is used by less than 5% of respondents. Cotton stubble is incorporated in autumn or summer by the large majority of respondents.

Figure 28 Usual management of crop residues before planting cotton



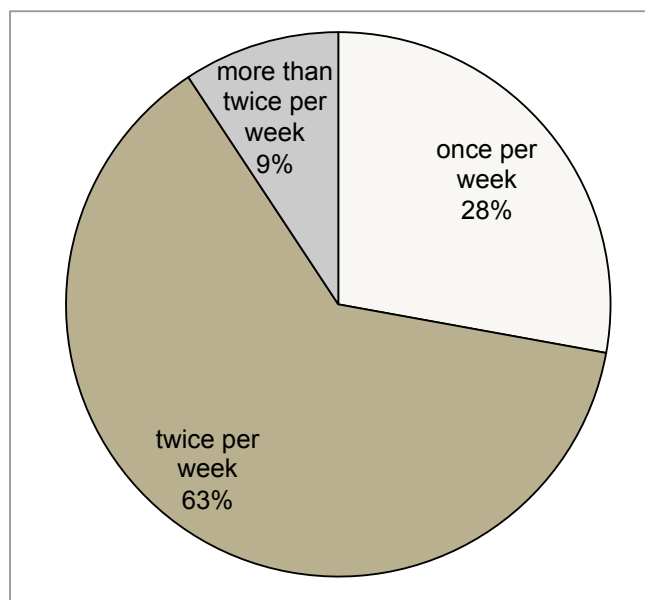
How do you usually manage residues / stubble from the previous crop before planting a cotton crop?

Crop protection stewardship

Biotechnology

Bollgard®II crops are mostly checked by an agronomist twice a week (63% of respondents) to inform insect management decisions (Figure 29). Just over a quarter of responding farms are checked once a week while 9% have their crops checked more than twice a week. No respondents indicated their Bollgard®II crops were checked less than once a week.

Figure 29 Frequency of checking of Bollgard®II crops by an agronomist for insect pest management decisions



How frequently does your consultant/ agronomist (or yourself) check your Bollgard®II cotton for making decisions about insect pests?

n=140

There is majority, but not complete, support for the insecticide and Bt resistance management efforts:

- 76% of respondents think that the long term value of complying with the Bollgard®II resistance management plan is worth the effort and cost (Figure 30). 11% do not agree with this.
- 7% of respondents indicated that they disagreed with the statement “All of my insecticide use decisions are consistent with the Insecticide Resistance Management Strategy” and 2% indicated they don’t know.
- Few respondents (13%) considered that Bollgard®II could be profitable if it required up to 4 insecticide sprays due to resistant grubs. There were some qualifying comments with this question including “depends which sprays they were”.
- 79% consider it important to have a choice of refuge options (Figure 30).

There were varied views about which element of the Bollgard®II resistance management plan was the most effective in delaying resistance (Figure 31). The industry has promoted the view that a combination of mechanisms is important.

- Refuges (37% of respondents) and pupae busting (36%) were mostly frequently considered to be the most effective. Only a few people considered the planting window or limited use of foliar Bt to be the most effective strategy (each 4%).
- 69% of respondents forecast that field failure to Bollgard®II will occur within 10 years if the cotton industry continues to use Bollgard®II as per the current Resistance Management Plan and no other Bt cottons become available. 19% think this would occur within 5 years.

Figure 30 Perceptions about insect resistance management

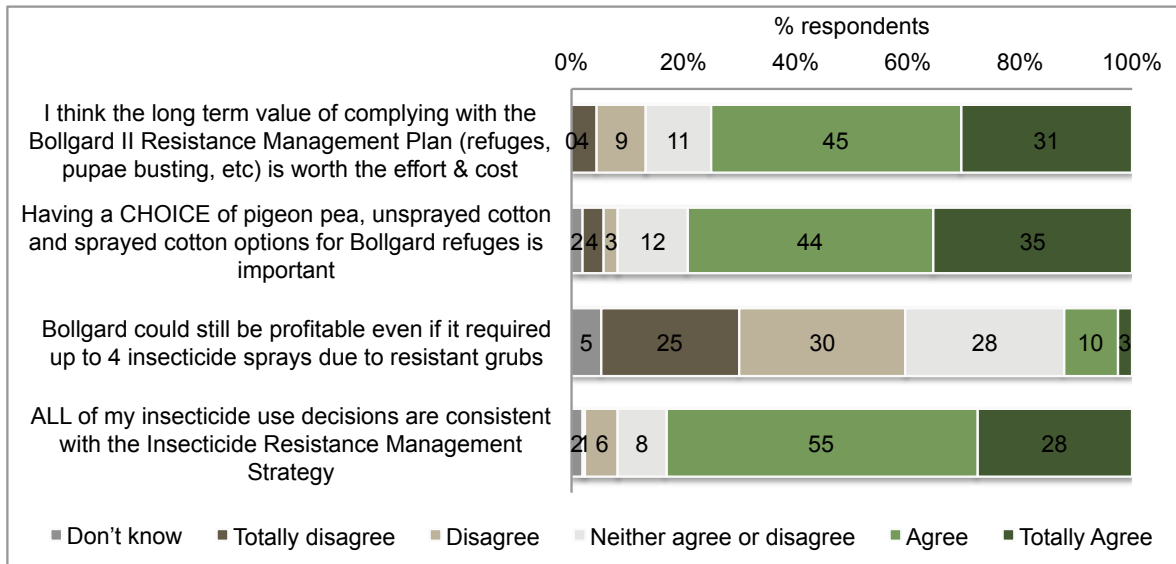
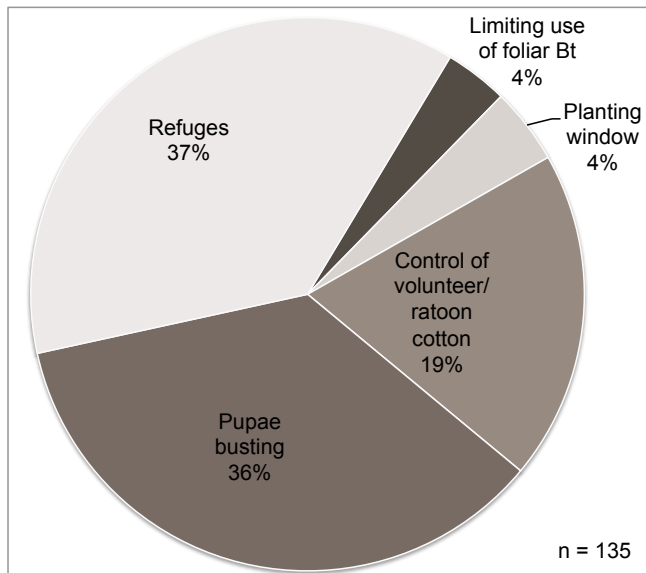
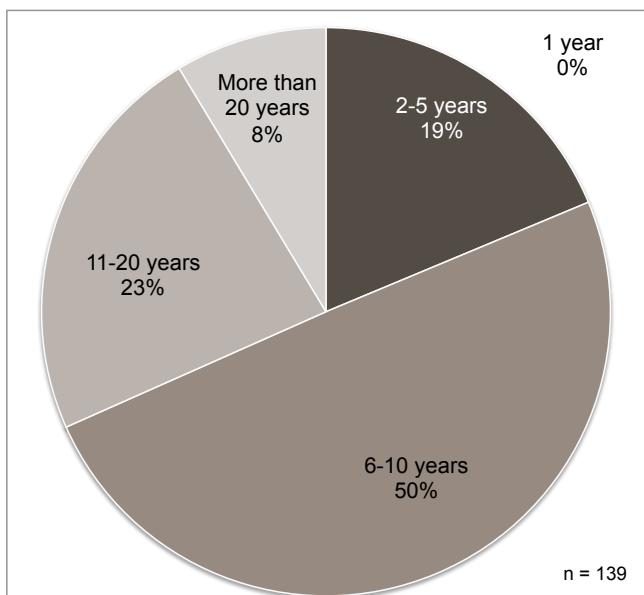


Figure 31 Proportion of respondents who considered each element of the Bollgard® II Resistance Management Plan to be the most effective for delaying resistance



Of the 5 elements of the Bollgard® II Resistance Management Plan which one element do you think is most effective for delaying resistance?

Figure 32 Perceived time to field failure of Bollgard® II managed under RMP with no new Bts

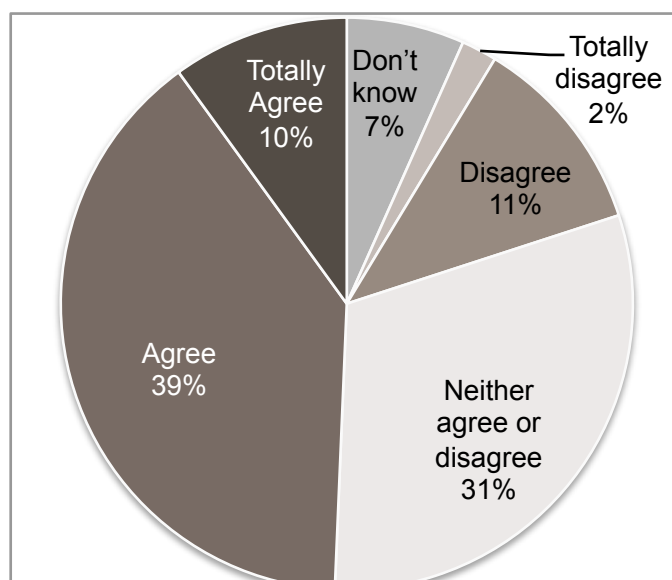


We are interested in understanding your perception of the robustness of the Bt technology. If the cotton industry continues to use Bollgard II as per the current Resistance Management Plan and no other Bt cottons become available (eg no Bollgard3) how many years DO YOU THINK will it be before 'field failure' of the technology occurs because of resistance?

Herbicide resistance

49% of responding farms believe they are proactive enough with their weed management to prevent herbicide resistance from developing on their farm (Figure 33). Some who disagreed or were neutral on this noted that they while they are proactive in their herbicide management practices they do already have herbicide resistant weeds present.

Figure 33 Perceptions on effectiveness of herbicide resistance management practices used



*Please indicate how closely the following statement reflects your cotton farming practices by indicating your agreement or disagreement:
I am proactive enough with my weed management to prevent herbicide resistance on my farm*

37 farms reported an area of herbicide resistant weeds on irrigation land, totaling 12,052 ha across these farms (Table 12). 31 farms reported herbicide resistant weeds detected in their dryland areas, totaling 7,608 ha. It is not possible to assess the proportion of farms affected as only 83 respondents completed this question and we are unable to determine whether the blanks are zero values, unknown areas or simply not reported.

Table 12 Number of farms that identified herbicide resistant weeds and the areas affected

n=83	Herbicide resistant weeds on IRRIGATED land				Herbicide resistant weeds on DRYLAND			
	No. Farms	Area reported (ha)			No. farms	Area reported (ha)		
		Avg.	Min	Max		Avg.	Min	Max
Resistant summer grasses	21	51	1	200	18	140	1	1000
Resistant winter grasses	15	173	2	934	15	135	2	600
Resistant broadleaf weeds	14	599	2	5000	8	281	80	1000
All resistant weed types	37	326	1	5100	31	245	1	1200

NB zero values are excluded from calculations – each average is the average for those farms reporting herbicide-resistant weeds; Dryland areas are not necessarily areas where dryland cotton is grown.

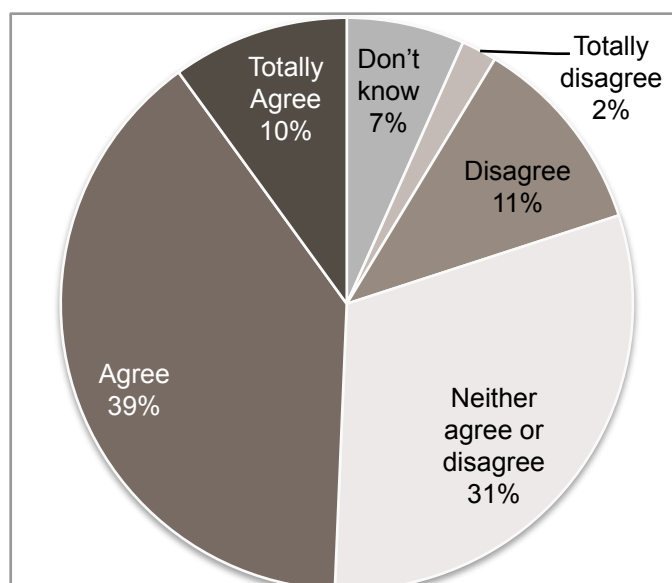
Herbicide spray drift

21 growers (13% of respondents) indicated that herbicide spray drift affected their 2012-13 cotton crop. Collectively, these growers reported a total area of 2,106 ha affected, ranging from 5 ha to 400 ha on individual farms and averaging 100.3 ha per farm.

One third of the affected farms indicated no loss of yield resulting from spray drift. 14 farms indicated an estimated yield loss due to spray drift of between 0.3 and 3 bales/ha (average 1.1 bales/ha).

Almost half of respondents considered that the CottonMap initiative has helped to reduce herbicide spray drift (Figure 34).

Figure 34 Perceptions on the effectiveness of CottonMap in reducing herbicide drift



Please indicate how closely the following statement reflects your cotton farming practices by indicating your agreement or disagreement: CottonMap has helped to reduce herbicide spray drift

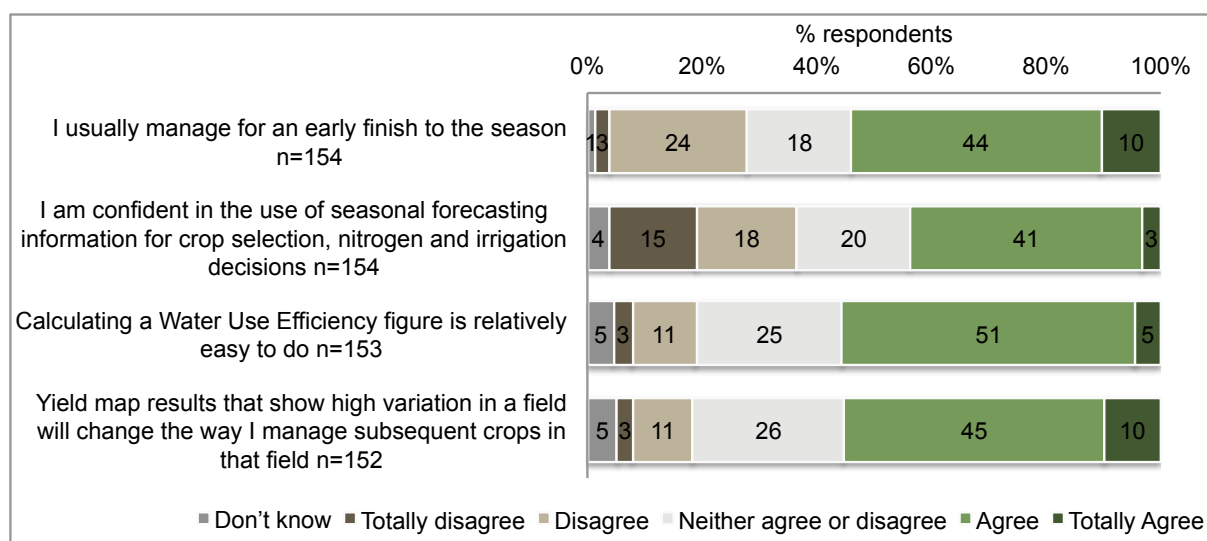
Other agronomy management

Whilst the survey focused on the themes nutrition, soils, energy, harvesting and workforce, there are many other agronomy issues of importance. The intent is for these issues to be explored in more detail in future years.

Responses to broad questions about a earliness, seasonal forecasting, water use efficiency and yield mapping are presented in (Figure 35). Some broad findings are:

- 54% of respondents usually manage for an early finish to the season. Earliness was a key issue prior to Bollgard®II crops due to the high insecticide costs of growing a crop for longer. Now that this is less of an issue it is interesting to note that earliness is still important to many growers.
- There may be some scope to increase growers' confidence in seasonal forecasting information for crop selection, nitrogen and irrigation decisions (41% agree that they are confident in use of this information, 3% totally agree).
- Just over half of respondents (56%) considered it easy to calculate a water use efficiency figure. Only 5% totally agreed that this calculation is easy to do. The high proportion of neutral and don't know responses may indicate many have not tried to calculate it and/or dryland growers may not see it is relevant to them.
- A similar pattern exists with the use of yield map results to influence subsequent management. 55% indicated that yield map results that show high variation in a field will change the way subsequent crop are managed in that field. 31% gave a neutral or 'don't know' response to this question.

Figure 35 Perceptions on management strategies



Energy

Energy has been widely discussed in industry forums as a major, increasing cost in cotton production. The survey sought to gather some quantification of energy costs and also gather information for a CRDC funded NCEA project on alternative energy options by Gary Sandell.

Energy usage

77 respondents provided information or estimates on the energy used for their 2012-13 cotton crop. This indicates that half of the respondents were unable or unwilling to share their energy costs for the crop. Perhaps related to this is the finding that relatively few respondents (11%) have measured or benchmarked their total energy use in the past 5 years (Figure 38). Table 13 displays the gathered and calculated information about energy use and cost. There are some considerable limitations in this data as they are estimates, costs per unit are highly varied and we are not certain that all respondents have estimated energy usage for the cotton crop only (vs whole farm use). It should therefore be regarded as broadly indicative only.

Where respondents have provided both usage and cost there is considerable variation in the costs / unit. For example, diesel costs vary from \$0.92-\$1.67/L. This may relate to differences in consideration of the diesel fuel rebate.

Where a cost only has been provided, a usage quantity has been estimated using standard. We note this may be too low in some cases. For example, while electricity costs indicated by the few respondents who gave usage and cost figures were mainly in the range of \$0.21 to \$0.25/kWhr, one indicated a cost of \$0.40/kWhr. Responses with diesel costs less than \$500 were excluded as these appear to be costs/ha. Another entry with excessively high costs/L was also excluded as an error. One petrol cost of below \$10 was excluded.

Please estimate the energy usage for your 2012-13 cotton crop (either usage or cost or both, approximate estimates are all that is needed)

Table 13 Reported and calculated energy use by farm and cotton area

n=77	No. respondents reporting use	Average use per farm ^	Average GJ use per farm	Average cost per farm ^	Average use per cotton ha *	Average cost per cotton ha *
Diesel	71 (92%)	195,545 L	7,548 GJ	\$272,202	228 L/ha	\$318 /ha
Petrol	18 (23%)	4,481 L	153 GJ	\$6,082	7 L/ha	\$10 /ha
Gas	2 (2.6%)	1,528 L	39 GJ	\$1,100	1.1 L/ha	\$1 /ha
Electricity	37 (48%)	273,388 kWhr	984 GJ	\$65,516	525 kWh/ha	\$125 /ha

^ based on actual values provided or where only usage was provided or only cost provided a figure has been calculated using rates from the NGER Technical guide: \$1.41/L diesel; \$1.33/L petrol; \$0.72/LPG and \$0.24 / kWhr electricity

* per cotton ha figures are calculated based on the area of cotton grown on each farm in 2012-13 (irrigated + dryland). They are very approximate as it is uncertain whether energy values have been provided specifically for cotton ha only.

The relative use of each type of energy can be compared both by expenditure (Figure 36) and total energy use (Figure 37). Diesel, used by 92% of respondents, is the highest both in total use and expenditure, followed by electricity. Note that solar energy is not included due to the limited cost/usage information provided. While 17% of respondents indicated they have solar in use somewhere on their farm (Figure 39), only two reported usage figures. This difference may be due to difficulty in calculating the usage metrics and cost for solar energy or it may be that the solar is not used for cotton production (eg household use only).

Figure 36 Relative expenditure on each energy type

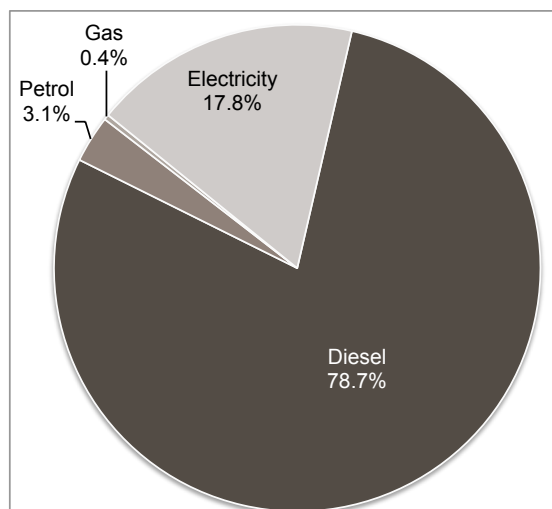
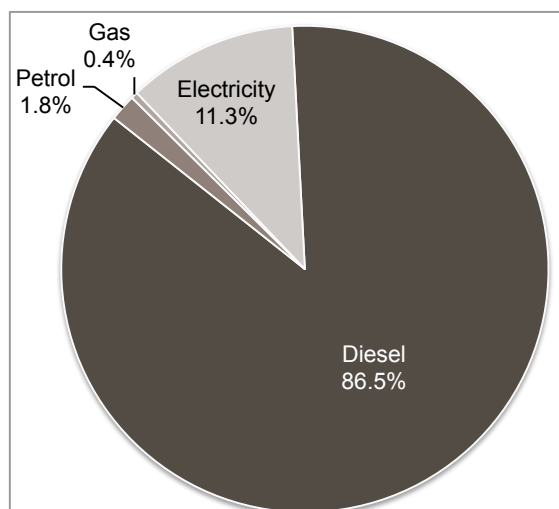
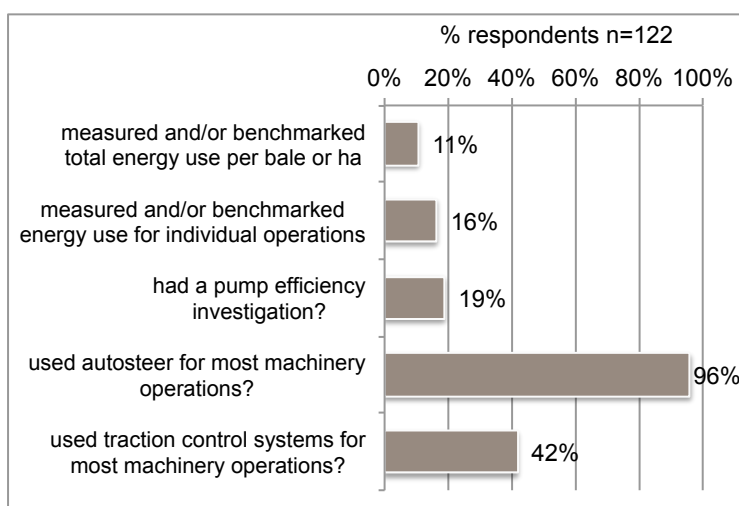


Figure 37 Relative use of each energy type (GJ)



Whilst there has been considerable discussion around energy costs in the industry, Figure 38 shows that only a small proportion of respondents had measured their energy use per bale or ha (11% of respondents) or of individual operations (16%). While irrigation is one of the major energy uses on irrigation properties², only approximately 24% of irrigator respondents have had a pump efficiency investigation done. By comparison, the machinery related energy saving practices had high rates of uptake (96% used autosteer and 42% used traction control). There are a number of reasons other than energy savings that may have motivated the uptake of these practices.

Figure 38 Energy investigations and selected energy saving practices used by respondents in the past 5 years



In the last 5 years have you ...

* Graph shows all respondents (including dryland). Approximately 24% of irrigator respondents have had a pump investigation done

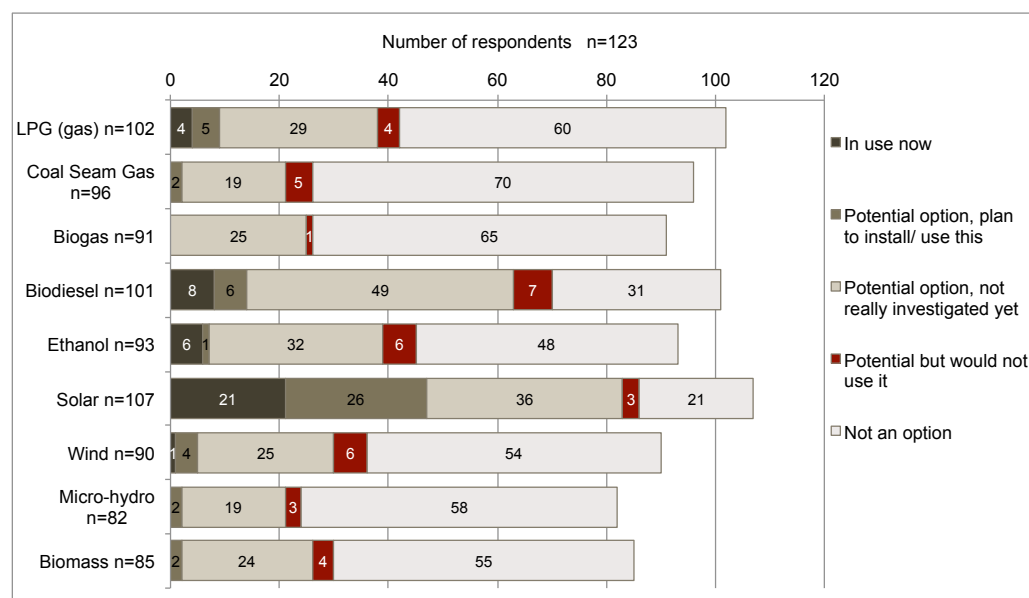
² Chen, Guangnan and Baillie, Craig (2007) Development of EnergyCalc – a tool to assess cotton on-farm energy uses. Report for the Cotton Research and Development Corporation (CRDC). NCEA Publication 1002565/1

Alternative energy

As part of an NCEA research project, the survey investigated current and potential use of energy sources alternate to diesel, petrol and electricity. While 123 people responded to this question, none gave an answer for every energy type, perhaps indicating their level of interest in or consideration of each energy type. The following analysis is based on the number responding to each part of the question.

26% of responding farms are using at least one of the alternative forms of energy listed in Figure 39. 8% are using two or more of these energy types. The most widely used alternative energy is solar (20% of respondents) with a further 24% planning to install it in the future. In addition to the current use, up to 58% of respondents believe they have the potential to use one of these alternative energy sources. The intended uses are shown in Table 14.

Figure 39 Use or perceived relevance of alternative energy sources



Please indicate how relevant each of these energy types are for your farm.

For those with relevance, please indicate how you would use them

A small number of respondents identified some potential energy sources that they would not use. Comments made (Table 14 and Table 15) indicate that reasons include: Biodiesel – problems with blocking injectors on machinery, not recommended by machinery manufacturers and may void warranty; Coal Seam Gas – environmental concerns; and Solar - expense.

Table 14 Applications used or intended for each type of alternate energy and other comments

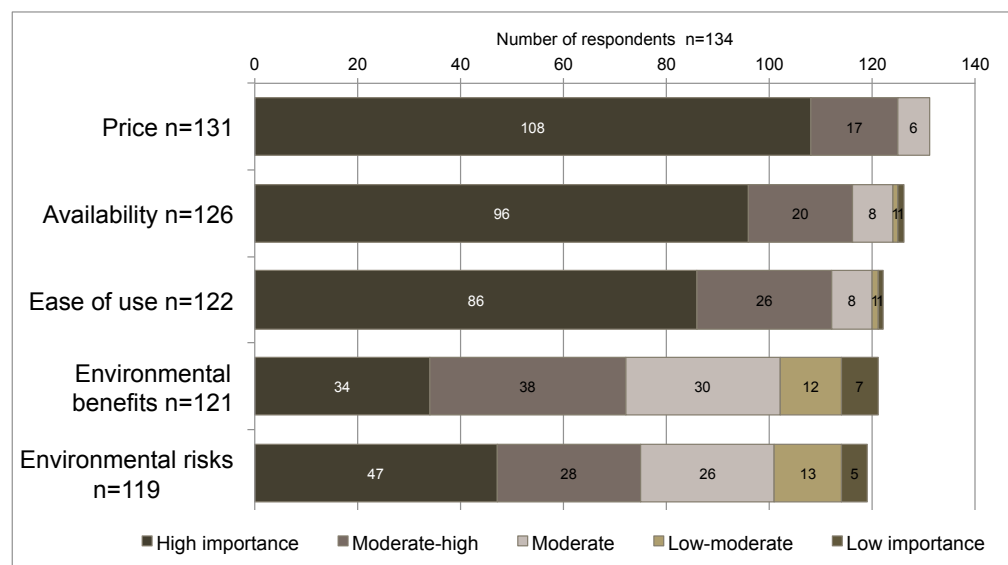
Each * indicates an individual response to this open ended question	LPG	Coal Seam Gas	Biogas	Bio-diesel	Ethanol	Solar	Wind	Biomass
House	*					***** *	*	*
Workshop	*					*****	**	*
Irrigation / pumping	***** *****	*****	***	***** *	**	**		
Bore engines	**							
Machinery fuel	**	***	*****	***** **	*****			*
Grain drying	*							
Have used in past				****				
Other comments		Never ever. Wells on farm but don't produce		Not recommend -ed by John Deere Whole farm		Feed into grid		Soil

Table 15 Growers' experiences with and views on adoption of alternative energy sources

General comments	Lower energy costs	Darling Downs
	Practicality, reliability	Northern NSW
Pumps	Using electricity on 6 of 12 high volume bore pumps is not worth the problems of a change over from diesel pumping	Northern NSW
	Slightly reducing flow from electric bores to save on power bills during peak power periods	Northern NSW
	Diesel /Gas pump Motor and cost of gas to high for any pump in costs	Macquarie
Biodiesel	Biodiesel- No problem	Northern NSW
	Use of biodiesel blocked filters	Northern NSW
	Investigated Bio-diesel and found the red-tape and costs to comply with Govt standards are prohibitive and are designed to deter you from using Bio-diesel "legally".	Northern NSW
	Biodiesel clogged filters and injector pump on truck	Northern NSW
	No experience. need biodiesel option from Cottonseed, Sunflower, Canola(On farm or Gin Biodiesel plant)	Northern NSW
	Biodiesel not suitable for newer common rail diesel engines in some of our machines- voids warranty	Macquarie
	Tried biodiesel - Bad experience with injectors on machinery. Would use again if available	Southern NSW
Solar	Spent a lot of money putting solar panels on 6 houses - very disappointed with process and the gain is uneconomic	Darling Downs
	Solar industry is a rip off	Darling Downs
	We have very positive experience with 10kw solar panel sites	Northern NSW
	2x 1.5kw Solar panels - haven't guaranteed savings	Northern NSW
	Solar-maintenance, installation contractors	Northern NSW
	Solar grid connected - cost effective in reducing general workshop/ house electricity bill	Northern NSW
	Solar powered bores	Northern NSW
	Solar perhaps, not achieved levels of energy promoted	Southern NSW

Price, availability and ease of use are clearly the major factors influencing decisions about energy type (Figure 40). Environmental benefits and risks are also important considerations to the large majority of respondents.

Figure 40 Relative importance of factors in decisions about alternative energy



How important are each of these factors in your decision about using alternative energy sources on your farm?

Other issues identified were: current alternatives not yet economically feasible, long term prices, expenses and performance.

The significance of price and availability were further reinforced in responses to an open ended question “what is the greatest limitation in improving energy use efficiency” to which:

- 47% referred to cost as the major limitation
- 19% identified capital costs
- 19% indicated availability and
- 19% identified a knowledge or information limitation.
- Ease of use and time were also issues.

Other limitations included:

- We have to work ground (cultivate) / pupae busting
- Impractical as our business uses electricity- watering and ginning both have experienced huge cost blow out due to unfair electricity pricing.
- Total amounts used is in high usage bracket
- Other parts of our farming system that need improvement more would give a bigger bang for your buck
- Uneconomic to do so ie: costs more to change than what you will save
- standardized expertise to operate
- Distance from suitable energy source; eg: 3 Place power high, horsepower needs.

Harvesting

By John McLean Bennett, NCEA

This section is primarily concerned with the incorporation of the John Deere 7760 round module picker (JD7760) into the farming system, specifically understanding the driving motivation to use and/ or purchase a JD7760, the perceived impacts of the technology and the attitudes associated with its use. This informs a CRDC funded research project by the NCEA.

All picking technologies

Growers were asked to indicate if they used conventional, JD7760 or Case IH 625 Module Express (CaseIH625) picking technology during harvest in the 2010-2011 through 2012-2013 seasons, and if so what area was picked with each technology. The reported areas picked are presented in Figure 41 and the proportion of growers using each technology reported in Figure 42. Since the 2010-2011 seasons, there has been a steady increase in the use of the JD7760 as compared to the conventional system. The JD7760 was introduced to the Australian cotton industry in 2008 and the results presented here support a rapid adoption of the technology, with the numbers reporting the area picked by the conventional system almost halving with each subsequent season.

Figure 41 Cotton area picked using the various technologies for 2010-2011 through 2012-2013 seasons

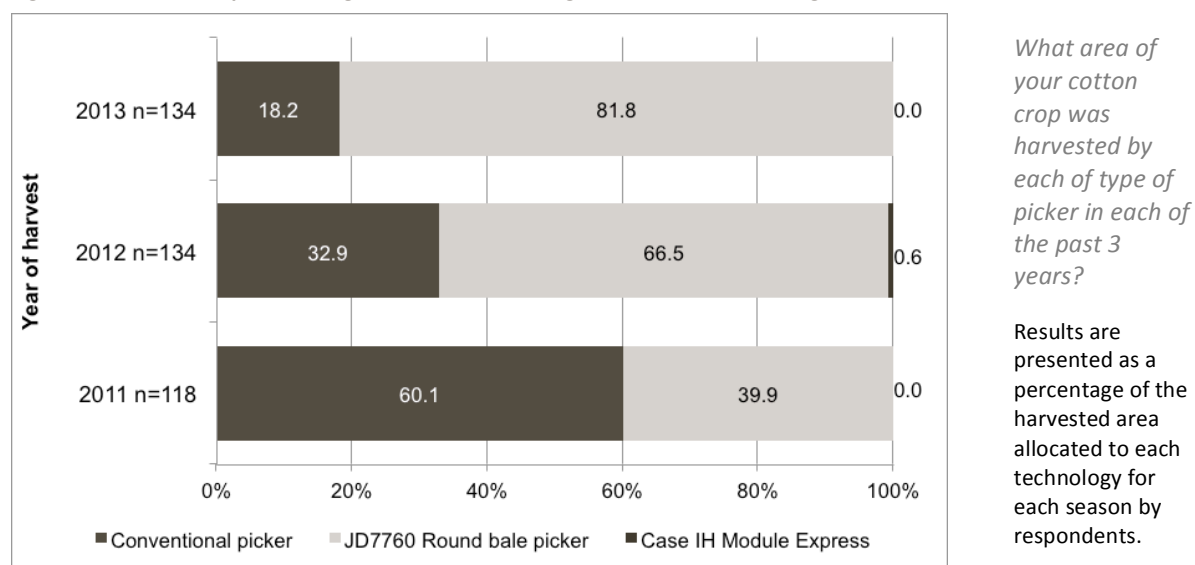
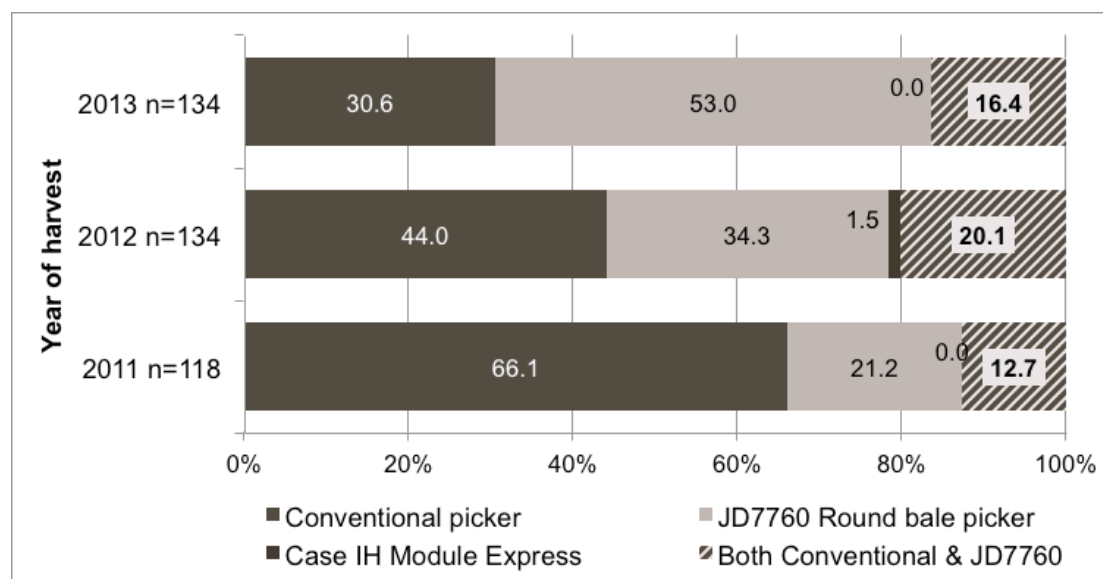


Figure 42 Percentage of growers using the various picking technologies for 2010-2011 through 2012-2013 seasons



When looking at the number of respondents reporting the use of the various picking technologies, it can be seen that fewer JD7760 machines, as a percentage of respondents, are required to pick the same area as the conventional system. This supports two interrelated notions:

- The conventional system is generally being retained by smaller operators
- The JD7760 is capable of a faster pick (further supported by Figure 43 and Figure 45)

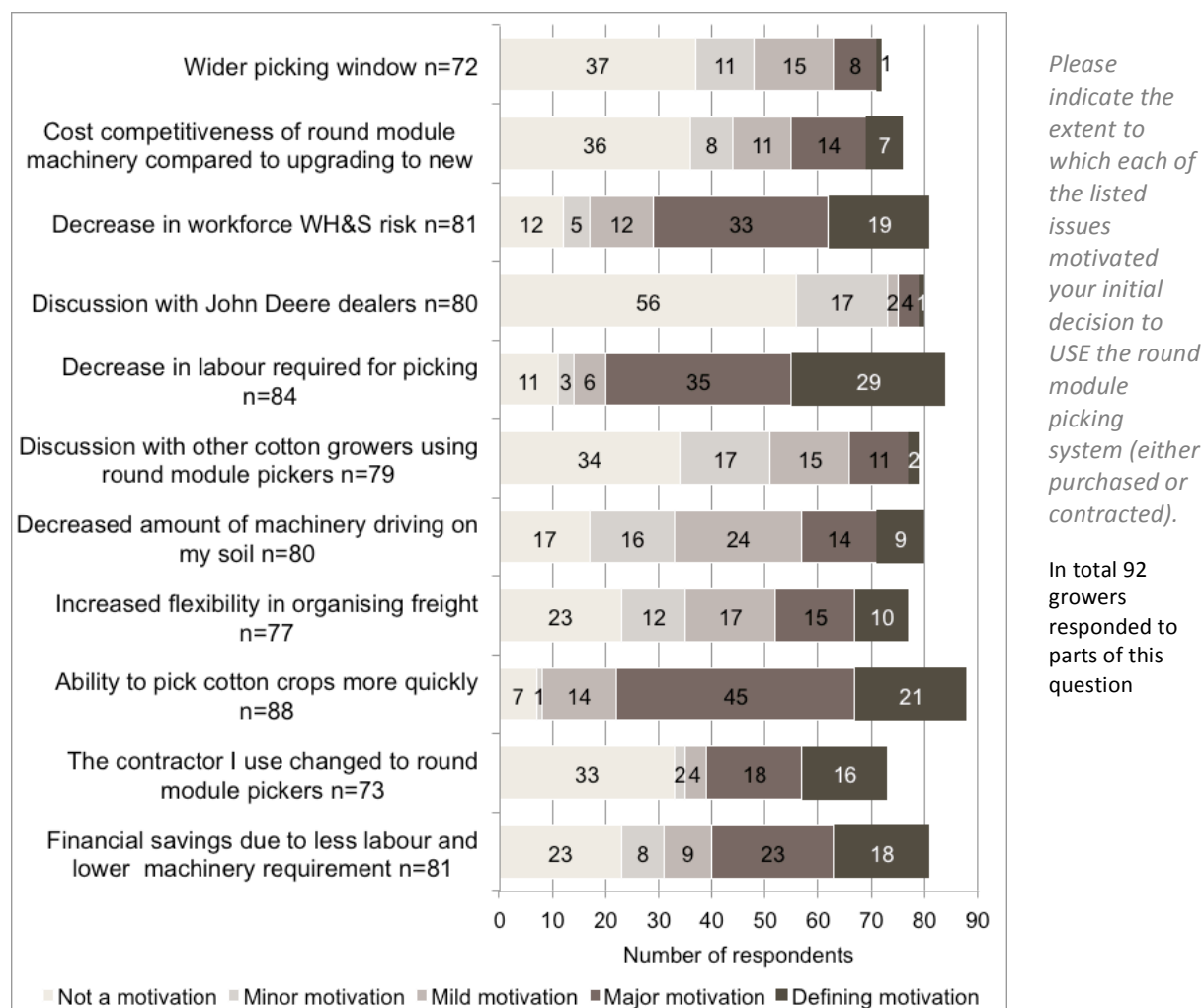
For example, in the 2012-2013 season, 81.8% of the reported area was picked using a JD7760 and 69.4% of growers reported using a JD7760, while 47% of growers reported using the conventional system to pick 18.2% of the reported area. On this basis, from the 201-2011 through 2012-2013 seasons, it is apparent that the JD7760 picking has become more efficient improving from 1.17 (ratio of JD7760 picked area and JD7760 reported use) to 1.27 area/use.

During the 2011-2012 season two growers reported using the CaseIH625 on board module picker. Anecdotal discussions with growers and dealers suggest that there are no CaseIH625 machines commercially operating in Australia. It might be that this use represented as demonstration of the technology as the total area reportedly picked by the CaseIH625 was 591 ha.

The John Deere 7760 picking technology

The following results refer only to growers who indicated the use of the JD7760 picking technology. Growers were asked to indicate from a list of statements their initial motivations to use the JD7760 picking technology (Figure 43) in order to understand the driving motivation for the technology adoption.

Figure 43 Initial motivation to use the JD7760 picker whether using a purchased machine or contract harvest



“Decrease in labour required for picking” was the initial motivation most selected by responding growers as the defining motivation. When considering “defining motivation” and “Major motivation” categories together, “Decrease in workforce WH&S risk”, and “Ability to pick cotton crops more quickly” should also be considered as major driving motivations of technology adoption.

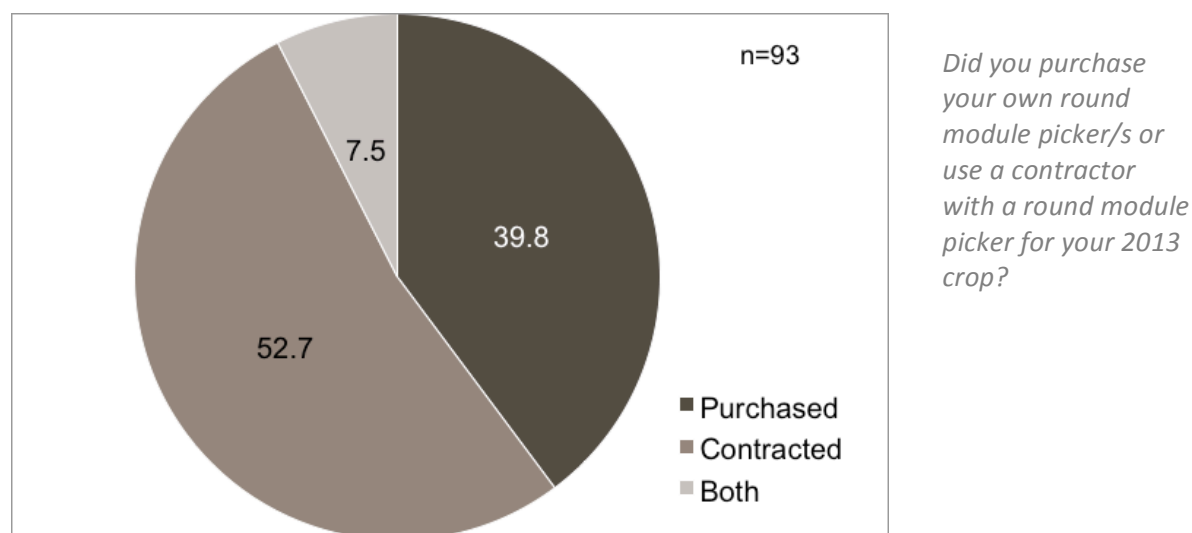
Interestingly, “Financial savings due to less labour and machinery requirement” is relatively evenly split between low and high motivation, with a slight majority leaning towards it being a driving motivation (combination of Major and Defining motivation categories). One grower commented that “Round bale cost a lot more \$ overall!!!”, while another suggested that “It is not true that there are financial savings in labour and machinery from changing to round module pickers.” The cost of the conventional and JD7760 systems has been considered on par by the industry³ and comparative costs of the two systems will be calculated in CRDC project NEC1301. However, it is apparent that irrespective of any actual financial savings that the prospect of a financial saving did act as a driver for adoption for a large proportion of responding growers.

The decision to adopt the JD7760 appears to be at an individual grower level, with the majority of respondents considering “Discussion with John Deere dealers” and “Discussion with other cotton growers using round module pickers” as low motivations to adopt.

During the 2012-2013 season, contract harvesting accounted for all or part of the harvesting on the majority (60.3%) of the responding farms that used a JD7760 (Figure 44). Where machines were purchased (47.3% of the respondents using a JD7760), the vast majority of picking was performed by one picker (Figure 45). In this season the average cotton picked by an owned/ leased JD7760 machine was 650.36 ha ($n=37$). In three cases during this season, growers reported that a single machine was picking almost twice the average area for the season, which indicates that other machines may be being underutilised.

The area of cotton picked exclusively by machines that were owned or leased rather than contract picked (39.8%, Figure 44) represented 54% of the total cotton area picked by JD7760 machines. So, while there were more people using a contracted JD7760 machine for harvest (52.7% using a contractor, Figure 43), as compared to 39.8% using an owned/ leased machine, the area of cotton picked by contractors was less (46% of the cotton harvested by JD7760 machines). This might indicate a potential saturation of JD7760 machines in the Australian market.

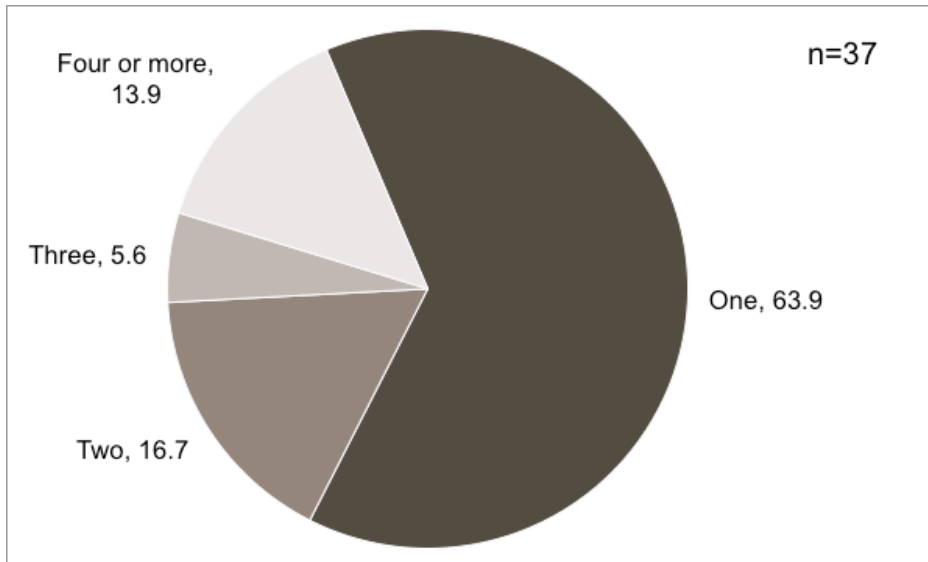
Figure 44 Percentage of growers indicating the use of a JD7760 in 2013 who purchased / leased a machine, used contract harvesters, or both



³ Woodhouse, N.P., Bennett, J.McL., Jensen, T.A. (2013) *Change in the cotton harvesting system: A review and implications for the John Deere 7760 cotton picker*. National Centre for Engineering in Agriculture Publication 1004960/13/1, USQ, Toowoomba.

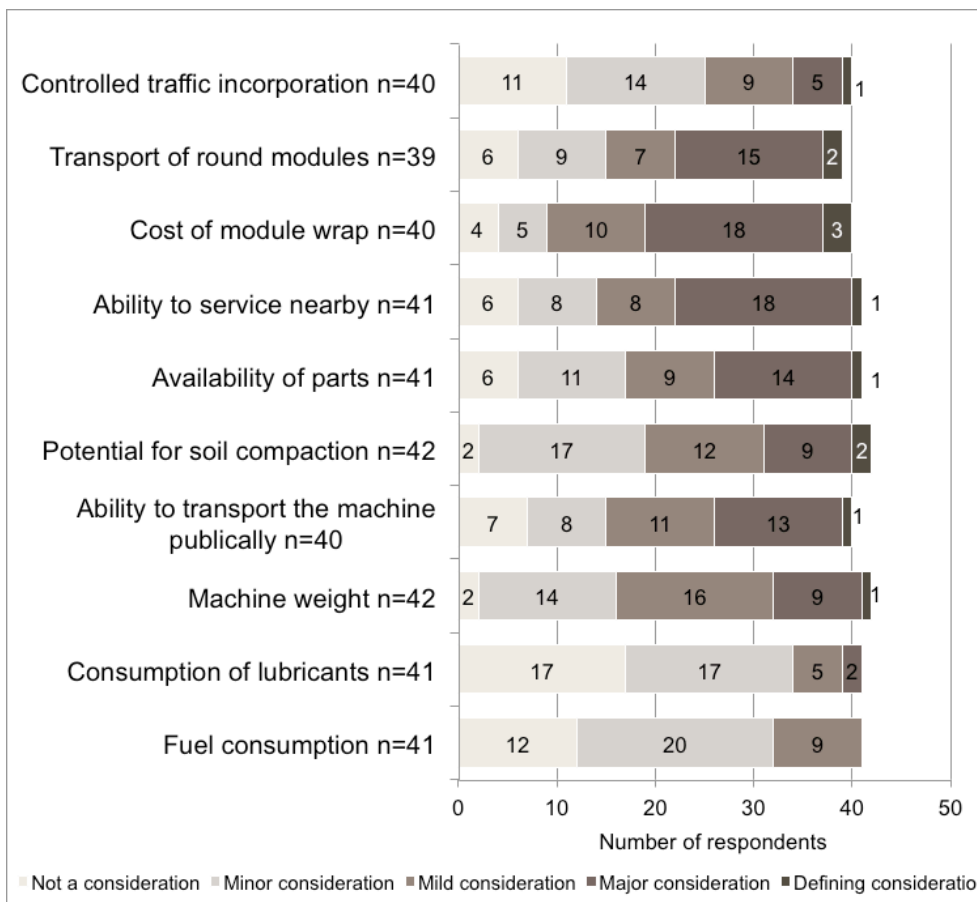
Growers were asked to indicate to what degree the considerations listed in Figure 45 featured in the purchasing/ leasing decision making process. This question differs to the data presented in Figure 43 in that it relates to purchasing considerations, rather than motivations, or impetus, to use the machine. That is to say, one might be motivated to use a machine by a defining impetus, but the decision to buy a machine is governed by a decision making process with various characteristics. This question seeks to understand those characteristics. This question also excludes those who only use contract JD7760 harvesting.

Figure 45 Number of JD7760s per farm as a percentage of respondents who had a machine



How many round module pickers do you currently have (owned or leased)
If you bought it in partnership with others please list your share of ownership (eg ½)

Figure 46 Considerations made by growers during the purchase / lease process of the JD7760



Please indicate the extent to which each of these issues were considered in your initial decision to PURCHASE or LEASE the round module picking system

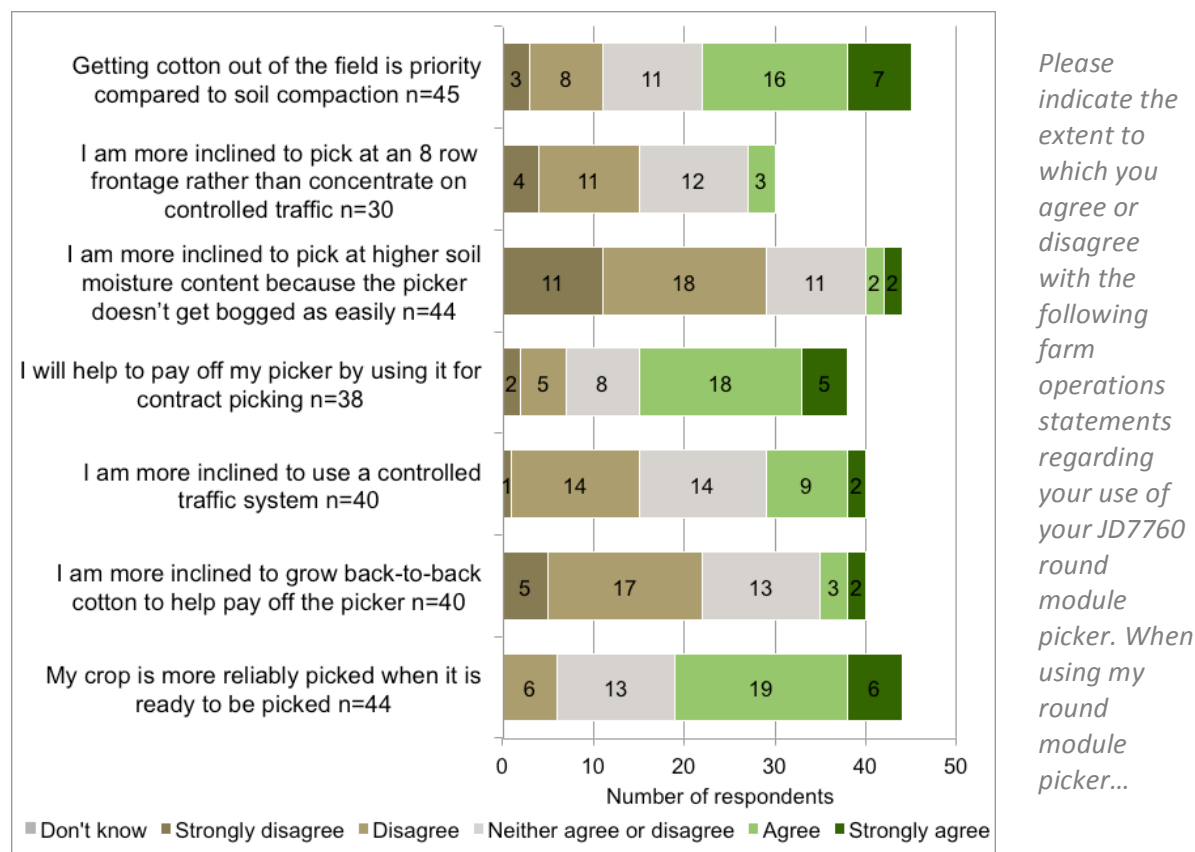
Interestingly, there was no single overriding defining consideration identified by responding growers. The major considerations in purchasing related to the ability to have the machine serviced,

the cost of module wrap, the availability of parts, the transport of round modules and the transport of the machine itself. Consumption of fuel and lubricants were generally not important considerations.

The machine weight and potential for soil compaction were cursory considerations with the majority of response in the Minor and Mild categories. The machines ability to be incorporated into a controlled traffic system was even less of a consideration.

Respondents who had purchased/ leased their JD7760 were asked to what extent they agreed/ disagreed with the attitudinal statements in Figure 47 in terms of utilising their picker within the farming system. These questions were split into those relating to soil compaction, attitudes towards paying the machine off and machine performance. Responding growers clearly thought that harvesting cotton was more important than causing soil compaction, but conversely were not inclined to pick at higher soil moisture content just because the machine could. This suggests that if climatic conditions and external circumstances require cotton be picked at detrimental soil moisture, then it will be. However, the more important point here is that where possible growers will attempt to avoid traffic at detrimental soil moisture.

Figure 47 Grower attitudes towards the use of an owned / leased JD7760 picker in their farming system



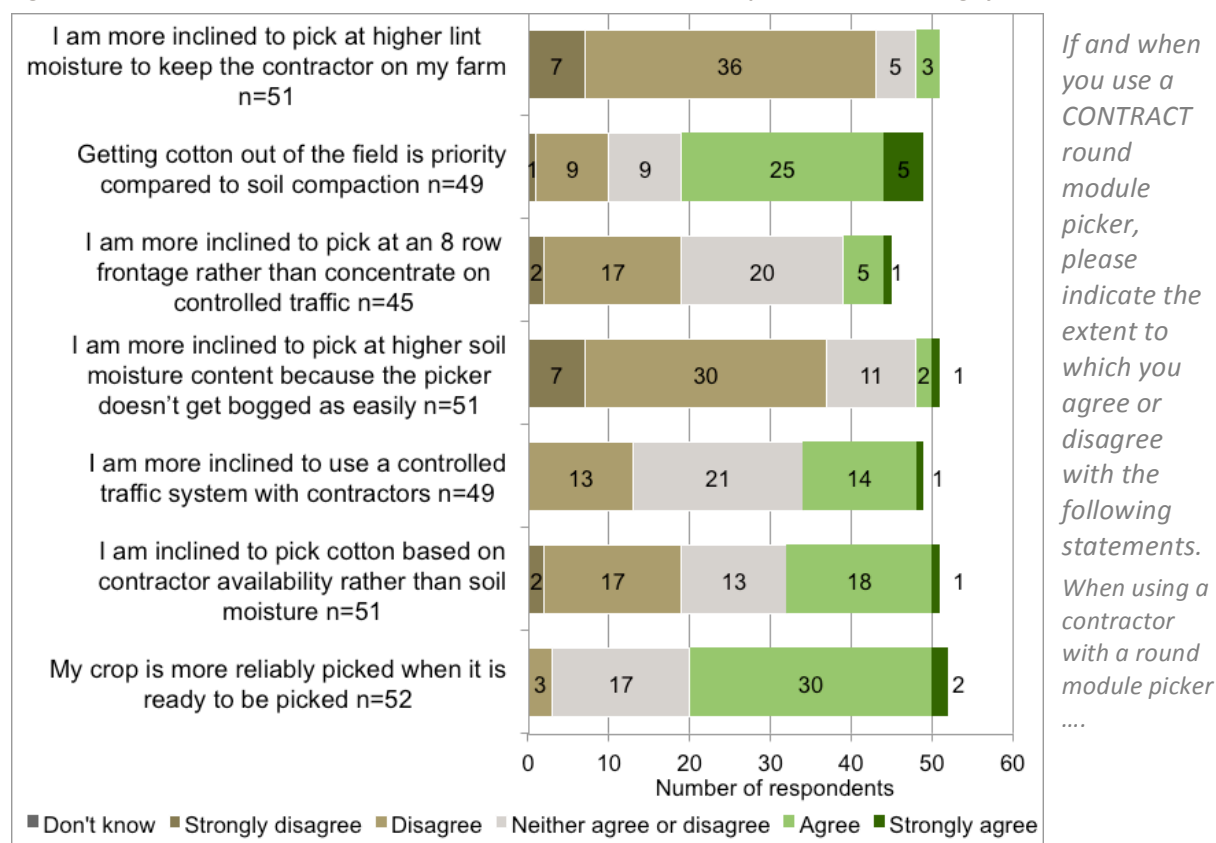
On the other hand, while many did consider the machine weight in their purchasing process (substantial weight between 32 and 36 tonnes), they were not overly inclined to consider a controlled traffic regime as being any more important than with their previous system. The ability to modify a JD7760 to pick on an 8 row frontage allows those using skip-row cotton systems to harvest more quickly by ensuring that all 6 heads are picking rather than running in skip rows. While the number of growers considering this was not assessed, it appears that the ability to do this does not cause growers to be any more inclined to do so.

In regards to paying off the JD7760 picker, 60.5% of respondents indicated they would use the picker for contract harvesting whilst only 12.5% are more inclined to grow back to back cotton.

Given the data presented earlier that might suggest that the Australian market for JD7760 pickers is becoming saturated and pickers are not necessarily picking at capacity. The fact growers are considering contract harvesting as a method to pay off their machine could be a pressure on the contract harvesting market and therefore the future ready availability of contract pickers. Although, those using contract pickers agreed that their crop was more reliably picked when it was ready to be picked (Figure 48); this statement, in terms of contractors, pertains to picker availability.

Respondents tended to agree that the JD7760 was more reliable at picking than previous systems, which is further demonstrated as an increased effective capacity of the machine (area of a field harvested per hour including unproductive time such as turning, unloading and maintenance).⁴

Figure 48 Grower attitudes towards the use of a contractor with a JD7760 picker in their farming system



While removing cotton from the field was still a clear priority as compared to avoiding soil compaction for respondents using contractors, encouragingly, they indicated that they did not feel more inclined to pick at high soil moisture just because the machine could. However, may feel slightly pressured to do so (split between disagree and agree) depending on contractor availability. Similarly, growers using contractors were no more inclined to use controlled traffic than those purchasing/ leasing their machines. This also means that they were generally no less inclined to use controlled traffic systems as a result of contract picking with a JD7760.

Respondents also indicated that they did not feel pressured to pick at higher lint moisture to keep the contractor on the farm.

⁴ Woodhouse, N.P., Bennett, J.McL., Jensen, T.A. (2013) *Change in the cotton harvesting system: A review and implications for the John Deere 7760 cotton picker*. National Centre for Engineering in Agriculture Publication 1004960/13/1, USQ, Toowoomba.

Human Resources

Survey respondents were asked a number of questions about their workforce as at January 2013 (ie mid-season). They were asked to include themselves and their family, but exclude gin staff in their responses. Table 16 provides basic figures on the average number and range of people employed on cotton farms as at January 2013, vacancies and recruitment.

Table 16 Cotton farm employment as at January 2013, numbers per farm

Numbers per farm	No. respondents	Average	Min. per respondent	Max. per respondent
Number of people employed	n=138	6.6	0	55
Vacancies	n=110	0.4	0	8
Number new to the farm in 2012	n=110	2.4	0	25
Number new to the industry in 2012	n=110	1.8	0	20

A crude calculation of the reported employment figures at January 2013 in relation to the area of cotton production in 2013 can be made (n=129). As the employment figures are for the whole farm (not only those who work in cotton), these calculations are least accurate for larger farms where cotton is only a small portion of the enterprise. This indicates that:

- Respondent farms have on average 1.6 employees per 100 cotton ha
- The hectares of cotton per employee is highly varied (9.8 to 449 cotton ha/employee), largely influenced by the area of cotton grown in 2012-13 relative to the overall farm size. Average area of cotton per employee is: Central Qld 92 ha; Darling Downs 87 ha; Southern Qld 149 ha; Northern NSW 118 ha; Macquarie 93 ha; Southern NSW 81 ha.
- The average is raised by a small proportion of farms who have large employee numbers and a number who had little cotton in 2012-13.
- 13% have less than 0.5 employees per 100 cotton ha
- 33% engage 0.5-1 employee per 100 cotton ha
- 25% have 1-2 employees per 100 cotton ha
- 23% have more than 2 employees per 100 cotton ha.

On-farm workforce: current staff, vacancies, those new to the farm and new to cotton, and planned recruitment

By Dr Jennifer Moffatt, The University of Melbourne

This section of the survey complements research work being carried out by The University of Melbourne for the CRDC.

Survey findings for on-farm workforce (excluding contractors) can be summarised as:

- Experienced staff are the largest group of staff reported in this survey, followed closely by those at Entry level. Most vacancies were also at these levels, however the largest number planned to be recruited were Entry level staff. The results suggest that this may refer to casuals on 417 visas.
- While full time permanent staff constituted approximately two-thirds of staff in January 2013, most of the remainder were casuals. In the permanent workforce the largest group are Experienced staff, however in the casual workforce the largest group is Entry level.
- The vacancy gap recorded in January 2013 is smaller (4.8%) than has been identified in other regional research evidence (vacancy gaps ranging from 11% to 20%).
- The number of people new to the farm in 2012 is comparatively similar to that for planned recruitment for 2013, the majority of which is Entry level.
- For about one-third, the decrease in labour requirements was a defining influence in deciding to use a round module picker; and for approximately one-quarter the reduction in Workplace, Health and Safety risk was a defining influence.
- More than three-quarters of those who used a round module picker indicated that it had reduced their labour requirements.

While 110 to 138 people responded to each of the questions on workforce, the questions comprised a number of sub-questions and many respondents left some cells blank. The number of respondents per sub-question in this section of the report varied from nil to 89; no conclusions can be drawn about those who did not respond to these sub-questions. As non-probability sampling was used, the results cannot be generalized beyond this sample. Due to the low response rate these results must be interpreted with great caution.

Table 17 shows that for those who responded to the survey questions on workforce, in total there were 913 staff in January 2013. The level of experience are shown in numbers of staff or vacancies in Table 17 and as relative percentages in Figure 49.

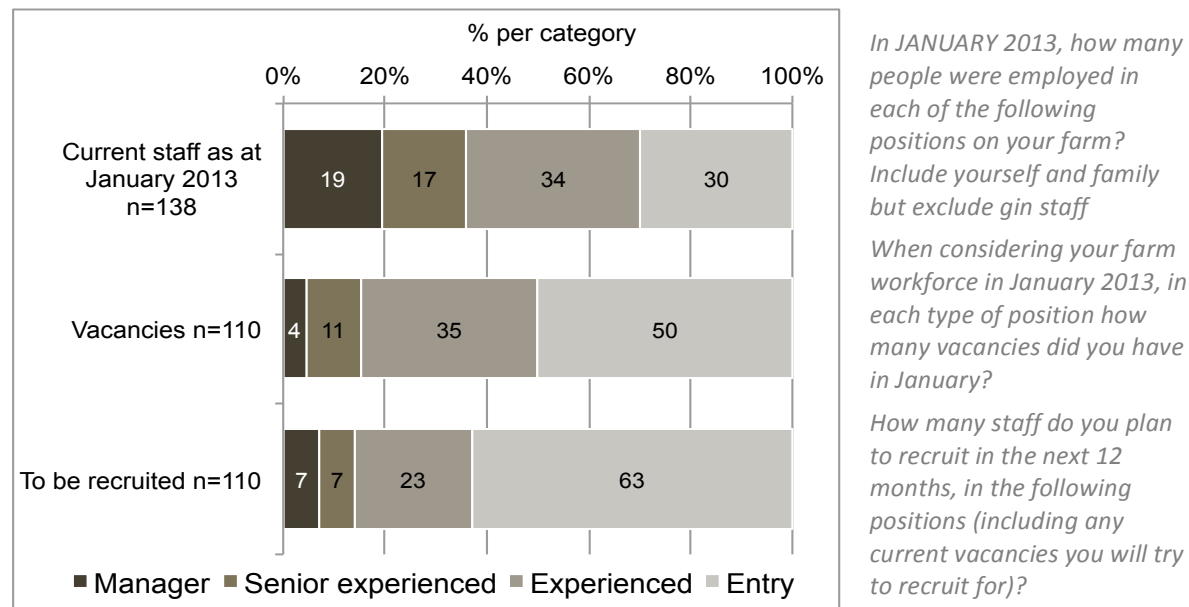
The largest number of staff per level, were Experienced (312, 34.2%), followed by Entry level (272, 29.8%). A person at the Experienced level would be an experienced farm hand or machinery operator, whereas Entry level would be an assistant farm hand or driver who requires supervision or is inexperienced.

Table 17 Staff and vacancies at January 2013, and planned recruitment for the next 12 months, by staff level

Level	Number of staff	Number of vacancies as of January 2013	Full staff (no. staff + vacancies)	No. staff to be recruited in 2013
Manager	177	2	179	20
Senior experienced	152	5	157	19
Experienced	312	16	328	64
Entry	272	23	295	176
TOTAL	913	46	959	279

The proportion of vacancies was highest for Entry level (half of the vacancies) and almost two-thirds of those to be recruited were Entry level staff. However approximately one-third of the vacancies were for Experienced staff and almost one-quarter of those to be recruited were Experienced staff. When the staffing gap is estimated, overall it is 4.8%, being higher for Entry level (7.8%) and Experienced level (4.9%) and lower for Manager and Senior Experienced.

Figure 49 Staff and vacancies at January 2013 and planned recruitment for the next 12 months, by staff level



The most prominent feature of Figure 49 is the gradient for Entry level staff. They constitute almost one-third of staff (29.8%), and half of the vacancies are at this level (50%), yet almost two-thirds (63.1%) of those to be recruited are at this level. The Manager level shows a similar feature with vacancies and planned recruitment. While 4.4% of the vacancies are at Manager level, almost double this, 7.2% of those to be recruited, are at this level. By contrast for Senior experienced and Experienced staff, the pattern is reversed.

While 10.9% of the vacancies are for Senior experienced staff, less than 7% (6.8%) of those to be recruited are at this level; similarly, while approximately one-third (34.8%) of the vacancies are for Experienced staff, less than one-quarter (22.9%) of those to be recruited are at this level. Disaggregating the levels into staffing categories provides some insight into these results, to which we now turn.

The largest category of staff, almost two-thirds, were full time permanent staff (63.5%), and most of the remainder were casuals (28.1%)(Table 18). Of the casual staff, almost two-thirds (64.6%) were backpackers (those on 417 visas). Of the full time permanent staff, only 17 were 457 visa holders.

Table 18 Number and proportion of fulltime permanent, part time permanent and casual staff, January 2013 (raw scores and percentages)

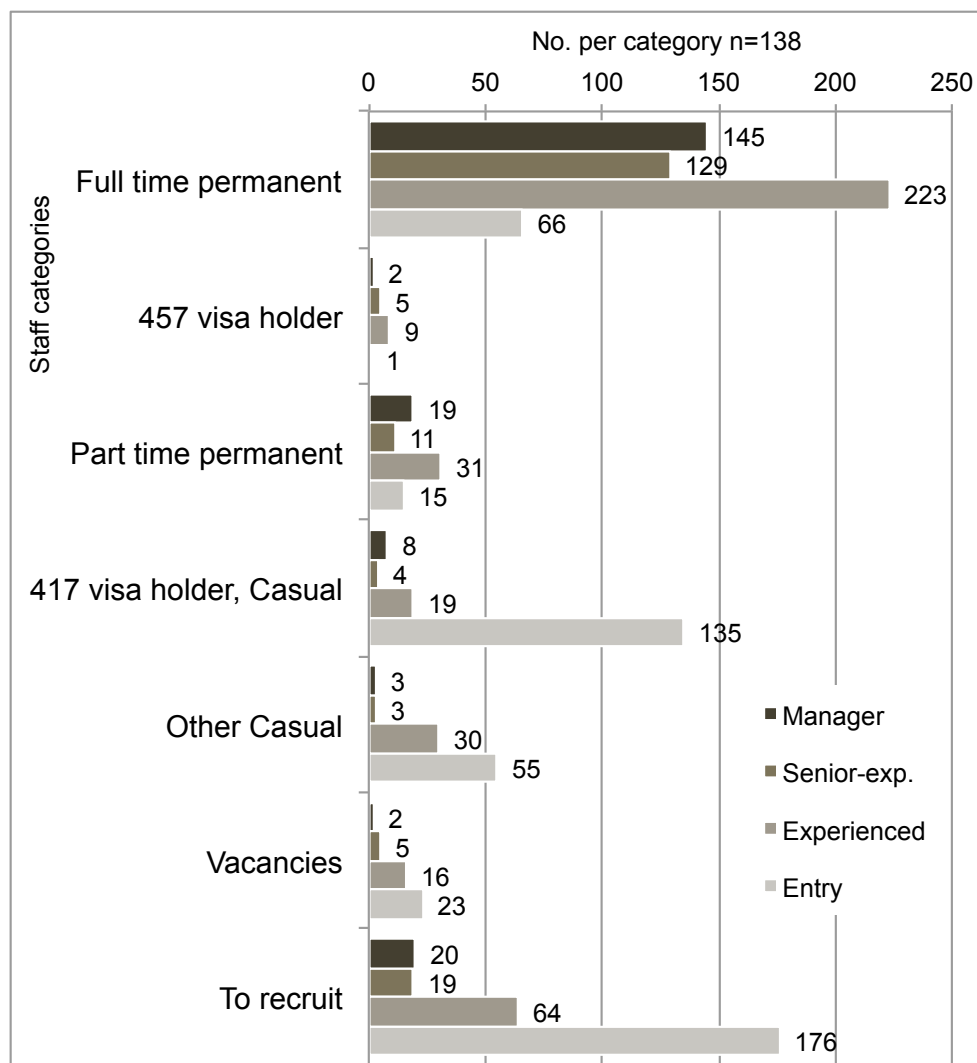
Staff category	Number	%	Staff sub-category	Number	%
Full time permanent	580	(63.5)	- 457 visa holders	17	(3)
			- Other full time	563	(97)
Part time permanent	76	(8.3)			
Casuals	257	(28.2)	- 417 visa holders	166	(64.6)
			- Other casuals	91	(35.4)
Total	913	(100)			

Figure 50 shows the staff (permanent and casual) and vacancies in January 2013, and those to be recruited over the next 12 months. It clearly depicts:

- the dominance of the full time permanent workforce
- the large number of Casuals at Entry level and in particular those on 417 visas
- the very small numbers of vacancies
- the plans to recruit a large number of Casuals at Entry level (To recruit)

The result for vacancies, a gap of 4.8% differs from CRDC workforce research conducted by The University of Melbourne in three production valleys, during 2012-2013. The results from those grower surveys were Emerald - 20% gap (November – December 2012); Gwydir - 16% gap (November – December 2012); and Lachlan Murrumbidgee – 11% (September 2013). Due to the differences in methodology between the case study and this survey, direct comparison is not possible. It may reflect differences between responding farms and regions. It may potentially indicate that the vacancies present in early season have been filled by mid-season.

Figure 50 Staff (permanent and casual) and vacancies at January 2013 and recruitment in the next 12 months (Raw scores)



In JANUARY 2013, how many people were employed in each of the following positions on your farm? Include yourself and family but exclude gin staff

When considering your farm workforce in January 2013, in each type of position how many vacancies did you have in January?

How many staff do you plan to recruit in the next 12 months, in the following positions (including any current vacancies you will try to recruit for)?

Permanent staff

For the purpose of this discussion, the terms “full time staff” and “part time staff” exclude those who are 457 visa holders as they are referred to specifically.

Experienced staff formed the largest category of the permanent workforce recorded by respondents to this survey question (Table 19, Figure 50).

The Experienced staff level was the largest group of permanent full time staff (39.6%), permanent part time staff (40.8%) then 457 visa holders (9 of 17). The rankings of proportions varied for the other staff categories. For employees who are not 457 visa holders, those at Manager level were the second largest group, with approximately one-quarter of permanent full time staff (25.7%) and permanent part time staff (25%). Senior experienced staff were the second largest group among 457 visa holders (5 of 17), third largest group of permanent full time staff (22.9%), and fourth largest group of permanent part time staff (14.5%). For permanent staff, Entry level were the smallest proportion in all categories except permanent part time staff, where they were the third largest proportion. (Full time permanent 11.7%; 457 visa holders 1 of 17; permanent part time staff 19.7%).

While there were plans to recruit permanent staff across all types of staff, the demand for Experienced staff was apparent with this being the category for which most recruits were sought, with almost one-third (30.2%) of the proposed full time permanent recruits, almost half of the permanent part time staff to be recruited (48.1%) and two-thirds of the 457 visa holders to be recruited (6 of 9). Entry level staff were the next largest group of proposed recruits, also across all staff categories – 27% of intended full time permanent, 26% of part time permanent and proposed 457 visa holder recruits (2 of 9). The numbers of proposed recruits for 457 visa holders and part time permanent staff are too low to elicit any discernable trend.

Table 19 Permanent staff in January 2013 and planned recruitment during the next 12 months
(Raw scores and percentages)

		Number	%	Number to recruit	%
Full time (excluding 457 visa holders)	Manager level	145	(25.8%)	12	(19.0)
	Senior experienced	129	(22.9%)	15	(23.8)
	Experienced	223	(39.6%)	19	(30.2)
	Entry	66	(11.7%)	17	(26.0)
	Totals	563	(100)	63	(100)
457 visa holders	Manager level	2		nil	
	Senior experienced	5		1	
	Experienced	9		6	
	Entry	1		2	
	Totals	17		9	
Part time permanent (excluding 457 visa holders)	Manager level	19	(25.0)	4	(14.8)
	Senior experienced	11	(14.5)	3	(11.1)
	Experienced	31	(40.8)	13	(48.2)
	Entry	15	(19.7)	7	(25.9)
	Totals	76	(100)	27	(100)

Casual staff

While casual staff constituted between one-quarter and one-third (28%) of staff in January 2013 (Table 18), it is a small, but important proportion for this seasonal crop. The results of this survey indicate that, for this sample, in the casual workforce, Entry level staff are the largest group and where the most future demand is, in particular for the 417 visa holders (Table 20).

The staffing profile of casuals contrasts with that of permanent staff, with most casual staff being at Entry level – for 417 visa holders (81.3%) and Other casuals (60.4%)(Table 20). In addition, most proposed casual recruits are at Entry level – 417 visa holders (93.5%), and as Other casuals (46.5%). This indicates a very strong demand for 417 visa holders, who are almost exclusively at Entry level.

While the proportion of Experienced 417 visa holders as casuals is small (11.4%) and the aim is to recruit few here, this contrasts with the Other casuals result. Almost one-third of 'Other casuals' were Experienced staff (32.97%) and almost two-thirds at entry level (60.4%) with the future demand for both levels being similar (Experienced 44.2%; Entry 46.5%).

Table 20 Casual staff in January 2013 and planned recruitment during the next 12 months
(Raw scores and percentages)

	Staff category	Number	%	No. to recruit	%
417 visa holders	Manager level	8	(4.8)	2	
	Senior experienced	4	(2.4)	Nil	
	Experienced	19	(11.4)	7	
	Entry	135	(81.3)	130	(93.5)
	Totals	166	(100)	139	(100)
Other casuals	Manager level	3	(3.3)	2	(9.3)
	Senior experienced	3	(3.3)	Nil	
	Experienced	30	(32.0)	19	(44.2)
	Entry	55	(60.4)	20	(46.5)
	Totals	91	(100)	43	(100)

New to the farm in 2012, and new to cotton

Respondents were asked to indicate the number of employees in January 2013 who were new to their farm in 2012, and how many were new to cotton in 2012.

If the number of people new to the farm in 2012 (Table 21) was treated as a proxy measure for recruitment, this would show that 269 people were recruited in 2012 (new to the farm), however as a proxy measure it needs to be treated with caution. The percentages recruited during 2012 generally reflect the percentages for proposed recruitment in 2013, which suggests a level of consistency (Table 21). For Manager and Senior experienced staff the difference between those recruited in 2012 and those proposed to be recruited during 2013 was within two percent. However, fewer (6.1%) Experienced staff and more (5.5%) Entry level staff were to be recruited in 2013, than were recruited in 2012.

When those new to cotton were considered, Table 21 shows that overall, approximately one-quarter (26.8%) of 2012 recruits had cotton experience, but this varied depending on the level of the employee. Very few of those at Entry level had cotton experience (6.4%) but one-third of those at Manager level did. More than three-quarters (76.2%) of the Senior Experienced recruits had cotton experience and approximately half (52.6%) of the Experienced staff did. This suggests that there is some staff movement in on-farm cotton production positions. The large number of Entry level staff new to cotton potentially reflects the 417 visa holders.

Table 21 Employees new to the farm in 2012 and new to cotton in 2012
(Raw scores and percentages)

	New to farm	% new to farm in 2012	% to be recruited in 2013	New to cotton	% with cotton experience
Manager level	15	5.6%	7.2%	10	33.0%
Senior experienced	21	7.8%	6.8%	5	76.2%
Experienced	78	29.0%	22.9%	37	52.6%
Entry	155	57.6%	63.1%	145	6.4%
Totals	269	100	100	197	26.8%

Number of hectares and staffing levels

Of those who responded to both the employment question and the farm size question, the total farm hectares reported is 502,166, serviced by 913 staff, giving one person per 550 hectares. When full time permanent staffing was compared across the size of the hectares, some trends appeared. The total number of hectares was divided approximately into thirds for the purposes of analysis (Small size: nil to 640 ha; Mid size: 650-1830; Large size: more than 1850ha). Each staffing level (eg Entry) was categorised into one only staff member in January 2012 at this level, two at this level and three or more at this level. Analysis was conducted on the levels and hectare size. The results generally reflect greater staff numbers as the number of hectares increases.

Entry level staff

- Where just one Entry level staff member was employed they were most likely to be on a mid size (53.8%), followed by large (30.8%), then small (15.4%).
- When two Entry level staff members were employed, they were most likely to be on a large size (60%), followed by mid (40%), then small (10%).
- If there were three or more Entry level staff, they were most likely to be on a large size (66.7%) or mid (33.3%).

Experienced staff

- Where just one Experienced staff member was employed this person was almost equally likely to be on any of the three sizes (Small: 36.7%, Mid: 33%, Large: 30%)
- If there were two Experienced staff employed, this was more likely to occur as the hectare size increased (Large: 40%, Mid: 36%, Small: 24%)
- When three or more Experienced staff were employed they were almost equally likely to be on large (48.3%) or mid (44.8%) and least likely to be on small farms (6.9%).

Senior experienced staff

- If just one Senior Experienced staff member was employed this person was most likely to be on a mid size (60%), but least likely to be on a small (20%) or large size (20%)
- When two Senior experienced staff were employed they were far more likely to be on a large size (71.4%), than small (21.4%) or mid size (7.1%)
- When three or more Senior experienced staff were employed, most would be on a large size (80%) with the remainder on a mid size (20%).

Manager level

- If only one Manager was employed, this person would be almost equally likely to be on any of the three sizes (Mid: 35.2%, Small: 33.3%, Large: 31.3%)
- Where two Managers were employed they were most likely to be on a mid size (47.6%), followed by large (33.3%), then small (19%)
- If there were three or more Managers, this was more likely to occur on larger properties (Large: 69.2%, Mid: 23.1%, Small: 7.7%).

The round module picker and workforce

In deciding to use a round module picker, the highest percentage attributed to being a defining influence was a decrease in the labour required (34.52%), while reducing the Workplace Health and Safety risk was ranked third at 23.46%. When asked the impact of using a round bale picker, more than half (53.26%) strongly agreed and more than one-quarter (28.26%) agreed that it had reduced their labour requirements.

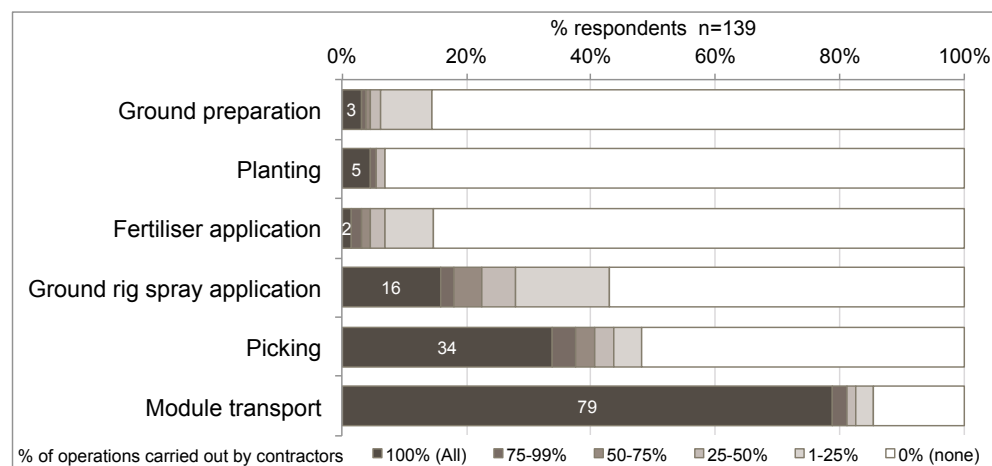
Use of contractors in farming operations

To understand the cotton industry workforce it is important to understand not only the staff employed by the farm but also the use of contractors. Contractors are engaged to undertake a range of farming operations to varying degrees on different farms (Figure 51):

- 98% of farms use contractors for at least some operations (including aerial application).
- 95% of farms use contractors for at least some of their on-farm operations (ie including aerial application and picking but excluding module transport).
- 49% of farms use contractors for on-ground, crop establishment and management operations (ie ground preparation, planting, fertiliser application and/or groundrig application).
- The 5% of farms who do not use contractors for any on-farm operations (ie anything other than module transport) are all located on the Darling Downs with farms less than 1900ha in size. Of these, 4 farms also do their own module transport.

Module transport is undertaken primarily by contractors with 85% of farms using contractors for this task at least some of the time and 79% of farms having all modules transported by contractors. 48% of farms engaged harvesting contractors for at least some of the harvest with 34% using only contract pickers. 43% of farms use ground rig contractors for some operations. Fewer farms use contractors for early crop stage operations with 15% of farms using contractors for some ground preparation, 7% for planting and 15% for fertiliser application.

Figure 51 Use of contractors to undertake various cotton farming operations



To what degree did you use contractors for any of these operations for your 2012-13 cotton crop?

Farm safety practices

Farm safety practices are an important part of the cotton industry's myBMP system. 62% of farms complete inductions for at least some workers, with 51% doing this for all new workers. As we know from Figure 51 that 98% of responding farms used contractors, it is interesting to note the lower use of inductions with contractors each season (24%). This may relate to repeated use of the same contractors each season. Relatively few farms are using formal systems for reporting farm hazards (28% of respondents) or have a documented health and safety plan (26%).

The survey sought to understand whether the *Cotton Small Business Workers Compensation Premium Discount Program that operated in 2002 – 2003* had an impact on ongoing safety practices. Only 17 respondents (12%) indicated that they had participated in this program whilst 30% did not recall whether or not they had. There appears to be a higher uptake of safety systems and plans amongst those who participated in the premium discount program (Figure 53).

Figure 52 Use of workplace induction and safety practices and systems

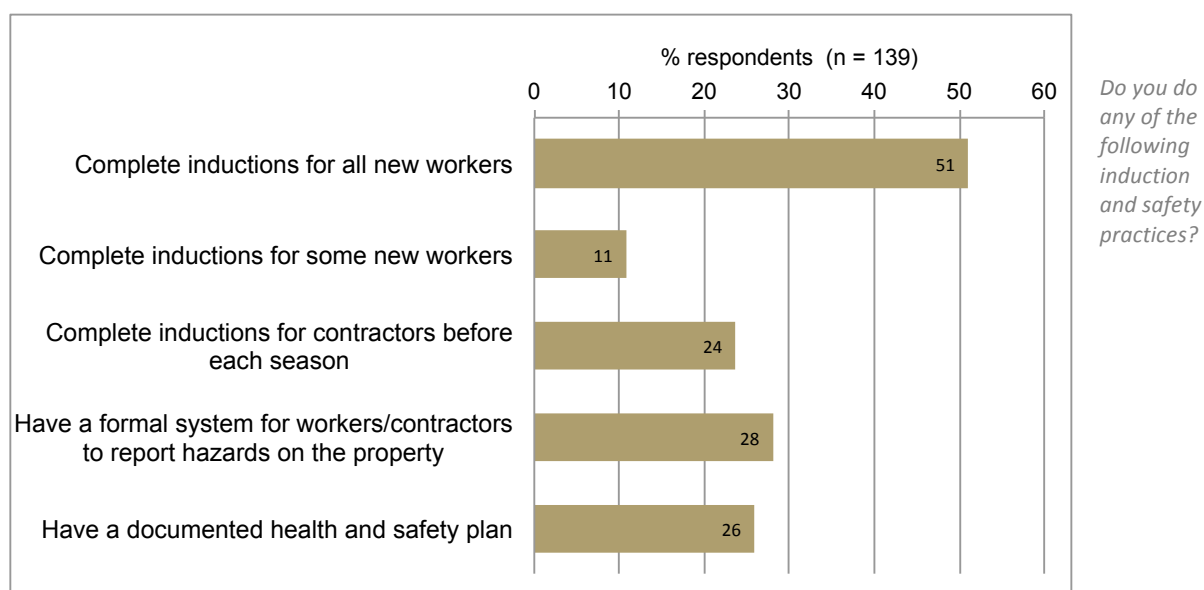
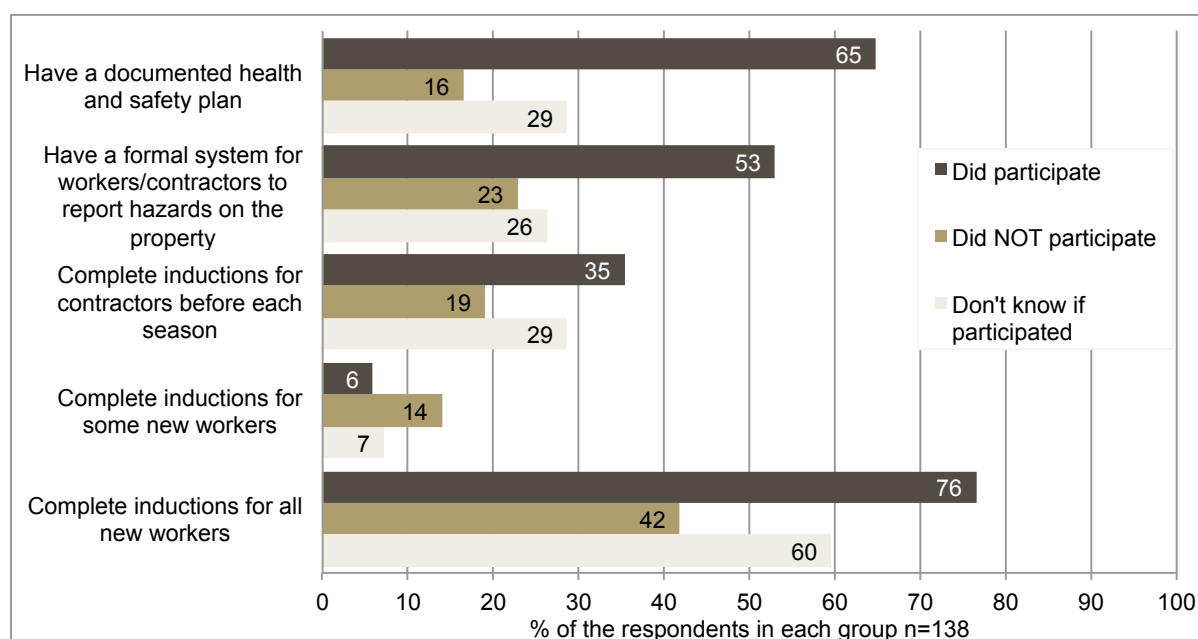


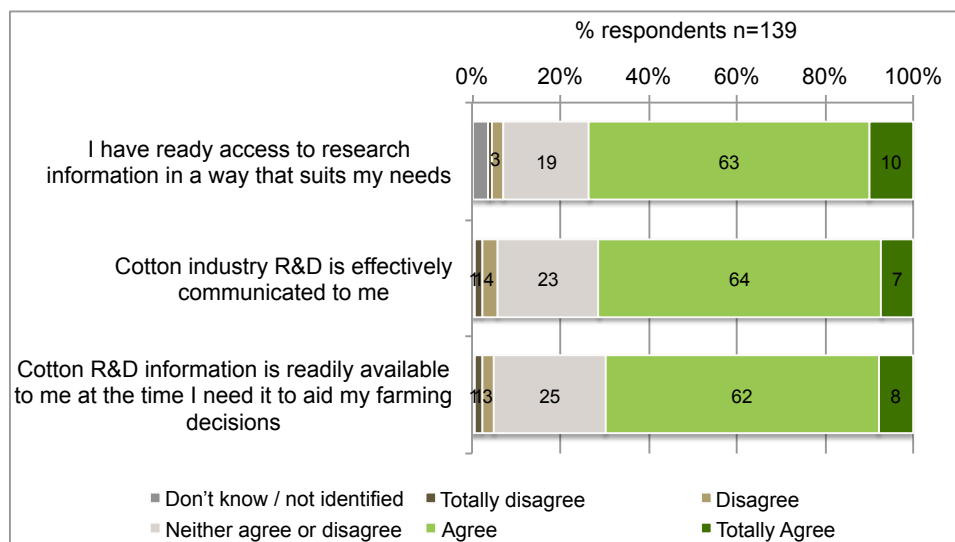
Figure 53 Use of workplace induction and safety practices according to participation in the Cotton Small Business Workers Business Compensation Plan (2002-2003)



Information for Cotton Decisions

70 – 73% of respondents indicated that cotton industry research and development is effectively communicated with information available in a timely manner to aid farming decisions (Figure 54). 19-25% neither agreed nor disagreed with these statements about communication of cotton R&D – possibly indicating that they do not seek out R&D in their decision making.

Figure 54 Perceptions on the communication of cotton research and development



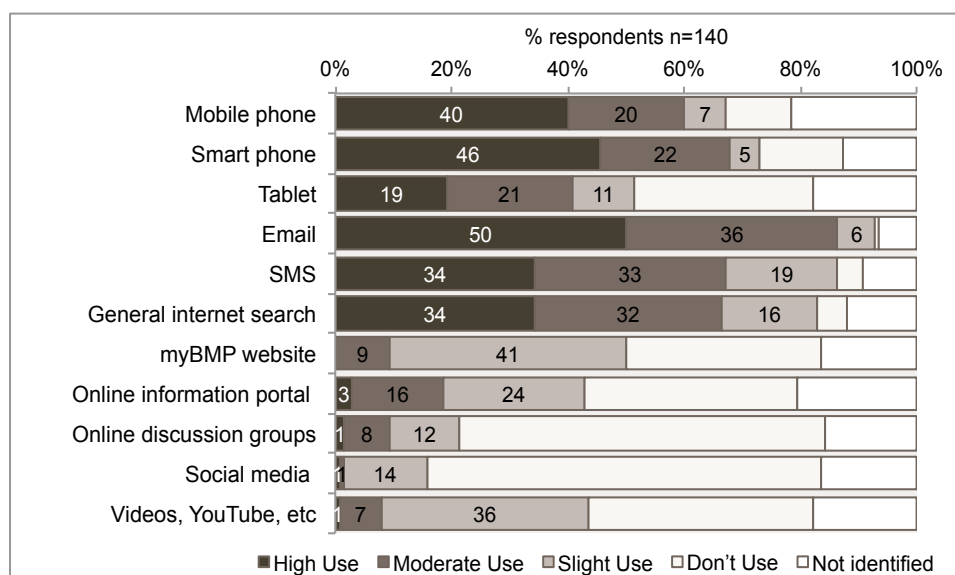
Please give your opinion on each of the following statements in relation to your cotton farming enterprise and the cotton industry

A further question asked about the use of information communication technologies to obtain information about the farming system (Figure 55). All of the 140 respondents to this question used some form of the listed technologies. The majority using several of these technologies with only one respondent indicating the only of these technologies he used was a mobile phone.

Other key points about use of information communication technologies in the farm business include:

- Mobile technology use is high with 82% of respondents indicating moderate or high use of a mobile phone, smart phone and/or tablet.
- Of the 27% of respondents who did not use a smartphone to access farming information, 47% of these did use a tablet.
- 84% used a smartphone or tablet.
- Social media use is low, reflecting similar findings in Cotton Australia's 2012 survey.
- 50% of respondents use the cotton industry's myBMP site, 41% only slightly.

Figure 55 Use of technologies for obtaining information about farming system



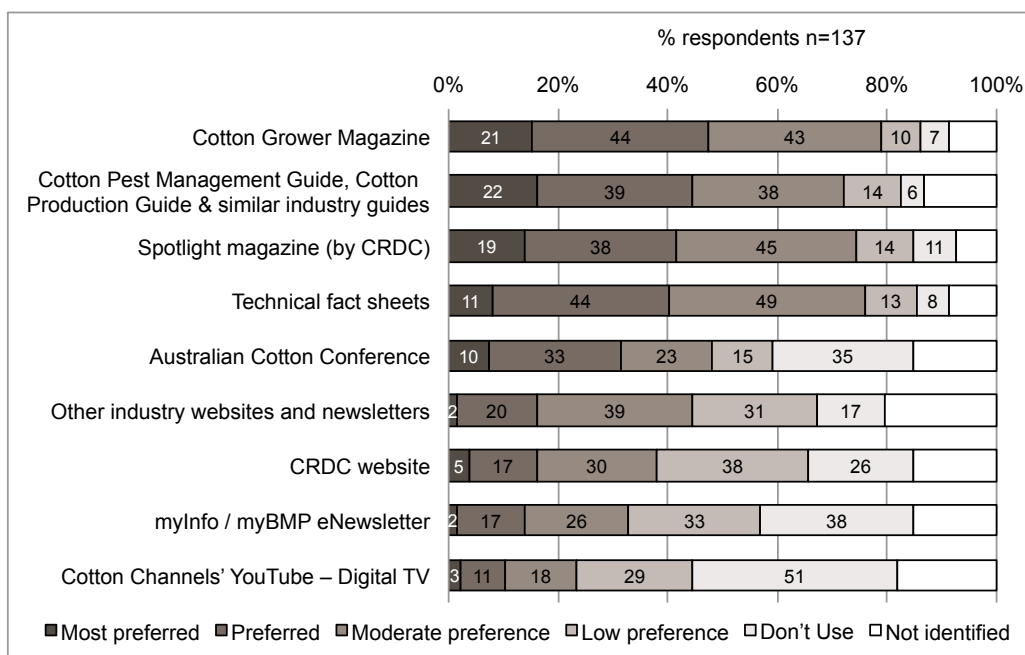
Which of the following technologies do you use for obtaining information about your farming system?

Respondents had a wide range of preferences, with the most preferred communication technology being:

- Email (35% of respondents)
- Smart phone (26%)
- General internet search (16%)
- Tablet (10%)
- Mobile phone (9%)
- SMS (2%)
- Online information portal (2%).

The most preferred mechanisms for receiving information about cotton research and development are The CottonGrower Magazine, the Cotton Pest Management Guide, the Spotlight magazine and Technical fact sheets (Figure 56). The Australian Cotton Conference and industry websites were also popular. Mentions were also made of receiving information from the agronomist and The Land or Qld Country Life.

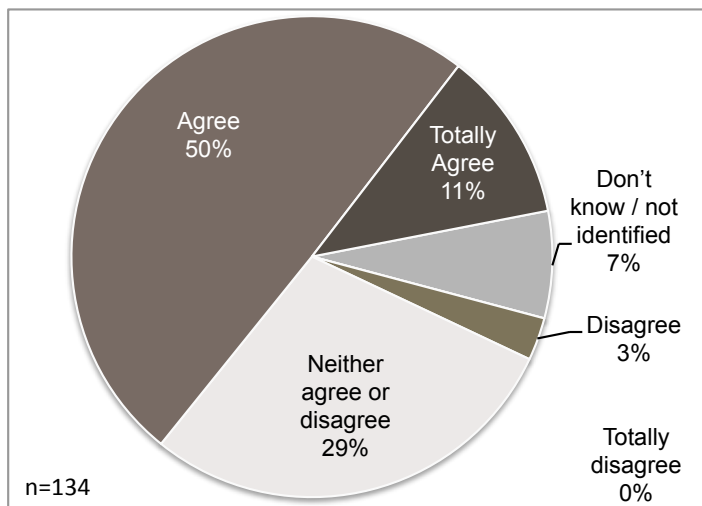
Figure 56 Preferred mechanisms for receiving information about cotton research and development



To receive information about cotton research and development please indicate your preference for each of these mechanisms

61% of respondents considered that cotton specific mobile apps could be helpful (Figure 57). 21 respondents made suggestions for the types of apps as follows.

Figure 57 Respondents' perceptions on whether cotton specific mobiles apps could help in their decisions



Please give your opinion on the following statement in relation to your cotton farming enterprise and the cotton industry: Cotton specific mobiles apps (for tablets, smartphones) could help in my cotton management decisions

The most requested topics for an app was for reliable weather information (including day degrees). Comment was made to include android apps.

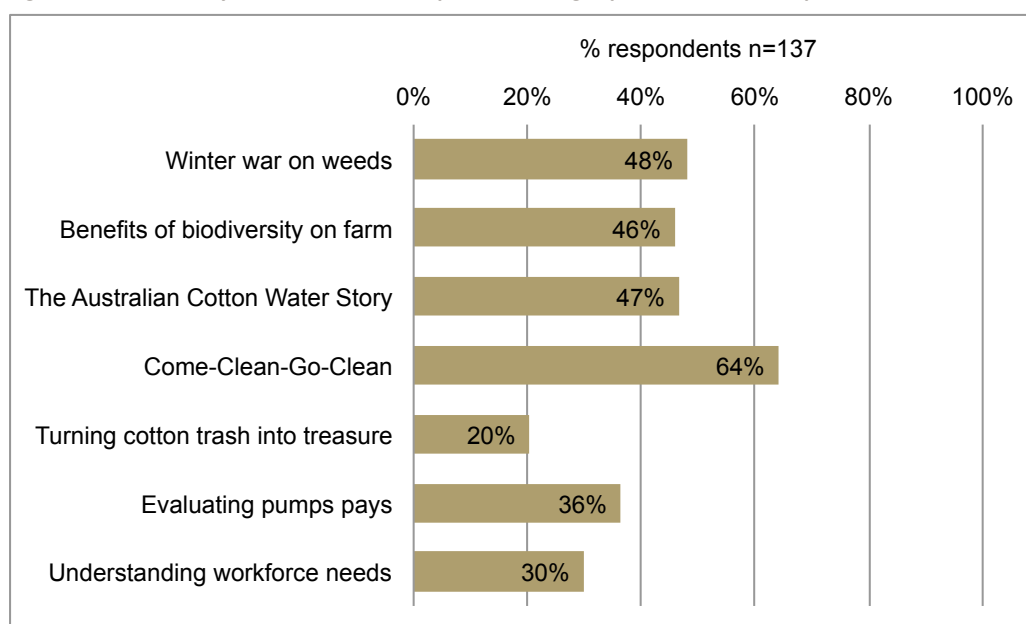
If you use smartphones or tablets, what types of apps (if any) would you like to see for cotton related information?

Other suggestions from growers were:

- Reliable Weather app
- Cotton Production Guide, Paddock record, gross margin comparisons
- Marketing
- Paddock Data entry, GPS mapping ,Round bale scanner
- Field manager, record keeper
- To be able to send round bale RFID info direct from picker to gin with an iPad or phone
- Mapping, survey
- Weather, day degrees
- Insect Identification
- Weather and Cotton market and Fert Market
- Weather, day degrees
- Insects, disease symptoms
- Water use, insect ID
- Spray Records
- Weather alerts , marketing
- Day degrees calculator
- Everything - agronomy, finance, OH&S
- Fertilizer and spray tables
- Irrigation Scheduler linked to weather- gives planning.

The surveys asked about growers' recall of some of elements of some of the research and development campaigns promoted over the past 12 months. Figure 58 illustrates recalls of specific messages by between 20% and 64% of respondents with the highest recall being of the long term campaign "Come-Clean-Go-Clean" (64% of respondents).

Figure 58 Recall of key research and development messages promoted over the past 12 months



In the past 12 months, do you recall reading or hearing about...

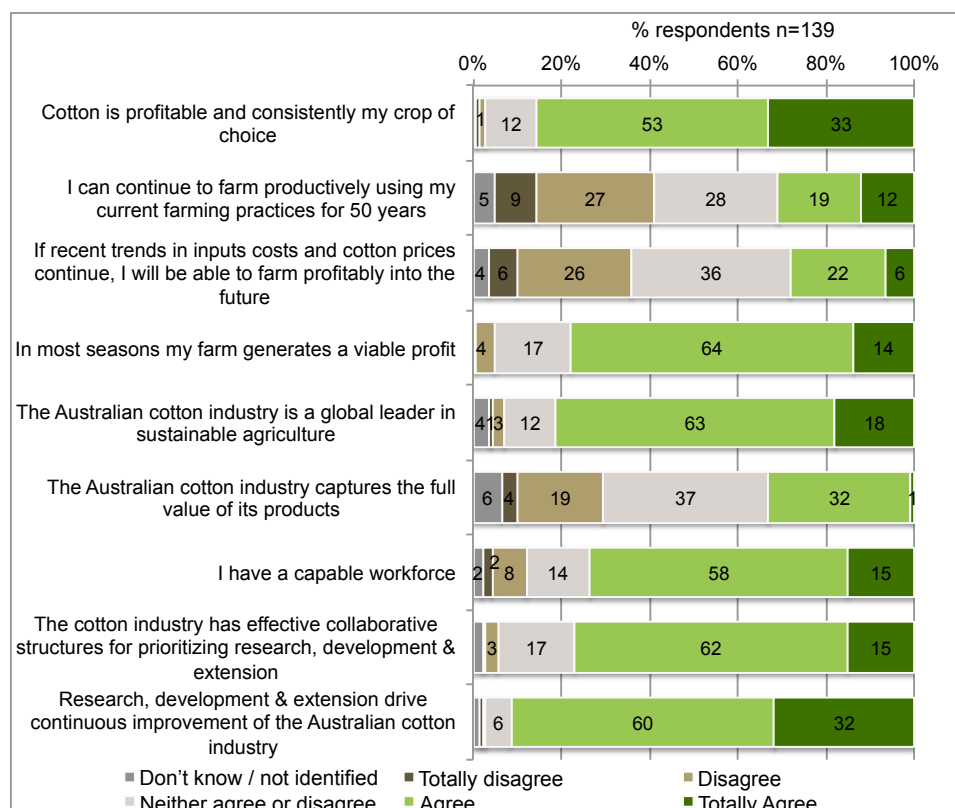
Perceptions and intentions

CRDC Strategic Plan Statements

The survey sought to establish a benchmark at the start of the CRDC Strategic R&D Plan 2013-18. As well as gathering data on a number of practices, growers were asked to indicate their level of agreement with a number of statements that reflect the stated outcomes of the CRDC Strategic R&D Plan. These responses, detailed in Figure 59, can be summarized as follows:

- CRDC Program: Farmers
 - 86% of respondents believe that cotton is profitable and consistently their crop of choice
 - 31% believe they can continue to farm productively using their current farming practices for 50 years
 - 28% indicated that if recent trends in inputs costs and cotton prices continue, they will be able to farm profitably into the future
 - 78% agreed that in most seasons their farm generates a viable profit
- CRDC Program: Industry
 - 81% of respondents regard the Australian cotton industry as a global leader in sustainable agriculture
- CRDC Program: Customers
 - 33% believe the Australian cotton industry captures the full value of its products
- CRDC Program: People
 - 73% indicated that they have a capable workforce
 - 77% believe the cotton industry has effective collaborative structures for prioritizing research, development & extension
- CRDC Program: Performance
 - 91% consider that research, development & extension drive continuous improvement of the Australian cotton industry.

Figure 59 Perceptions of farm and industry performance in relation to CRDC Strategic Plan Outcomes

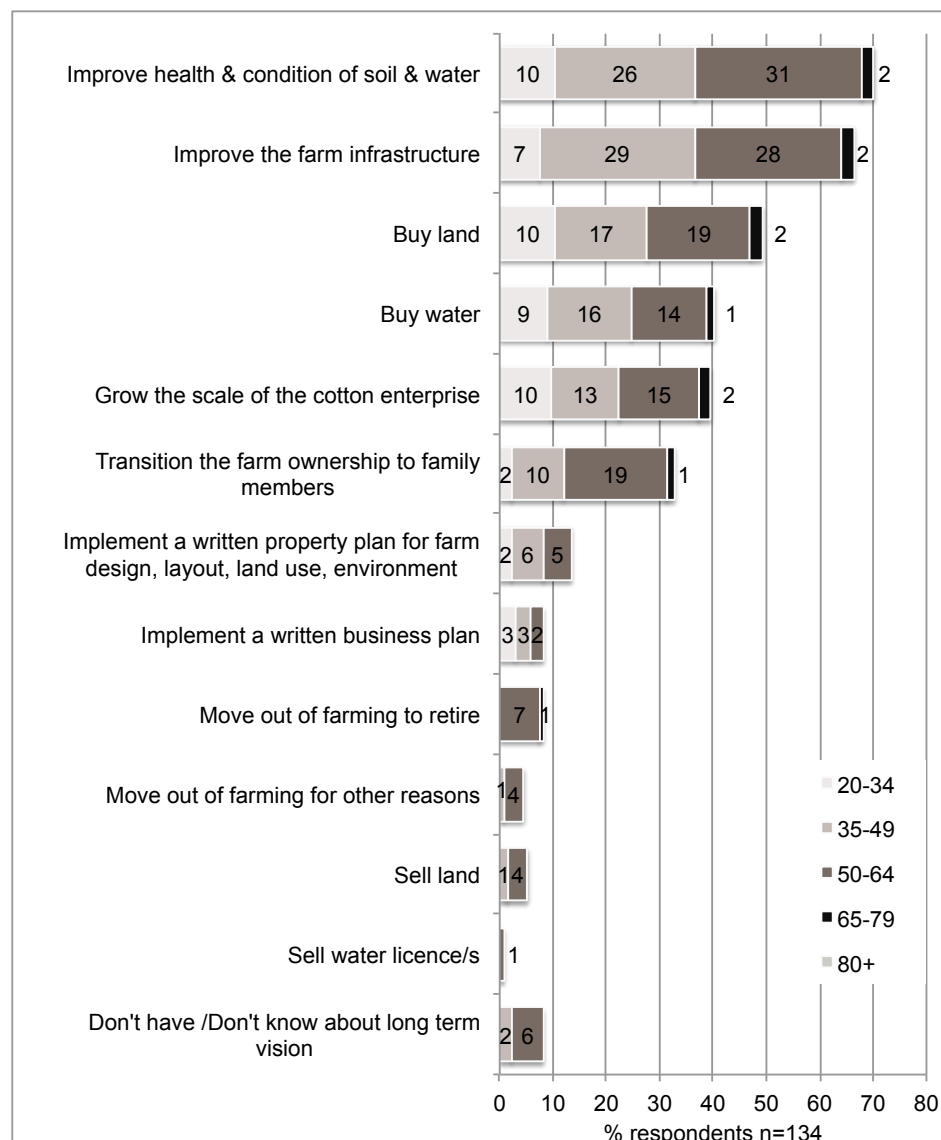


Please give your opinion on each of the following statements in relation to your cotton farming enterprise and the cotton industry

Aspirations for the future of the farming business

As part of the NCEA work on harvester decisions, they were interested to understand any differences based on future aspirations for the farm. For this purpose, the survey asked respondents to identify future plans for the farming business. Figure 60 illustrates that at least two thirds of respondents intend to improve their farm condition (70% of all respondents) and infrastructure (66%). Close to half intend to grow their farm assets and/or cotton enterprise, with 49% intending to buy land, 40% to buy water and 40% to grow the scale of the cotton enterprise. One third (33%) intend to transition the farm ownership to family members. 11% of respondents indicated they will move out of farming to retire or for other reasons, only one of these growers was under 50 years of age. There are no other strong correlations between age of respondents and their intentions. It is relevant to note that a number of the replies to the survey distribution (without a completed survey) were received from people on the cotton industry list who had retired from their cotton growing business prior to the survey.

Figure 60 Intentions for the future of the farming business by age of respondents



Which of these are a likely part of you or your employers' long term vision for this farming business?

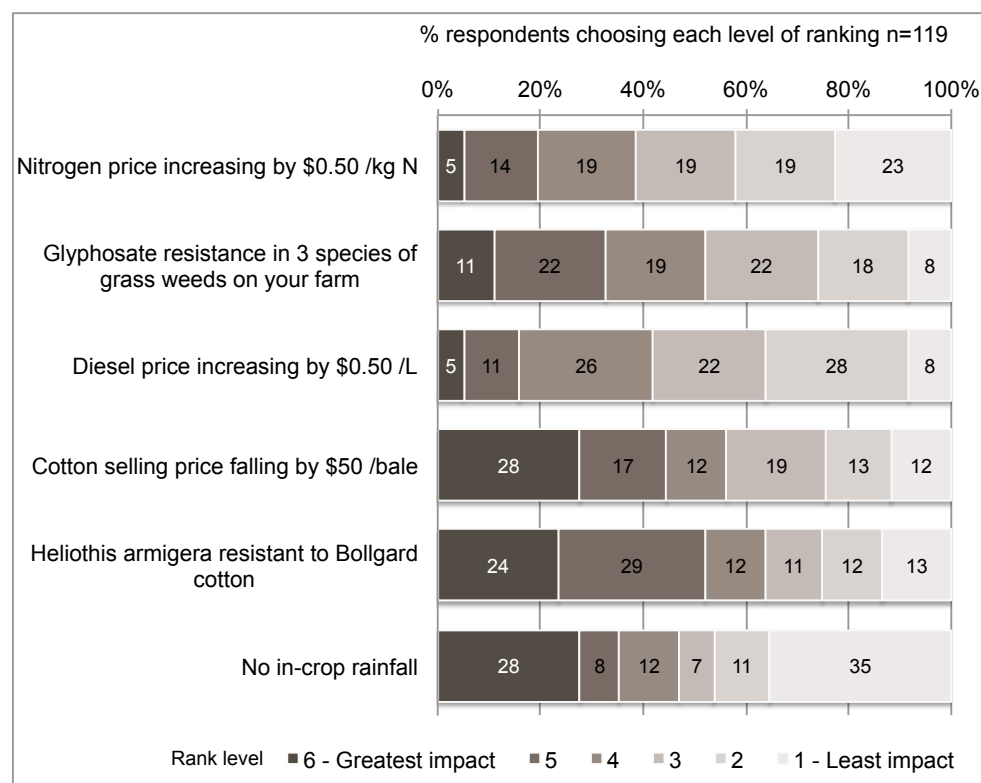
Influences on productivity and profitability

CRDC were interested to understand growers' view of the relative significance to profitability of a range of issues. Figure 61 illustrates highly varied views. It does show that the highest proportion of respondents (52%) felt that *Heliothis* resistance to Bollgard cotton would make the greatest or second greatest impact. The next most significant issue was glyphosate resistance, though the perceptions to this being mixed with 33% rating it as high impact (rank 5,6), 41% as moderate (rank 3,4) and 26% as least impact (rank 1,2).

The issue of no in-crop rainfall received was rated low impact (rank 1 or 2) by 46% and as high impact (rank 5,6) by 35%, possibly reflecting differences based on availability of irrigation water.

A \$0.50/L increase in diesel price received mostly moderate to low levels of impact rankings (76% ranked it as 2,3 or 4) as did an increase in nitrogen price of \$0.50/kg (81% ranking it 4 or lower).

Figure 61 Perceived impact on cotton gross margin of hypothetical scenarios



Of these 'hypothetical' scenarios, which would you expect to have greatest impact on your cotton gross margin? Rank in order of impact where 1 = least impact and 6 = Greatest impact

Limitations and drivers of productivity, profitability and high yield

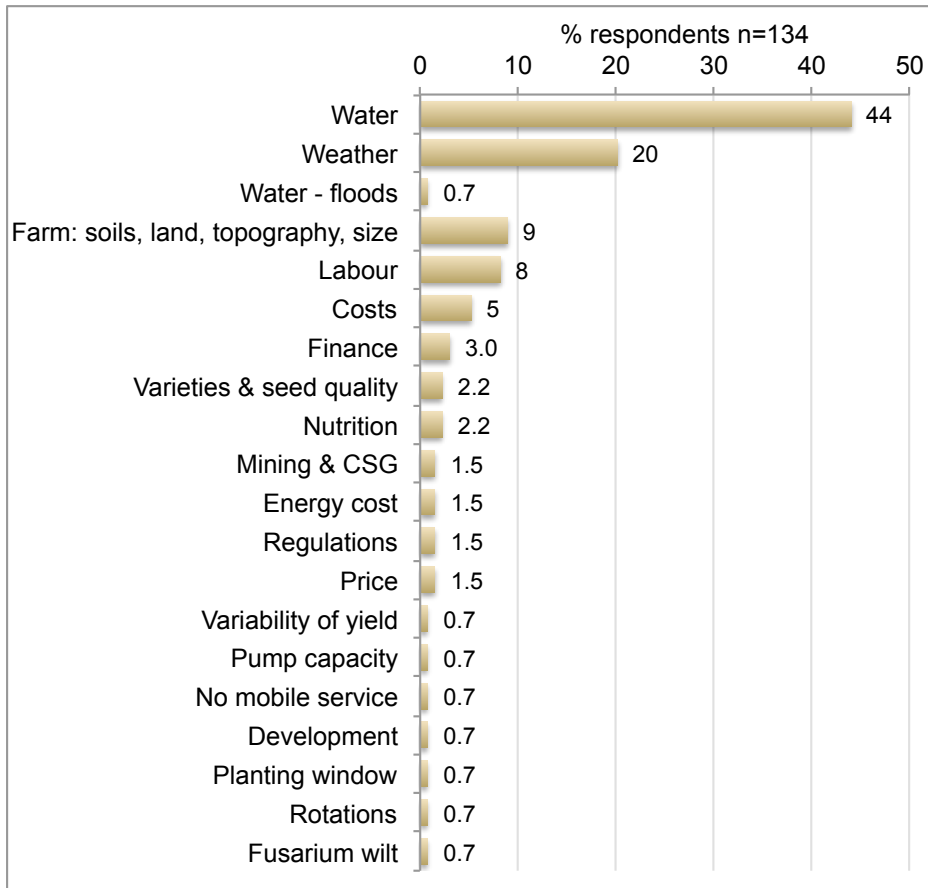
An open ended question was asked to identify respondents' views on the limitations and drivers of their cotton system. Clustered responses are depicted in the following graphs and individual responses are provided in Table 22.

Whilst several limitations to cotton production were identified, water and weather were by far the most frequently mentioned (Figure 62).

A greater variety of factors were identified by growers as the strongest drivers of profitability in their farm business (Figure 63). The three most mentioned were yield, price and water.

There was even greater variation in the factors thought to drive high cotton yields. Water and weather/seasonal conditions were again thought to be major factors. Management practices were also thought to be important, in particular the timeliness of inputs and operations (with timing of irrigations mentioned specifically), attention to detail and nutrition mentioned frequently.

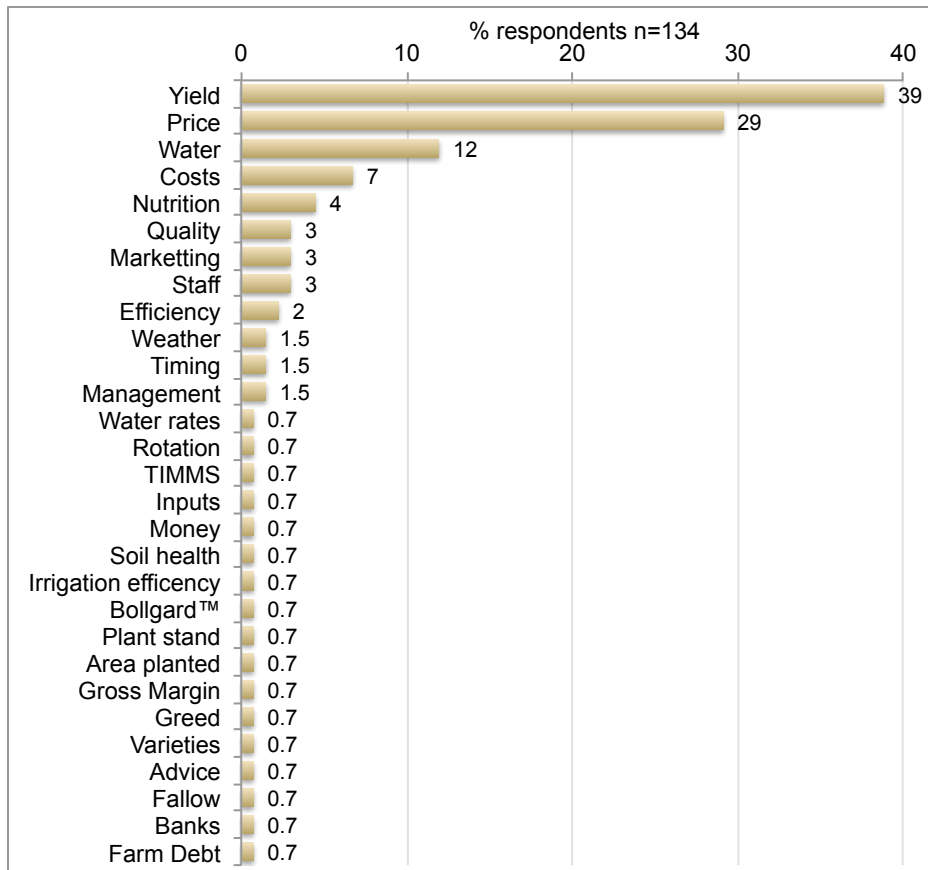
Figure 62 Biggest limitations to cotton production and profitability identified by growers



In just one or two words, please describe what you consider to be the biggest limitation to your farms' cotton production

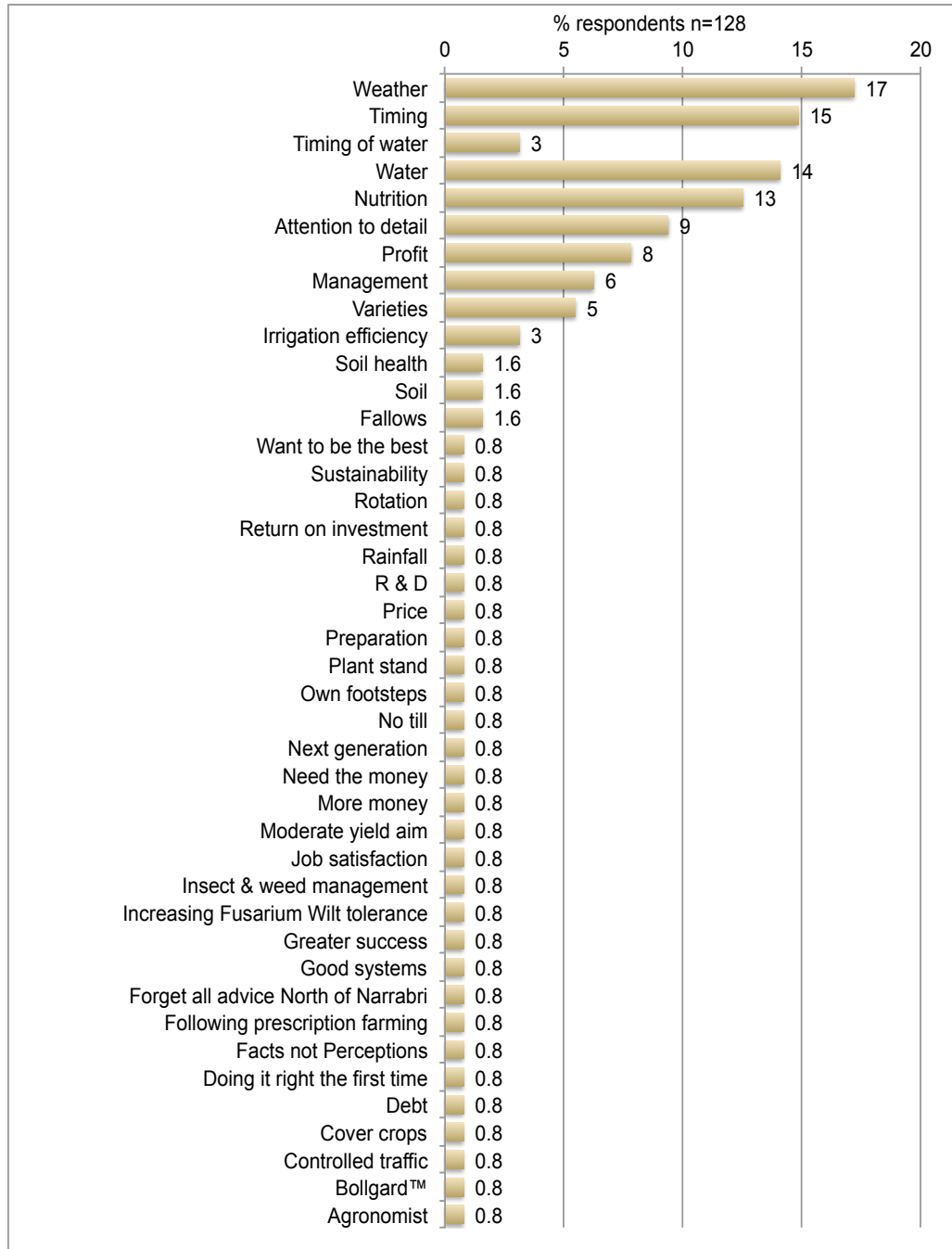
NB totals are greater than 100% as some respondents identified two issues

Figure 63 Strongest drivers of profitability from cotton in the farm business identified by respondents



In just one or two words, please describe what you consider to be the strongest driver of profitability from cotton for your farm business

Figure 64 Key reasons listed by respondents for achieving above average cotton yields



In just one or two words, please describe what you consider to be the key reasons for achieving above average cotton yields

Table 22 Individual responses identifying the limitations and drivers in cotton production and profitability

<i>In just one or two words, please describe what you consider to be</i>	the biggest limitation to your farms' cotton production	the strongest driver of profitability from cotton for your farm business?	key reasons for achieving above average cotton yields?
Central Queensland	Labour	Quality	Profitability
		Water rates	Water rates
	Labour	\$/Bale	Want to be the best
	Soil Type		
	Weather		
	Weather /planting window	Rotation	Weather
	Weather	Keeping costs down	Management
	Weather	Marketing	Timing
Red Tape	TIMMS		
Darling Downs	Land & Water	Yield	Profit
	Weather & Profitability	Price & yield	Attention to every detail
	Rotations/no zero fill	Price	Management, Rainfall
	End Price	End Price	Timing
	Nutrition	Nutrition	Nutrition
	Water	Cost down-price per bale	Fallows. Soil health
	Lack of Water	Increasing Yield	Management
	Water availability	Price & water	Nutrition & water
	Cotton Price	Returns	Good season and price
	World over supply of cotton. high costs in Australia	We can achieve good yields	Suitable soil and climate
	cost/ Ha	Yield	Fertiliser program
	Water, input costs	Quality, yield	Profit, sustainability
	Experienced labour	Quality not quantity	Try a moderate yield approach. Don't set standard to high
	Fusarium Wilt	Yield	Increasing Fusarium Wilt tolerance
	Rainfall/ Varieties	Yield and price	Timing
	Weather	Price for commodity	Varieties
	CSG expansion	Yield quality	
	Weather	Fertilizer/ water	
	Water	Water	Water
	Water	Inputs	Attention to detail
	Availability of water	Availability of water	Availability of water
	Nutrition	Money	More Money
	Moisture	Moisture, yield, price per bale	Cover crops, controlled traffic
	Water	Irrigation efficiency	Irrigation efficiency
	Energy costs	Soil health	Soil health and hygiene
	Southern Qld	Water	Water, fertiliser
Water		Yield	Doing it right the first time
	Soil type	Fertiliser	Timeliness
	No mobile service		
	Staff knowledge	Yield/ price	Get everything right
	Weather	Yield	Own footsteps
	Rain	Price	Good Soil
	Development	Yield	Profitability
	Water	Yield	Attention to detail
	Cost	Bollgard	No Till and Bolgard
	Rain	Plant stand /N	Plant stand/N
	Water availability	Cotton price	Fertiliser and timing of water
	Water	Input costs	Timeliness
	Weather	Yield	Water
	Weather	Yield	Water

<i>In just one or two words, please describe what you consider to be</i>	the biggest limitation to your farms' cotton production	the strongest driver of profitability from cotton for your farm business?	key reasons for achieving above average cotton yields?
Northern NSW	Seasonal conditions	Yield	Good systems
	Water	Yield	On time every time
	water reliability, seasonal variability	area planted, yield, price	relentless attention to detail in production system
	water	efficiency, price	Weather
	water	yield	attention to detail
	Water	Yield	R & D
	Government policies	40%marketing 40%production 20%costs	Management
	Rain	Rain	rain (moisture conservation at all times)
	Water	Water	Good Nutrition
	labour & timing	timing & labour	timing
	Cost of inputs, water, fertiliser, fuel etc	Gross Margin	Varieties, good season with water
	last couple of years has been the weather	Yield	Right water, nutrients and a bit of luck with weather
	Soil chemistry	Yield	Climate, Nutrition, Water
	Water	Price/ marketing	Basics right
Topography and water	Improving Yield	Water application, fert needs	
fertiliser efficiency	cost control	water timing	
Water & weather	cost, yield, price	Next generation & debt	
Water	Yield	Attention to Detail	
Age of workers	Myself	Some good seasonal data/ weather	
good labour	greed	need the money	
Water	Yield	Fertiliser	
Water Availability	Water Availability	irrigation timing applications	
Water/ Rainfall	New Seed varieties	74BRF Seed	
Bore Yield	Cotton Price	The Weather	
Finance	Yield and Price	timing	
Water use efficiency	Yield efficiency	Attentionn to detail with operations and watering	
Water security	Price	Water management	
Water	Lastest advice		
	Yield	Timing /Luck	
Flooding	Yield	Attention to detail	
Water	Water	Water	
Trained labour OHS	Cotton prices	Seasonal conditions	
Water	Yield	Timing	
Workforce	Cotton price	Rainfall (dryland) , Insect management, weed control, fallow management	
water	Improving yields	Improved varieties	
Water	Higher yields	Good weather- high yielding varieties	
Water	Yield	Greater success	
Costs	Yield and price	Good management	
Land availability	Fallow land	Profit	
water	water	timing	
Soil moisture	Soil moisture	Liquid Nutrition	
Coal and Coal seam Gas	Yields and prices	Management and Varieties	
water, varieties	cost of production	timing	
		weather	
Weather rainfall	Commodity price	Timeliness farm practices	
water	banks	water use efficiently	
soil , weather	staff	Management	
water availability	yield	timely irrigation	

<i>In just one or two words, please describe what you consider to be</i>	the biggest limitation to your farms' cotton production	the strongest driver of profitability from cotton for your farm business?	key reasons for achieving above average cotton yields?
	Water	Yield	Season
	water, weather conditions	water , fert	as above
	Season variations	Weather	Mild summer moderately wet
	diesel cost	prices	new practices
	Area	?	Fertiliser, water
Macquarie	Skilled labour	Yield	Task timing and seasonal conditions
	water	yield	being on time
	Water	Yield	Preparation
	Water Availability	Yeild	Attention to detail
	Water, weather	Efficiency	Attention to detail
	Water Reliability	Yield, Price	Water and Nitrogen
	Water availability	Yield Price	Profit Drivers
	Capital	Profit	Profit
	Water	Price	Drip Irrigation
	Seasonal variability	Yield and price vs costs	profit
	water	water	weather(sunlight)
	size, water availability	price bale	climate/ seasonal conditions and water availability
	size, water availability	price / bale	climate /seasonal conditions & water availability
	Water	Water	Water
	Water profits		
	water	people	timing
	water	team work	weather
	water	water	nitrogen
	Water	Yield	Return on investment
	water	yield/ price	income
	water	Yield is King!	Procedural timing in all operations
	labour	price	water/seasonal/ seed breeding
	Water	Cotton price	Season
Southern NSW	Water	Price	Facts not Perceptions
	Climate / water	High yields / prices	Having water available
	\$, Water	Management	Following prescription farming
	Increasing costs	Price and Yield	Rotation
	Hardforming variabilty of yields		
	Layout	Farm Debt	Job satisfaction
	Water Knowledge	Yield	Good Agronomist need a Cotton Bible
	Sufficient cashflow	Timing	Timing and water management
	Farm size	Marketing	Profit
	Sodic soils	Water availability	Timely inputs
	seed quality . summer warer pump capacity	Price	Forget all advice North of Narrabri
	Weather	Cost per ML	Good conditions and hot summer

Additional comments

26 respondents made additional comments about further research and information. These are collated in Table 23. Whilst these have been clustered according to themes it should be noted that comments were made about the need to better understand the relative importance of these.

“Soils, energy efficiency and pumps , water use efficiency - where do I get the most benefit? Should I concentrate on one or try to do all together. Cost is a consideration.”

“Energy efficiency; Fertiliser application - type, amount & timing, research; Staff efficiency. These are our three biggest costs.”

Table 23 Suggestions for further research or information from CRDC

Theme	Comment
Crop Protection: Weeds	We badly need 'Liberty' available to manage weed resistance and should be mandatory - research needs to be done on benefits to industry of rotation of RR and liberty as is done with Canola in Canada Fleabane control
Stewardship: Resistance management	Refuge area to be reduced for RRF crops to 5% Refuges 5% unsprayed Cotton versus 5% Pigeon peas? The % of refuge in Dryland crops is too high- 5% would be acceptable We need to greatly improve the process of pupae busting and removal of crop residues for Dryland Growers- ie: less tillage operations to achieve a results
Resource efficiencies: Soils & Nutrition	I would love to be able to combine sulphur which is available readily with Starter Z. This season I have used sulphate ammonia-gran am 60-40% blend. A lot of bulk Fertiliser application - type, amount & timing, research Soils The industry needs to get off the Methadone program (excessive nitrogen use) Slow release Urea products, is the extra expense worth it? Manure - fact or fiction, application issues, type of I think there still needs to be more research into soil biology- soil microbes and how they process nutrients. A lot of how soils work is still misunderstood. Nitrogen recipe for variable seasons
Resource efficiencies: Energy	Alternative energy subsidy Energy efficiency Energy efficiency and pumps On farm Biodiesel plants or gin located, some in USA
Resource efficiencies: Tillage	Look at better methods to treat cotton stubble breakdown, eg biological spray to improve decomposition of the cotton plant into mulch.
Resource efficiencies: Water	Bankless channels Water use efficiency (x2) Saving labour in water methods eg: Bankless channels
Harvesting	We currently use controlled traffic at 12 metre centres thus 8 metres as suggested does not fit. 6m picker is used and 6m side buster (6x40' Rows) Round Module picker compaction and longterm effect on yields and sustainability
Fibre quality	Weathering of cotton lint in field ie, when best to harvest after rain.
People	Staff efficiency Employment Training for Cotton farming; OHS Training courses for Cotton business
Policy	Government interference effecting profit i.g. water controls, vegetation control etc. There is no National energy policy into the future! Very Political but someone needs to drive it before it becomes a crisis. Natural Gas may be fertilizer piggyback - N2
Research and communication	Applications for mobile/ ipad Cotton research must stay @ the fore front of every cotton grower thinking , without the research and tools to maintain cotton production we are doomed. Increasing costs vs yield/price diminishing Aussie cotton has excellent Aussie researches Cotton Bible - All Elements Required for a top Crop from the Soil to the Bale. More focus on growing Cotton South of Narrabri Where do I get the most benefit? Should I concentrate on one or try to do all together. Cost is a consideration

Table 24 Other comments about cotton production, profitability and research

Planting	Planter accuracy testing (Metermax checks)
Varieties	<p>The Cotton Variety improvement in the last ten years is astonishing</p> <p>Cotton Industry needs to put more time and money into conventional RRF Varieties</p> <p>Sicot 74 BRF has been a large step forward for our Dryland cotton production</p> <p>Cotton resistant to 2,4D</p> <p>Need shorter season varieties - Continued Research</p>
Water	<p>Grow on less water/ha without reducing yield.</p> <p>Water charges from State Water need to be addressed</p>
Weeds	Resistant Barnyard grass & fleabane in irrigation
Biotechnology	<p>Cotton production profitability would dramatically increase if Bollgard licences were decreased</p> <p>Bt costs in low cotton price years under \$450. \$50 a bale when cotton is \$260 is too much for Dryland and yields of 3.5-4 bales Ha</p> <p>Pupae Busting and ground cover conflict</p> <p>Unsprayed conventional cotton in strips across fields is the most effective refuge</p> <p>Keep promoting biotechnology as beneficial for the Cotton Industry</p> <p>Monsanto are reducing profitability for the farmer</p>
Energy	We can be some of the most efficient producers in the world but we need to reduce our energy costs to stay competitive.
Soil	Soil health and profitability are a key consideration in our business but Southern Cotton Farming is challenged by environmental (wet) risks and decisions on timing can over ride soil health and environment in favour of profit
Harvesting	<p>The sleeping giant of the cotton industry at the moment is compaction from the 7760 pickers, it is starting to show up in yields after 3yrs of use</p> <p>Cotton wrap needs to be cheaper</p>
Ginning	The whole Ginning process is an antiquated process . It needs to be online, transparent increase efficiency or let us send it to China to be Ginned
Seed value	Need to get better value from the cotton seed we produce. Investigate ways to either value add from the current form of the cotton seed or breed better traits into the cotton seed in order to get better returns
General	<p>Its great to see research happening</p> <p>Finally, I thought I would never finish this survey!</p> <p>The Cotton Industry is light years ahead of the Grain and Livestock Industries</p> <p>The Australian Cotton Industry has remained profitable almost exclusively by its research efforts in, increased yields, fibre quality and all other agronomic pursuits ie; N, P trials etc</p>



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Appendix B

Project Report

**2013 Grower Survey of
Cotton Farming Practices
and
Regional Workshops to
Identify Research Issues**

RRR 1201

Report of the Data Review and
Think Tanks

July 2013

for the Cotton Research & Development Corporation

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Executive summary

In completion of Milestones 2.1 this project has:

- Convened 11 ‘Think Tank’ workshops involving 140 participants (73 growers, 37 agronomists and 33 industry) to identify local issues for research and / or extension. These were arranged in collaboration with the Regional Deliver Officers for:
 - Central Queensland
 - Darling Downs
 - Macintyre
 - St George
 - Gwydir
 - Lower Namoi
 - Breeza
 - Boggabri
 - Macquarie
 - Southern
 - Wincott
- Prepared a “Snapshot of Cotton Practices” drawing together data from Grower, CCA and Environmental Audit surveys and other sources. This was used during the Think Tank workshops and, on suggestion of a few growers, posted to all growers with the 2013 Survey.
- Circulated the regional Think Tank meetings notes back to all participants, generally within a week of the meeting.
- Collated issues from all Think Tanks and provided these to CRDC.
- A wide range of issues were raised at the Think Tanks with key ones explored in more detail. It is important that the full detail is reviewed. For example, whilst some broad issues were raised several times, within each there were many quite specific, thought out queries that came from different meetings. Similarly, there are several novel ideas that may have only been raised once or twice but could potentially be of real value for the future.
- Some of the most often mentioned issues included:
 - **Nutrition** - including the efficient timing and application of fertilisers to minimise losses and optimize efficiency. Interactions between nutrition, plant growth, root development, soil condition, field history, water, testing of requirements.
 - **Managing stressed crops** – heat stresses, water shortages and/or waterlogging. Optimising the economics of recovery strategies, reassessing yield targets.
 - **Crop growth management** – better understanding the impact of growth regulators in different seasonal conditions at different growth stages. Understanding the interaction of plant growth management with nutrition and water.
 - **Agronomy matched to irrigation** systems and decisions
 - Continue to seek ways to **reduce losses from water storages**
 - **Managing herbicide resistance** and **volunteer RoundupReady Cotton**
 - **Alternatives to pupae busting** and **alternative refuge options**, particularly in dryland. Planting window.
 - **Understanding the factors driving high yielding cotton** fields or patches in a field.
 - **Extension and packaging** of older and current research.
 - **Local trials.**

The following recommendations are made as a result of the work to date:

Think Tanks – Next steps

1. Communication of Think Tank findings.
2. Consider the Think Tank issues in review of the Preliminary Research Proposals and fill gaps
3. D&D team convene small group meetings annually to review local RD&E issues
4. Review of Think Tank findings with Cotton Australia panels
5. Develop extension strategies at a local and/or national level to address the technical issues and the preferred extension methods raised at the Think Tanks

Cotton Practices Survey 2013 – Next steps

6. Encourage growers to complete the survey
7. Communicate survey findings

Technical recommendations

8. Convene a nitrogen X soils forum and develop a strategic nutrition initiative
9. Increase industry and scientific knowledge of the interaction between cotton physiology, crop management and climatic conditions
 - a. Technical review of current knowledge on the management and impact of growth regulators in cotton, including farm case studies.
 - b. Compile a series of economic case studies on the management of stressed crops, supported by an overview drawn from the science.
 - c. Deliver regional training opportunities eg local trials, Physiology Masterclass, etc.
10. Research and extension effort to investigate the management options for Volunteer RoundUp Ready cotton
11. Continue the extension campaign on herbicide resistance
12. Implement regionally based, nationally coordinated trials to address the key issues raised.

Data review

A review of existing data on industry practices was completed in order to prompt discussion at the regional meetings and in planning the 2013 cotton grower survey.

Two elements of data review were completed:

Tracking change in the Australian Cotton Industry: An overview of surveys and data sources. – attached as Appendix B1

This was prepared to help identify the various surveys that have been conducted by cotton industry organisations. There would be more surveys conducted by the private sector and by specific projects.

The industry surveys were conducted by a range of providers and some have not been fully published. For the Grower surveys prior to 2011 the raw data is not available.

Cotton Practices Snapshot - images of this report are attached as Appendix B2.

Further analysis of 2011 Grower Survey data was undertaken and combined with data from other surveys and projects.

The initial data compilation was prepared to stimulate discussions in the Think Tanks. Comment from some of those meetings was made that it would be good to distribute this information to all growers. It was therefore decided to distribute a copy of this data snapshot together with the 2013 survey request. Input from CRDC and Cotton Australia developed the version that is attached.

Regional workshops – “Think Tanks”

Discussions with Cotton Australia commenced in Autumn 2012 about the potential of holding these meetings with Cotton Grower Associations. It was agreed to postpone the Think Tanks until Autumn 2013 so as not to conflict with the workshops conducted by Cotton Australia in winter 2012.

The CottonInfo Development & Delivery team saw an opportunity for the Think Tanks to help in their local planning processes and kindly offered to organize the Think Tanks for their local regions. This partnership worked well. We are very grateful to the Regional Delivery Officers (RDO) for their help and enthusiasm in arranging the Think Tanks. Explanatory notes were provided, attached as Appendix B3.

A total of 11 Think Tanks were held between March and June 2013 - well exceeding the original plan for 7 regional meetings. Table 1 lists the dates of the Think Tanks and the participants in each meeting. Think Tanks were facilitated by either Ingrid or Guy Roth and organised by the local RDO. Cotton Australia advisory panel members were all personally invited to their local meeting and in many cases were consulted with to arrange the meeting date. In Central Queensland the process formed part of the forum for their local project (CQ Limitations Assessment) and was arranged by the CHCG&IA together with Susan Maas (CRDC). In addition, research issues identified at the Walgett Field Day were provided by Tim Weaver (NSW DPI) and have been included in the collation of issues. The Wincott meeting was added following a request by Sally Dickinson.

The Think Tanks were run as an open discussion forum to identify local issues. There was a request to provide an overview of the research planning process and so we worked with Tracey Leven (CRDC) to prepare an outline of CRDC’s planning timeline (Appendix B4) and spoke briefly to this at the start of each meeting.

We then asked an open question of “what are the key issues for RDE”. (In larger groups participants were asked to write down their top 2-3 idea before the discussion commenced, a strategy to encourage all voices to be heard and ensure ideas were captured) We explored these and other issues further using the Cotton Practices Snapshot to further prompt discussion of the issues and to progress to discuss other issues. Think Tanks generally involved 2 hours of discussion.

Table 1 Think tank dates and participants

Region	Date	Panel Rep.	Growers	Agonomists	Other	Apologies (some input prior)	Convenors
Gwydir	18 March	Tony Bailey (Apology Hugh Ball)	Michael Seery Stu Doyle Rob Holmes Nick Gillingham Mike Stone			Angus Doolin Simon Doolin Will Kirkby Stu Gall Doug Marshall	Ingrid Roth Sally Dickinson
Southern	4 April		Gavin Dal Broi, Mark Williams, Scott Hogan, Rob Houghton, Mick Storrer, Matt Mitchell, Peter Toohey	Alan Jones, Michael Taylor, Steve Phillips, Nick Hutchins, Jorian Milliard, Pat McGuinness, Tom Webb, Mat ?, Chris Andigetto, Heath McWhitter, Richard Malone	Rob Hoggers, Carlos Rahme, Jennifer Moffatt, John Sykes, Brian Halse, Linda McKellar	James Hill, Tim Commins, Keith Burge	Guy Roth, Keiran O'Keefe
MacIntyre	9 April & 1 May	Nigel Corish, Tony Taylor	Toby Makim	Helen Crossley, Brendan Griffiths, Tim Richards, Fred Ghirardello	Bec Fing, Amy Billsborough, Sall Dickinson, Robert Mensah		Ingrid Roth, Alice Devlin
Breeza	11 April		Angus Duddy, Jamie Burt, Rod Grant, John Hamparsum, Gordon Brownhill, Ian Carter, Craig Charters, David Ronald	Jim Hunt, Aaron Goddard, Mark Goddard, Dwayne Schubert, Carol Sanson, Kim Duver	Sandy Young	David Brownhill, Rod Smith	Kirily Blomfield, Guy Roth, Hosted by John Hamparsum
Central Queensland (Emerald)	16 April	Neek Morawitz, Damien Erbacher	Nigel Burnett, Andrew Geddes, Graham Volck, George Sypher, Andrew Keeley, Sam Millar, Peter Galea, Catherine Galea, Dougall Millar, Rob Ingram, Craig Barsby, Chris Ryan, Chris McCullagh, Ross Burnett, Hamish Millar	Graham Spackman, Jamie Iker, Amanda Noone, David Parlato, Ellie Hampton, Darren Young, Stewart Brotherton	Paul Grundy, Mike Bange, Stephen Allen, Steve Yeates, Lance Pendergast, Duncan Weir, Geoff Hunter, Geoff McIntyre, Gail Spargo, Greg Kauter, Guy Roth, Liz Alexander, Renee Anderson		Cameron Geddes, Susan Maas, Ingrid Roth
Wincott	1 May	n/a	Alison Benn (St George)		Michelle Smith (Goondiwindi)		Sally Dickinson, Ingrid Roth
Macquarie	14 May	Bill Tyrwhitt	Brett Cumberland, Ben Egan, Rob Tuck, Sally Quigley, Barry Dugan, Gus O'Brien, Stu Denston, Sinclair Steele	Craig McDonald, Ryan Pratten, Dave Klaare, Andrew Cooper, Claire Jenkins, Christie Chapman	Sally Ceeney, Julie Wise, Bob Ford, Luke Sampson, Cathy Hertel		Ingrid Roth, Amanda Thomas
Lower Namoi	21 May	Andrew Greste, Phil Firth	Amanda Gilmour, Rob Eveleigh, Katrina Murray, Mike Carberry,		Claire Welsh	Matt Norrie	Sandy Young, Geoff Hunter, Guy Roth
St George	22 May	Glenn Rogan	Kent Benn, Alison Benn, Jaye Bonthron, Jane Hill, Bec Lindert, Hamish McIntyre, Ian Brimblecombe, Richard Ross, Jason Speedy, Cleave Rogan, Scott Armstrong				Sally Dickinson, Guy Roth
Darling Downs	19 June	John Cameron	Greg Bender, Glen Fresser, Jamie Grant, David Walton	Liz Lobsey	Marie Louise Offner, Duncan Weir		John Smith, Guy Roth
Boggabri	20 June		Peter Watson, Darren Eather, Chris Goulden, John Watson, Simon Kearney, Brendan Warnock, Thomas Swain, Mark Hamblin, Andrew Watson	Rob Weinthal, Chris McCormick	Sandy Young	Rod Smith	Kirily Blomfield, Geoff Hunter, Guy Roth (hosted by Peter Watson)

Reporting of regional issues identified

The notes of each meeting were returned promptly to participants for comment. The issues identified in each region were collated into an excel spreadsheet as requested and coded against the new CRDC Strategic Plan (2013-18). This spreadsheet has been provided separately to CRDC.

A summary of key issues is presented in Table 2. **It is important that this summation is read together with the full collation as it contains considerable detail. Many issues were raised in several regions, often with differences in the detail of the queries.**

Notes from each of the think tanks are attached as Appendix B5 and the spreadsheet has been provided to CRDC. Each issue has been coded to fit into one CRDC Strategy – many would easily fit into several.

Communication

Think Tanks were held with the intent that the ideas put forward by growers would be communicated to CRDC and Cotton Australia for planning and to researchers to help them in understanding regional views to help shape their current work or in developing new project proposals.

Attendees at regional Think Tanks were provided with a copy of the notes of their local meeting (generally within a week) and given the opportunity to provide further comments/corrections.

It had been intended that the issues identified by the Think Tanks would be communicated to the Cotton Australia panels in time for their May meeting and to researchers in time for consideration in developing PRPs. However, a meeting with CRDC (Paula Jones and Susan Maas) and Cotton Australia (Greg Kauter) determined that communication to the panels would be delayed until the August meeting with a CRDC response and that communication to researchers would be by CRDC in a refined format at a later date.

As directed, we have provided the information only to CRDC and Cotton Australia. We have had several queries about the information which we have either discussed or referred to CRDC.

Appendix B1 Tracking change in the Australian Cotton Industry:

An overview of surveys and data sources – WORKING DRAFT

Ingrid Roth & Guy Roth

October 2012

CRDC Project RRR1201: Grower Survey Cotton Farming Practices & Grower Workshops

Surveys of the cotton industry are undertaken regularly for a wide range of reasons, including:

- Measuring adoption of key practices
- Monitoring change over time – to justify & target RDE investment
- Identifying key issues and concerns faced by growers and industry members
- Targeting research and extension efforts
- Measuring the impact of research and extension investments
- Market intelligence
- Specific research projects.

Surveys are undertaken by and for industry organisations, research projects and the commercial sectors.

Following is a draft listing of the surveys undertaken in the cotton industry. This aims to provide an overview of the data sets collected (and possibly available).

It is not comprehensive and in particular we have not identified the many surveys conducted for commercial sectors. **Please add and edit where possible, thanks.**

Surveys are rarely popular! The information collected is valuable to the industry. However, growers are often frustrated by the need to complete more surveys.

This may be because:

- There are many, uncoordinated surveys, sometimes operating at the same time.
- Surveys are time consuming
- Feedback is limited
- Question design
- Survey conduct eg Interviewers not familiar with the industry.

Cotton Census?

A single, coordinated “Cotton Census” survey of cotton growers conducted on a regular basis instead of the multiple, ad hoc surveys could have better response and less demands on growers.

This could be designed by/for Cotton Australia, CRDC and others to meet their particular needs. There is potential to involve agchem sector to reduce their surveys – and potentially provide fundings and/or incentives for grower participation.

CRDC have allocated funds for a grower survey to be conducted again in 2013 by Roth Rural.

This will help to identify key variations in practice, adoption of technologies and potential areas to focus RDE efforts. It could be the first Cotton Census.

INDUSTRY SURVEYS of GROWERS

Survey	Year	Respondents	Provider / Author	Investors	Purpose	Yields, quality	Crop protection	Water	Soils, nutrition, farm systems	Labour, HR, skills	Environment	Financials	Communication	Issues & priorities	Notes
Cotton Australia Grower survey	2012	Growers	Cotton Australia	Cotton Australia	Strategic planning								*	*	
CHCG&IA Grower survey	2012	CQ Growers	CHCG&IA + I Roth	CRDC	Limitations assessment, RDE needs, management	*	*	*	*					*	Underway, surveys being gathered by CQ interview team. Led by Tech Committee of CHCG&IA
Environmental Audit	2012	Growers Stakeholders	Inovact	CRDC	Environmental Audit		*	*	*		*				
Grower Survey	2011	Growers	GHD (I Roth) with Cotton D&D team	Cotton CRC CRDC	Measuring adoption for economic impact assessment of CRC Planning RDE	*	*	*	*	*			*		For Cotton CRC targets Revisits some Qs from 2006/7 183 responses
Soils & Nutrition Grower Survey	2010	Growers	D Weir	Cotton CRC CRDC					*						
Grower Survey	2008	Growers	Western Research Institute + CCA	Cotton CRC CRDC	Tracking change Planning RDE	*		*		*					Growers, Employment, Technology, BMP, Climate change, Training, OH&S 79 responses
Grower Survey	2007	Growers	Western Research Institute + CCA	Cotton CRC CRDC	Tracking change Planning RDE	*	*	*	*	*	*		*		You & your farm; Your consultant; Farming Practices 76 responses
Grower Survey	2006	Growers	UNE + CCA (B Doyle)	Cotton CRC CRDC	Benchmark of farm practices at start of 3 rd CRC	**		*	*		*		*		BMP Land & Water Role of consultant 122 responses
IPM & Area Wide management Focus	2001 1997?	Growers, research,	J Coutts, I Christiansen &	CRDC, Cotton CRC	Attitudes to IPM & extension		*	*					*	*	Focus groups conducted by extension team

Survey	Year	Respondents	Provider / Author	Investors	Purpose	Yields, quality	Crop protection	Water	Soils, nutrition, farm systems	Labour, HR, skills	Environment	Financials	Communication	Issues & priorities	Notes
group study		extension	extension team		needs										
Cotton Industry Benchmark Survey	2000 (published 2002)	Growers	Cotton CRC Extension (McIntyre et al)	Cotton CRC CRDC											Reported in 2002 Cotton conference proceedings
Cotton Industry Benchmark Survey	1997 (published 2000)	Growers	Cotton CRC Extension (Inglis, Shaw)	Cotton CRC CRDC	Benchmarking		*		*				*		To benchmark level of adoption CRC, focus on soils & systems CRDC Occasional Paper 2000
Gwydir & MacIntyre valley cotton survey	1995	Growers in Gwydir & MacIntyre	Cotton Extension (D Gibb)	Cotton CRC CRDC			*	*	*					*	Summary in the 2000 report
Macquarie Valley Benchmark survey	1993	Growers in Macquarie	Cotton Extension (J Holden)	Cotton CRC CRDC	Benchmarking, extension planning										Summary in 2000 report
BOYCE Comparative Analysis	1995 – 2012	Growers: Boyce clients + extras	Boyce Chartered Accountants	CRDC, Boyce	Financial performance, RDE targeting	*	*	*	*	*		*	*		Not annual. Paused from 2007 - 2011
Disease surveys	30 years	Farms	Pathology team: CSD; NSW DPI; QDAFF	CRDC	Monitor for disease occurrence										Disease focus, also collect data on plant date, variety, use of seed treatments, volunteers
CSD Variety Trial database	Annual	Variety trial cooperators	CSD	CSD	Variety performance & management	*	*	*	*						Individual field data incl performance & management
Emerald Cotton growing survey	1981-82	Growers	I Brimblecombe B Pyke		ID cause of low yields	*		*	*						

Additional analysis

Report	Year	Respondents	Provider / Author	Investors	Purpose	Notes
Bollgard comparison report	2006-07	Drawn from grower & consultant surveys (some specific questions added to those surveys)	WRI + CCA	Cotton CRC & CRDC	Performance of the GM technologies	Further analysis of previous years' grower survey & consultant surveys. Some specific additional questions/survey was provided with the other surveys for the Bollgard experience.
Weed management & Roundup Ready	2004-05		UNE + CCA	Cotton CRC & CRDC		
Bollgard experience	2004-05		UNE + CCA	Cotton CRC & CRDC		
Impressions of extension in the Australian cotton industry	2004		UNE	Cotton CRC & CRDC	Extension review	

COTTON CONSULTANT SURVEYS

The CCA have surveyed members since 1988. These were initially market audits, sold to the agChem companies as the major source of income to fund CCA activities. More recently the CRDC / Cotton CRC have been the major investor in qualitative surveys of farm practice.

Survey	Year/s	Respondents	Author	Investors	Purpose	Yields, quality	Crop protection	Water	Soils, nutrition, Farming Systems	Labour, HR	Environment	Financials	Communications	Issues & priorities
CCA Market Audit / Quantitative survey	Annual since 1988 (not 2011?)	CCA members	CCA + survey partner^ + CCA survey director (Dave Clark, Nick Barton, et al)	Initially AgChem Co's	Product use market intelligence (for Agchem); Tracking trends (CRDC) Core funding for CCA operations	*	*							^ In several years CCA contracted the survey design & analysis: Dave Clarke (CCA director) to 1999 2000- Pieter Kwint 2001-2006 B Doyle UNE IRF 2007 Western Research Institute CCA now via Agworld lite Guy has data back to 1995/96 season, electronic data sets since 2000.
CCA Qualitative survey	Annual since ~ 2005?	CCA members	CCA (Fiona Anderson) + Helen Dugdale	CRDC Cotton CRC	Tracking trends in management practices & adoption	*	*	*	*				*	Previously design/analysis by B Doyle UNE IRF then Western Research Institute. Now managed by Fiona Anderson (CCA) with analysis/presentation by Helen Dugdale (for CRDC) Most useful for crop protection (ie core issues that consultants advise on)
Review of Employer Succession and Professional Development Needs in the Agribusiness Sector	2012	Agronomy firms, advisers, large farms	Gordon Stone	CRDC 12013	Assess professional development & personnel needs					*	*	*		Focus is on the agronomy sector. Collected through interviews

PROJECT SURVEYS

A number of research & extension projects have undertaken surveys wither as a core part of the research or for evaluation of the project or program.

These may have surveyed a cross section of industry, regional sectors, project participants or core stakeholders.

NB This list is not comprehensive.

Survey	Year/s	Respondents	Provider	Investors	Purpose	Yield, quality	Crop protection	Water	Soils, nutrition, Farming Systems	Labour, HR	Environment	Financials	Communications	Issues & priorities
Innovative work: Cotton workforce development for sustained competitive advantage	2012/13	Growers	Uni Melbourne R Nettle	CRDC	Understand human capacity in the cotton industry					*				Local interviews + analysis of census data
CRC UWA Student	2011	Lower Namoi Growers	Alison Wilson	Cotton CRC	Model productivity & socio-economic implications of changing water allocations			*						
Namoi Groundwater management	2011	Groundwater users in Namoi catchment	CSU A Curtis, E Sharp et al	Cotton CRC 3.01.05	Building trust between agencies & communities			*					*	210 responses (54%) Namoi catchment Measured trustworthiness of agency and staff
Namoi Groundwater monitoring	2009	Groundwater users in Namoi	GHD Hassall (I Roth) as part of UNSW WRL project	Cotton CRC	Understand current practice and future desires for groundwater monitoring & communication			*					*	Phone interviews of groundwater users followed by 2 workshops
Qld RWUE surveys		Irrigators / project participants	Coutts/ QualData did several of these		Project evaluation			*						
Storages measurement survey	2009-2011	Growers participating in project	David Wigginton + GHD	National Water Commission	Project evaluation			*						

PUBLIC SURVEYS

There are a number of surveys conducted that are broader than the cotton industry but do provide some information of relevance.

At a higher level these include the:

- Census, five yearly, last was 2011
- Agricultural Census, five yearly, latest was 2011 <http://www.abs.gov.au/websitedbs/c311215.nsf/web/Agriculture+-+Agricultural+Census>
- ABS Water use on Australian Farms – reported from the Ag census
- Agriculture Resource Management Survey (ARMS)
- Land Management Practices Survey (LAMPS) – 2011-12 is first time – for Carbon farming initiative
- ABS Environment & Agriculture survey - currently under review

Regional NRM bodies have also undertaken some surveys, etc.

CORPORATE SURVEYS

Whilst agchem companies had invested in the CCA survey, they also commission independent market research. We have little information on these to date.

Survey	Year/s	Respondents	Provider	Investors	Purpose
Syngenta	2011	Growers			Yield, quality Crop protection Water Soils, nutrition, Farming Systems Labour, HR Environment Financials Communications Issues & priorities

Table 2 Summation of key issues raised in Think Tanks mapped to CRDC Strategies

Farmers

Successful Crop Protection

Shading indicates region/s where the issue was raised

Issue	Questions	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
DISEASE													
Verticilium Wilt	Management options (non-breeding) Why is it getting worse? Influence of soil, climate and water quality?												
Early season diseases; Black Root Rot	Best practice for establishment re Rhyzoctina, pythium, BRR? Impact of Black Root Rot on earliness. Threshold levels and implications.												
Fusarium	New options eg Bioremediation												
INSECTS													
Whitefly	Confidence, understanding, local thresholds relating to honeydew impact on quality & how best to manage												
Thresholds	Cumulative and combined pest thresholds GVB - Confidence in thresholds; Thrip thresholds												
Wireworms / seed treatments	Resistance risk, management options												
WEEDS													
Volunteer Cotton	A big issue. Best practice options: What works? What doesn't? Control in back to back cotton - More options Field test to tell if cotton weeds have RR gene												
Novel weed control options	eg biological control; Weed seeker technology use												
Specific weeds	Fleabane, Summer grasses Channel weed control esp Diuron alternate Relevant options used in research												
Ratoon cotton removal	Review of ratoon management practices, including self sown ratoons. Key message is do it right the first time as the cost of not doing it right is a lot more.												

Productive resource efficiencies

Issue	Questions	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
WEATHER, CLIMATE, PLANT STRESS, YIELD TARGETS													
Better weather forecasting	To aid defoliation timing decisions, harvest, irrigations												
Predicting heat or waterlogging stress & managing for it	Better forecasting to predict stresses + management tools (nutrition, Pix, Irrigation timing, agronomy) Management tactics before & after a heatwave												
Recovery	Economics of recovering a stressed crop; eg Case studies, matrix Maximise yield on best crops & Maximise profit in limited situation Match late season management to a reassessed yield target Tactics for a crop when you run out of water												
Plant resilience in hot regions	Genetics												
Yield targets	Adapt management to suit a realistic yield target Review high yielding fields/ or high yielding patches in fields and identify drivers of that high yield/ management / conditions What is creating the high yields? Gather farmers ideas into a book												
Optimum planting time/growing window	Early plant with management for earlier vigour to aim for good weather window for boll set Best timing with BRF varieties?												
PLANT ESTABLISHMENT & GROWTH													
Seedling vigour	Agronomy practices Seed size, quality, vigour and germination testing												
Growth regulators	Early vs mid season vs cut-out strategies Rates, timing, crop stage Understanding the impact of growth regulators in different seasonal conditions eg Does shortening of nodes and decreasing the number of nodes decrease boll load? Effect on bolls + economics Interactions with water, nutrition, etc												
Defoliation	Timing of defoliation for fibre quality												
NUTRITION													
Nutrient budgets	Input - output balance for high yielding crops												
Application	Efficiency, Timing, placement, product type, losses Variable rates along the row? Does it return from tailwater? Foliar & liquid fertilisers Spreaders vs direct drill Split applications & water run N Weather X N placement X timing												
Nitrogen	Map the N budget – tests & measures to validate N requirement Reducing losses – Entech? Black Urea? Hormone? Humic acids? Products Return on investment Denitrification – where has N gone? Testing? Are denitrification losses less in cooler areas? vv. Are losses faster in warmer areas? Timing – when best to apply to get the most out of it? Late applied N – how effective? How late?												

Issue	Questions	CQ	D. Downs	Macintyre	St George	Gwydir	Lower Namoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
Downfield movement of N	Losses down the row (esp.N) and impact on yield – best management options? Eg Alternate furrow placement, variable rates down the row. Measure N down the field in soil & water through season – losses to movement, denitrification												
P, K, Zn, S	P & K placement & rates. Big variation in K results, application strategies. Why? Is potassium a real issue? Rotation influence? S & Zn deficiencies?												
Interactions	Nutrition X soils X canopy management NPK interactions – does N help recover more P & K? Nutrition under different irrigation systems Root physiology X waterlogging X nutrition interactions												
Rotation influence	Legumes, green manures, fallow – influence on nutrient uptake												
Tests	Petiole testing for N needs at 700+ day degrees Accuracy of petiole tests for P K Zn Petiole vs leaf testing Soil testing procedures & interpretation In field nutrient test (quicker turnaround) Interpretation & use of results												
Composting & manures	Data & best use												
Trials	LOCAL trials, soil specific Some would like these to be long term P&K, others interested in N												
Nitrogen management case studies	Project to work closely with 6 farms using their nutrition programs – track & measure where the N goes												
Extension	Revisit the basics - Gather & package current information Extension / development program on N nutrition.												
SOILS & SYSTEMS													
Soil compaction	Concern about new pickers and other machinery												
Ground preparation	Post picking ground preparation. Review options: root cutting, stewardship, managing ratoons, etc. Need some good learnings/BMPs.												
Sub-soils	Sodic (or chloride) sub soil limitations.												
Interactions	Nutrition X soil condition X canopy management in BollgardII												
Rotation crops	Review limiting factors Dryland options Planting into stubble												
Crop Sequence and soil – plant interactions	Back-to-back cotton (impact on crop development, nutrition and yield) – management interactions Long fallow disorder, Root system development Soil health												
Row spacing	Row spacing & configurations												

Issue	Questions	CQ	D. Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breza	Macquarie	Southern	Wincott
WATER													
WUE	Better WUE accounting												
Irrigation strategies, scheduling & stresses for optimum yield & fibre quality	Best strategies to balance waterlogging vs heat stress Deficits for local conditions Limited water strategies Scheduling linked with key growth stages Better scheduling tools (better probes, drones, infrared etc) & better use of existing tools Yield impact of last irrigation Impacts on fibre quality Bollgard irrigation												
Bankless Channels	Bankless channels, and waterlogging												
Remote control	Remote control / automation of furrow irrigation												
Lateral & Pivot management	Agronomy package for laterals & pivots IPM under laterals & pivots Nutrition under different irrigation systems Management of the systems (local discussion) Economics of overhead vs furrow – simple messages												
Storage losses	Keep looking for ways to reduce losses from storages Increase off farm storage (new dams) Storage management – erosion maintenance												
Waterlogging	Guideline for ameliorating water logging impacts												
Infrastructure	Infrastructure options & economics Water delivery – gates, gabions, etc												
Water quality	Impact of bore water quality on yields/soils												
HARVESTING, TECHNOLOGY, ENERGY													
Lint Moisture	Care with lint moisture with round bale picking at night – an improved meter would help												
Yield maps	Getting more out of yield maps – training, knowledge & logistics On-board camera to helping to understand the problems detected in yield maps												
Energy	Reducing energy costs, benchmarking fuel efficiency, Alternatives Pump efficiencies, round bale transport												

Varieties

(not CRDC Strategic Plan)

Conventional RR	Need better conventional varieties - with performance equivalent to BGII varieties; Also want good varieties with RR traits but not Bt												
Locally suited varieties	Incl shorter season - Strong germinators, cool tolerant, faster finishers, good yield. Adapted to dryland												
More options	Reduce reliance on 1-2 varieties Liberty Link in good performing varieties												

Profitable Futures		CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
Drones	What might they offer?												
Hydrogen powered tractors	Options for reducing energy cost												
Growing cotton from ratoons	Revisit this – is there any scope as part of a low input system?												
New weed control options	Alternatives to tillage or chemicals eg Biological control												
Plant sensors	Focus on water, nutrient stress, etc. Need to be user friendly												
Rotations	Alternatives eg hemp												

Industry

Respected Stewardship

Issue	Questions	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
INSECT RESISTANCE MANAGEMENT													
Insect populations & resistance	What impact is Bollgard having on Helicoverpa populations? Lengthen life of products Risk of seeds treatments followed by same chemical group												
Bt management: Refuges	Dryland - Need industry to lead to reduce refuge requirement Research to find an attractant alternative to pigeon pea												
Bt management: Planting window	Is the planting window really effective for resistance management? Is there a strong enough scientific basis? Can be a challenge												
Bt management: Pupae busting	Alternative options, especially for dryland.												
WEEDS													
Weed resistance	Recognised as a big issue with need for an industry campaign and for each grower to have a plan. Need to align with other efforts, not duplicate												
Volunteer cotton	A big issue that is unique to the cotton industry												
OTHER													
Farm hygiene	Have become complacent – reinvigorate the campaigns Not only disease - weed seeds & herbicide resistance may be more of a concern to growers at the moment												
Spray Drift	Hormone drift & insecticide drift Impact on fibre quality (affects defoliation – increases trash)												

Responsible Landscape Management

Natural Assets													
Feral pigs	Damage to farms & cotton is getting worse												
Glyphosate drift onto trees	Cumulative impact on landscape												

Customers

Assured Products

Issue	Questions	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
FIBRE QUALITY													
Managing for quality	Management through all agronomy: defoliation, spray drift issues, water - esp. last irrigation, heat stress Honeydew - understanding in what conditions it does cause a quality problem (sometimes it goes away, if you start to spray it's a costly treadmill) Are there agronomy options to manage for Mic in hot seasons ?												
Ginning	Improve the consistency and quality of ginning Better understanding ginning & impact on quality												
Classing	Convene a review of the P&D grading system and sheet in conjunction of the HVI colour testing review. Colour palettes of HVI classing versus visual classing. Checklist for growers relating to P&D sheet and marketing												
Varieties	Key to improving quality, longer fibre, micronaire, etc												
Market research	Understanding global perceptions of Australian cotton												

Differentiated Products

Seed	Need more markets and increase value for seed. Hi oleic oil gene for improving seed value. Fuzzy seed management transport.												
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Competitive Futures

Medical applications & building products	Explore the possibilities.												
Nanotechnology	Can it be used to ID cotton all the way down the value chain												
Gin trash to wood	Value adding option?												

People

Workforce capacity

Issue	Questions	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
Growers Skills	Business skills of growers, agronomists and industry in general Wincott Skills survey showed interest in more information about computer systems, government subsidies, loan management and budgets.												
Consultants' skills	Provide more training. There has been a huge turnover and capacity shift in the consulting sector. Can we improve their business skills?												
Decision making roles	Understanding role of family in the farm business - who is making decisions, influencing information flow?												
Research capacity	Concern about sucession planning for retiring researchers Need for a good career path to attract scientists Make use of Trangie Research Station with its high security water												
Local research trials	Keen to see work within the region												
Human resources	Human resources was identified as a key challenge & influence on farm practices - but was generally not considered to be an R&D issue												

Networks

Issue	Questions	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
R&D input	Small group discussions like the Think Tanks across the valley Reinvigorate local R&D committee												
Younger farmers	Not getting to meetings - need a different strategy												
Adoption & practice change	Cotton Conference Forum on adoption and practice change. Get a good discussion going across the industry?												

Communication

Extension methods	A range of suggestions that need to be viewed for each region, include: - Trial books - Small group discussions - Compile research review summaries of specific topics of interest - Standard trials protocols - Cotton Tales - Field days - Case Studies of grower practices eg nutrition - Simple messages Bring back the excitement!	CQ	D.Downs	Macintyre	St George	Gwydir	LowerNamoi	Walgett	Boggabri	Breeza	Macquarie	Southern	Wincott
Variety specific agronomy packages	Variety, row spacing, crop management, disease, planting, PGRs. Like GRDC's barley packages												
Nutrition extension program	Revisit the basics and compile case studies of grower practice												
Business & financials	More financial info; business skills training												
New generation	Need to revisit some basics as there is a new generation who missed things like soil pits, etc												
Understanding information flow and preferences	Understanding the information seeking preferences of men & women Who does information go to on farm? how is it filtered?												

Performance

Best Practice

BMP	Continue to support BMP in case a need arises Don't use it, still scared of the old BMP Value needed or cost reduction / incentive (eg CSD discount) Develop a BMP app or more user friendly interface for a computer Communciation about the information that is in there												
Record keeping													

Recommendations and Next Steps

The following recommendations are drawn based on our interpretation and consideration of the issues. They are by no means the full list of activities that CRDC could implement in relation to the issues raised in Think Tanks.

17. Communication of Think Tank findings

A number of research and extension personnel have asked about the findings of the Think Tanks. It is our recommendation that these findings are communicated to researchers, the D&D team and Cotton Australia. We suggest that the full detail of comments from each region be circulated as this provides the local insight that may help researchers in targeting their messages to industry issues.

Option 1 – Short term communication

Release the spreadsheet collated by this project as a “raw report” to research, extension and Cotton Australia staff. Some minor editing may be required to correct alignment with Strategies, etc. This is possible as it would not be endorsed as a CRDC view.

Option 2 – Longer term

CRDC respond to the issues raised in the Think Tanks by adding to the spreadsheet some detail of current investments and where there is an identified R,D or E need. This would be the ideal longer term communication as the understanding of current research relating to issues raised would be of great value for D&D planning.

Option 2 would clearly take a considerable time to collate and we therefore recommend that Option 1 be implemented in the short term with Option 2 for the longer term.

In addition, a summary could be communicated via Spotlight.

Furthermore, as many of issues relating to varieties were raised it is recommended that this be communicated to CSD and the CSIRO Plant Breeding Unit.

18. Review of Think Tank findings with Cotton Australia panels

It would be of potential value for the Cotton Australia panels to review the Think Tank issues. The next step may be for the panels to work with CRDC to develop a consolidated, well informed perspective on the research and extension needs in relation to the issues raised and improve their clarity. Whilst we aimed to use a strategic focus, RD&E issue will vary over time and depending on the people involved in workshops. A cross industry discussion of the issues by the panels will help to deepen the insight to the issues and their relative priority. The think tank notes are really the start of a journey rather than an end point.

19. Consider the Think Tank issues in review of the Preliminary Research Proposals and fill gaps

For key issues raised from the Think Tanks which do require research or extension effort, consider these in reviewing the Preliminary Research Proposals. Request that relevant PRPs be adapted to match the industry need or commission new work to fill gaps.

It is recommended that CRDC engage participation of a grower or agronomist from the regional Think Tanks in these discussions to help shape the new projects.

20. D&D team convene small group meetings annually to review local RD&E issues

It is recommended that the Think Tank process be repeated on an annual basis in each region. This is most effectively done in small group discussions but would ideally involve different participants in future years in a series of small groups so that a wider range of views can be explored. This would ideally build on the findings from the 2013 Think Tanks and CRDC response.

These meetings could be convened by the Regional Delivery Officers as a part of their local planning activities / local reference groups. The process of engagement is as valuable as the content, in particular if effective feedback loops are in place.

It may be worth having some meetings specifically focused on dryland cotton.

It is recommended that the issues from each region be collated using a common framework to help in identifying issues for national campaigns.

21. Develop extension strategies at a local and/or national level to address the technical issues and the preferred extension methods raised at the Think Tanks

A number of suggestions from the Think Tanks were made for extension activities to address specific needs (eg A book of case studies of the on-farm nutrition management strategies used by 10-12 growers). There were also broader comments about the types of extension methods that are considered useful. Many of these referred back to activities that had been valued in the past (eg Trial books, local trials, CottonTales, single issue field days). There was also mention of there being many newcomers to the industry (growers & agronomists) and the potential need to revisit some of the older campaigns (eg SOILpak delivery) for this audience.

It is recommended to review the full detail of issues and methods identified in the Think Tanks and consider this in the development of a CottonInfo extension strategy. There are new technologies and now a new team to advance ideas raised.

Technical Recommendations

These are just a few ideas on advancing some of the issues raised. There were many more specific issues raised, and they too are just as worthy of consideration.

22. Convene a Nitrogen X Soils Forum and Develop a Strategic Nutrition Initiative

Nutrition and the interactions with soils and the farming system is a highly topical issue in most regions. The interest is not so much in rates but in the more complex interactions and the most efficient methods for fertiliser placement and timing.

A strategic research initiative for Cotton Nutrition is recommended to expand the scientific and industry knowledge on efficient nutrition management. This would align with CRDC's Strategies in Productive Resources Efficiencies.

As a critical planning step, a Nutrition X Soils forum is recommended to be convened by CRDC, modeled on the style of CRDC's former Farming Systems forums. It is also recommended to review the research on fertiliser placement conducted over several decades in other farming systems such as sugar/grains to identify relevance for cotton systems.

23. Increase industry and scientific knowledge of the interaction between cotton physiology, crop management and climatic conditions

A number of the issues raised relate to cotton plant physiology and growth/development, its interaction with environmental factors and the ability to manipulate plant growth to optimize fibre yield and quality. It is recommended to underpin information on growth regulators and plant stress with a solid understanding of how cotton plant physiology and growth/development translates into yield and fibre quality.

It may be justified to establish either a research initiative and/or a technical lead in the D&D team focused on cotton plant physiology and plant growth to optimize fibre yield & quality under variable seasonal conditions.

Three areas of activity are suggested in the shorter term:

- d. **Technical review of current knowledge on the management and impact of growth regulators in cotton**, including farm case studies. Whilst research will likely argue that this work has been done, there are clearly many questions amongst growers/agronomists and considerable financial expenditure occurring on growth regulators and their application.
- e. Compile a series of **economic case studies on the management of stressed crops**, supported by an overview drawn from the science.

Case studies with 10-15 growers could review the practices that they used to recover a crop that had been stressed by heat waves conditions, running out of water, waterlogging or flooding. Key questions to consider are: what were the strategies used? How did they decide on these strategies? Do they believe they were successful? What would they do differently? An economic analysis of the strategies would be valuable to help determine whether the decision to increase inputs or reduce inputs would be the most profitable.

This is recommended to be done in 2013 to draw on the recent experiences with both extreme heat, water shortages and flooding.

- f. **Deliver regional training opportunities to build understanding of cotton plant physiology, growth/development and management** eg local trials, Physiology Masterclass.

24. Continue the extension campaign on herbicide resistance

There appears to be strong awareness of the threat of herbicide resistance and in some cases its presence. There seems to be need for a campaign to increase vigilance in farm hygiene and weed management strategies to prevent spread and further development of resistant weeds. Cotton industry extension campaigns need to be strongly aligned with efforts of other sectors (eg GRDC).

25. Research and extension effort to investigate the management options for Volunteer RoundUp Ready cotton

This is a major concern that requires cotton industry leadership. As noted in one Think Tank: "GRDC is doing a lot on herbicide resistance but volunteer cotton is our own problem – we need to deal with that one as an industry".

26. Implement regionally based, nationally coordinated trials to address key issues raised

There is a strong desire for research conducted locally – ie away from ACRI. This may partly relate to a lack of awareness of the research that is underway and partly due to real differences in soils, climate and/or systems. Local trials or learning sites will help to engage growers with research.

Appendices

- B1. Tracking change in the Australian Cotton Industry: An overview of surveys and data sources.
- B2. Cotton Farming Practices – Data Snapshot
- B3. Cotton Think Tanks - planning notes
- B4. CRDC planning process
- B5. Cotton Think Tanks – meeting notes

Appendix B2. Cotton Farming Practices – Data Snapshot

This version of the data snapshot was prepared with input from Susan Maas and printed as a small booklet and mailed out together with the 2013 Cotton Practices survey. An earlier version was used to prompt discussion at the Think Tanks.



COTTON FARMING PRACTICES

A snapshot of trends

Like its growers, the Australian cotton industry relies on data to inform decisions and drive progress.

Cotton growers have shared their information through farm practice surveys for CRDC and the Cotton CRC in 1997, 2001, 2006, 2007, 2008 and 2011 and an environmental audit in 2012. CRDC also work with Crop Consultants Australia for annual surveys of their members. This input is greatly appreciated as it provides really valuable information to help understand the range in industry practice; identify potential for inputs to be used more efficiently; prioritise research, development & extension; and to 'tell the industry story' with clear facts.

We hope you find interesting the following snapshot about cotton crop management across the industry.

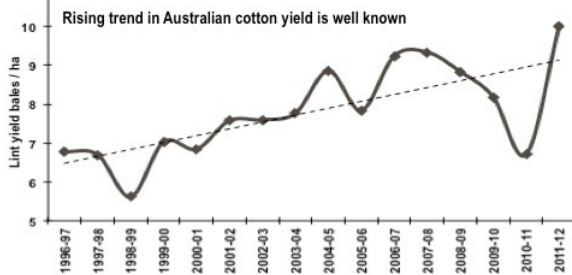
Thank you for taking the time to complete the 2013 Cotton Grower Survey, we look forward to reporting the findings.

ROTH RURAL & REGIONAL Prepared by Ingrid Roth & Guy Roth 02 6792 5340 | Ingridroth@roth.net.au | guyroth@roth.net.au and Susan Maas for the Cotton Research & Development Corporation (CRDC)

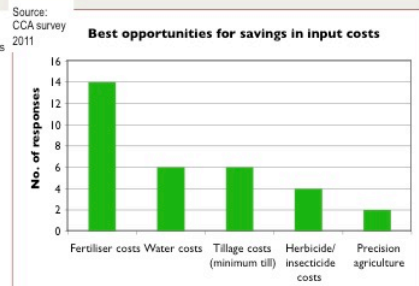
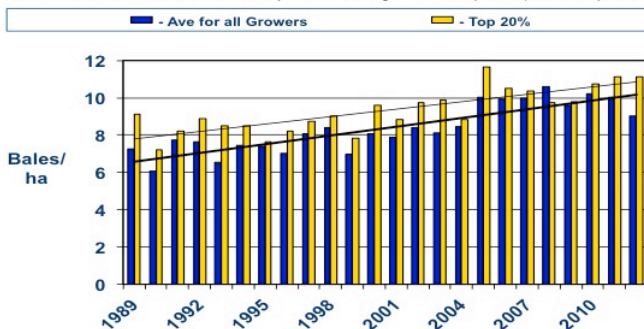


PROFITABLE PRACTICES - HOW DO YOU COMPARE?

Long term average figures of top producers prove that it is possible to achieve a benchmark cost of production in the \$290-\$350/bale range in a 'normal' year' Source: 2012 Boyce and CRDC Cotton Comparative analysis



Yields trends with differences between top 20% and average Source: Boyce Comparative Analysis 2012



Average price per bale \$486

2012 Average Yield 9.71 bales/ha
Top 20% 11.45 bales/ha

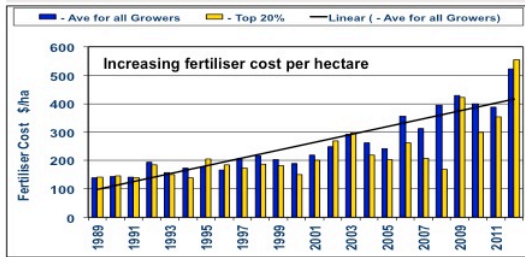
Operating costs
Average \$3236 /ha
Top 20% \$3524 /ha

Farm operating profit
Average \$1213 /ha
Top 20% \$2090 /ha
Low cost \$1390 /ha

Source: 2012 Boyce Cotton Comparative analysis

SOIL HEALTH: NUTRITION

- On average, fertiliser costs have increased by \$130/ha from previous year to the 2011/12 season (2012 Boyce Cotton Comparative analysis)
- 13% of farms surveyed in 2011 used manures or composts in their nutrition program. (2011 Grower survey)
- Nutrient rates are highly variable across farms
- Rates do not clearly correlate to yield or farm size.



	Kg N / bale	Avg	Min	Max
Central Qld	34	19	19	44
Darling Downs	35	8	8	100
St George / Dirranbandi	24	16	16	35
Border Rivers (incl Mungindi)	22	18	18	32
Gwydir	25	8	8	48
Lower Namoi (incl Walgett)	21	6	6	52
Upper Namoi	20	10	10	28
Bourke	23	19	19	30
Macquarie	20	8	8	29
Lachlan Murrumbidgee	23	9	9	36
All regions	25	6	6	100

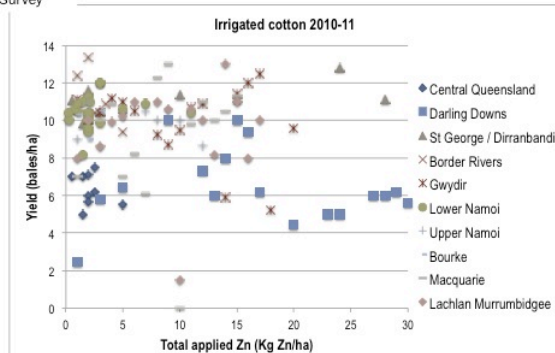
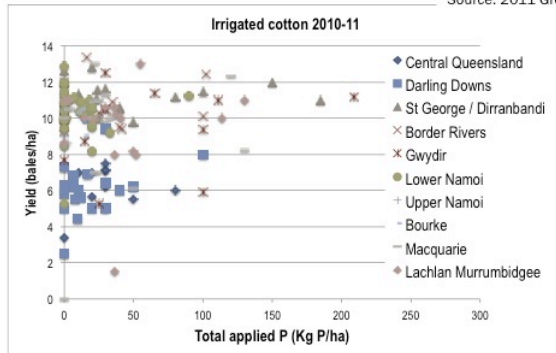
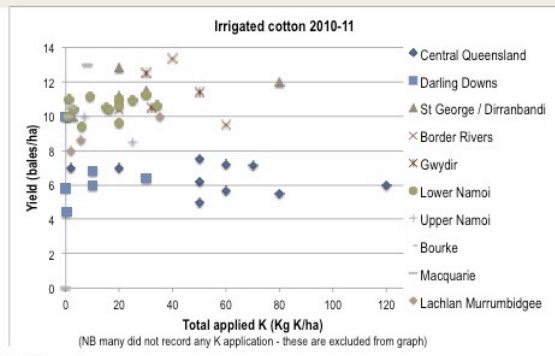
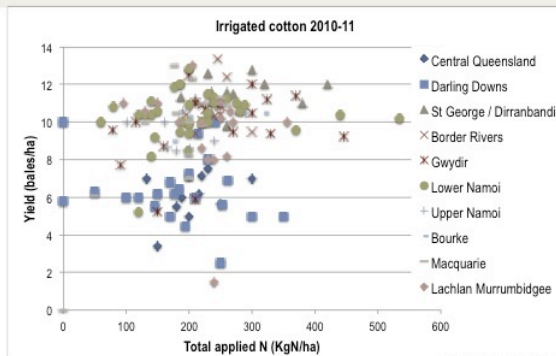
Nitrogen rate per harvested bale from irrigated cotton in 2010-11
(2011 Grower Survey)

- The 2011 grower survey and 2012 Environmental Audit identified that:
- 81% of growers in 2011 used soil testing in deciding fertilisers rates.
 - 69% of growers in 2010 soil tested annually or seasonally
 - 38% used leaf or petiole testing.
 - 83% considered there had been improvement in use of soil & leaf testing.

Average applied nutrient rates recorded in grower surveys 1997-2011

FERTILISER	1997	2001	2006	2007	2011 Irrigated	2011 Dryland	Trend
Pre season nitrogen - solid fertiliser (kg N/ha)		80	87	101	142	89	↑
Pre season nitrogen - gas fertiliser (kg N/ha)		78	71	60	155	84	↑
In season nitrogen - solid fertiliser (kg N/ha)		17	29	60	99	45	↑
In season nitrogen - gas fertiliser (kg N/ha)		8	14	18	83	40	↑
In season N water applied (kgN/ha)					57	5	
TOTAL applied N kg/ha	125	176			217	96	
Pre season phosphorus fertiliser (kg P/ha)		23	30	35	42	14	↑
In season phosphorus fertiliser (kg P/ha)		2	3	2	20	13	↑
TOTAL applied P kg/ha					40	16	
Pre season potassium fertiliser (kg K/ha)		8	16	24	33	7	↑
In season potassium fertiliser (kg K/ha)		0	2	4	15	2	↑
TOTAL applied K kg/ha					28	7	
Zinc fertiliser (kg Zn/ha)		5	5	5	4.4	3.7	↔
Sulphur (kg S/ha)					6.3	2.4	
Trace elements					21	4	

SOIL HEALTH: NUTRITION



SOIL HEALTH: NUTRITION

Timing of Nitrogen application

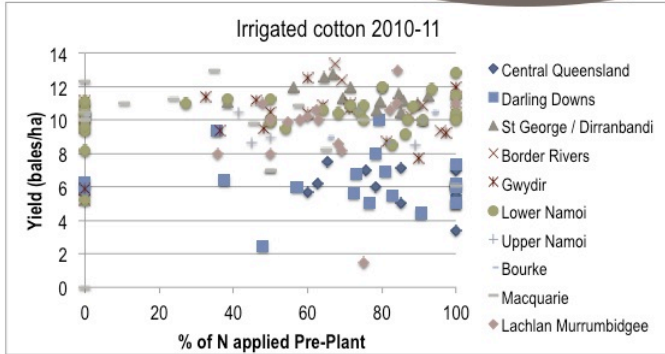
- Split applications of nitrogen are applied to most cotton crops.
- There was a wide variation in the proportion of Nitrogen applied pre-plant
- There was no clear link between the proportion of N applied pre-plant and the yield achieved.
- Water run nitrogen (generally Urea) was common for topping up N in-season.

Sources: 2010 CCA survey & 2011 Grower Survey

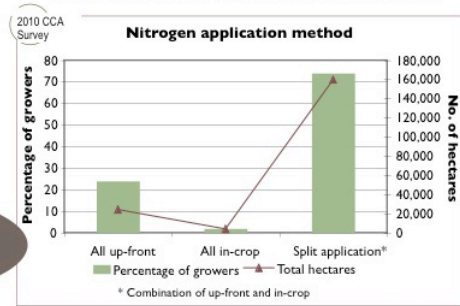
Most growers had a wet winter in 2010 which may have affected some pre-plant fertiliser application. Flooding in 2011 likely resulted in some additional N applications.

Is this typical?
How did your fertiliser strategy in 2012-13 compare to 2010-11?

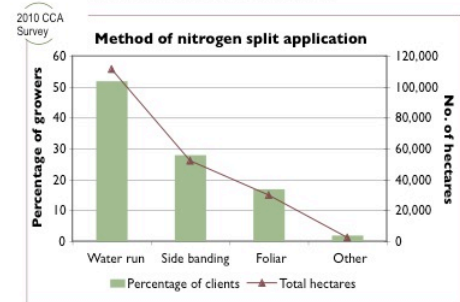
Proportion of N applied pre-plant vs yield (2011 Grower survey)



Proportion of hectares using N timing strategies



Format of in-season N application



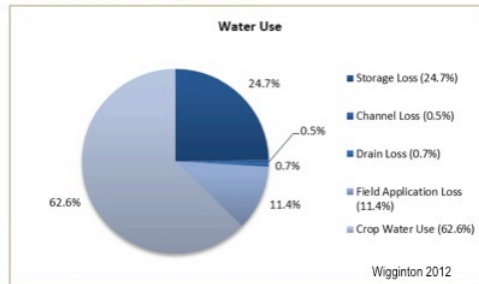
WATER MANAGEMENT

Industry has improved its water productivity by 40% over the last decade. The industry has a goal of further doubling water use efficiency/productivity again over next 10 years.

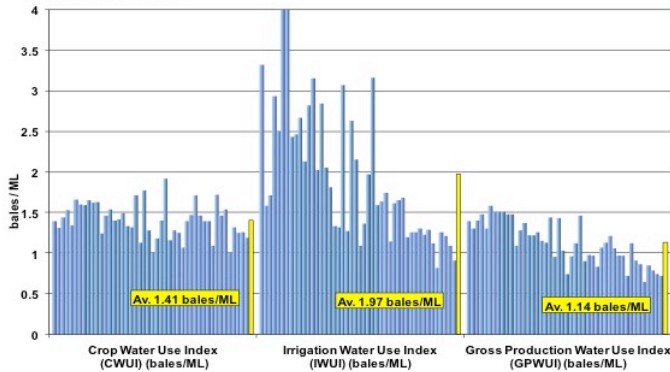
Measured farm benchmarking data shows there is a large range in the data. 63% of water is used by the crop. The largest loss of water was on farm storages (evaporation). There is a large variation around these averages.

This data was published in the Australian Cotton Water Story (2012)

Proportion of water used or lost across all farms
Source: Montgomery & Wigginton 2012

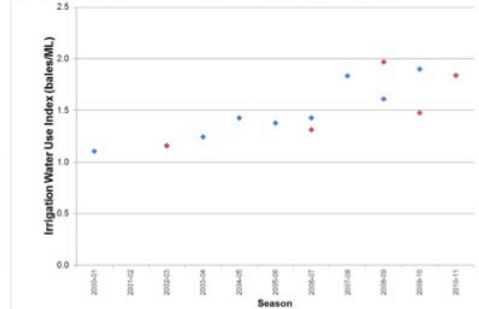


Water use efficiency benchmarked on farms across the industry
Source: Montgomery 2010



Increasing cotton productivity (bales/ML applied)

Source: Harris 2012



WATER MANAGEMENT

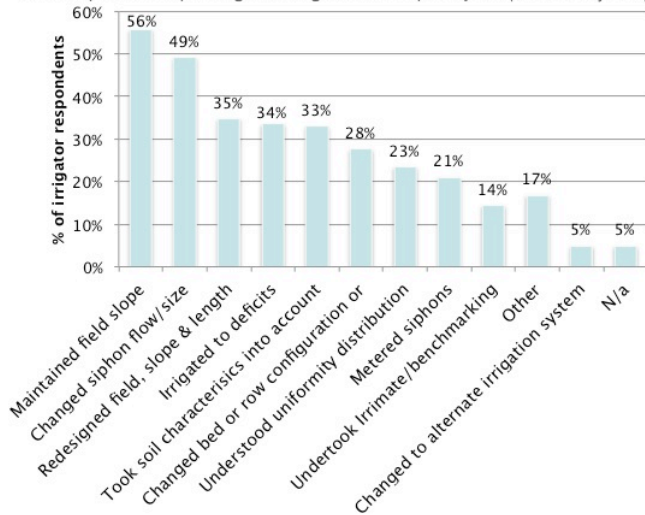
Grower survey findings	2006	2011
Irrigators using soil moisture probes for scheduling	40%	70%
Irrigators monitoring groundwater quality	20%	62%

Between 2006 and 2011:

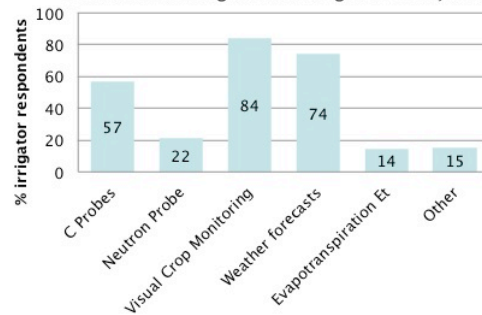
- Half of all irrigators made changes to their siphon flow and/or size
- 42% more growers monitored groundwater quality
- The use of soil moisture probes for irrigation scheduling increased by 30%

Some irrigators are using both neutron probes and capacitance probes such as Environscans (eg neutron probes for timing of first irrigation/s and CProbes later season)

Grower's practices in optimising furrow irrigation over the past 5 years (Grower survey 2011)



Methods used for irrigation scheduling (Grower Survey 2011)

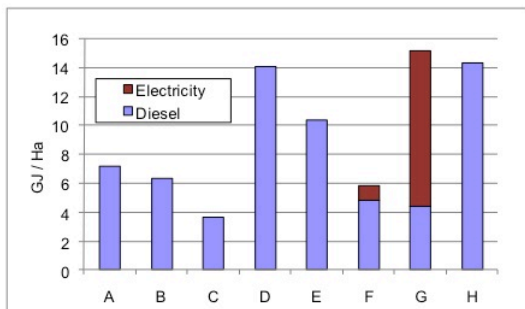


ENERGY

The National Centre for Engineering in Agriculture (NCEA) has conducted 8 case study energy assessments across the Australian Cotton Industry for a range of farming regions and farming practices (e.g., conventional tillage, minimum tillage, dryland farming, and irrigation) in both NSW and Queensland.

On farm energy use was found to range from 3.7 to 15.2 GJ/ha costing \$80 to \$310/ha. Diesel energy inputs ranged from 95 to 365 litres/ha, with most farms using 120 to 180 litres/ha. (Source Development of Energycalc, 2007, G.Chen & C.Baillie NCEA,)

How much energy did you use in 2012-13?

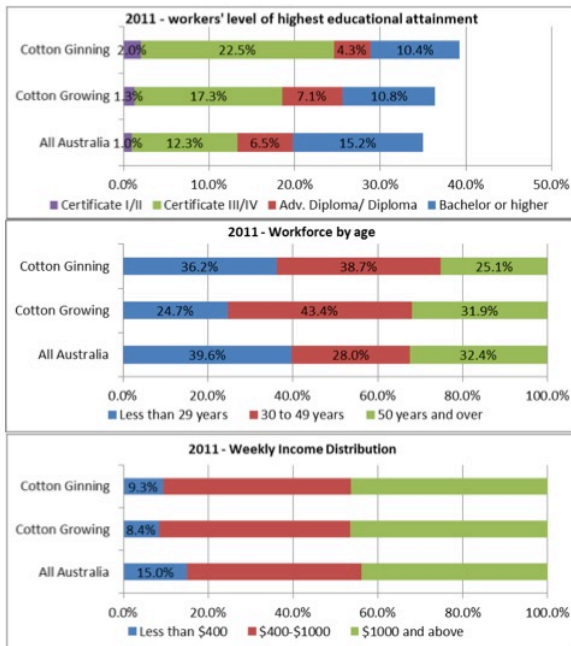


	Tillage method	Irrigation method	Water Sources
Farm A	Conventional tillage	Diesel pump	Surface water
Farm B	Conventional tillage	Diesel pump	Surface water
Farm C	Minimum tillage	Gravity feed	Surface water
Farm D	Conventional tillage	Diesel pump	Ground water
Farm E	Minimum tillage	Diesel pump	Ground water
Farm F	Conventional tillage	Electric pump	Surface water
Farm G	Minimum tillage	Electric pump	Ground water
Farm H	Minimum Tillage	Diesel pump	Surface water

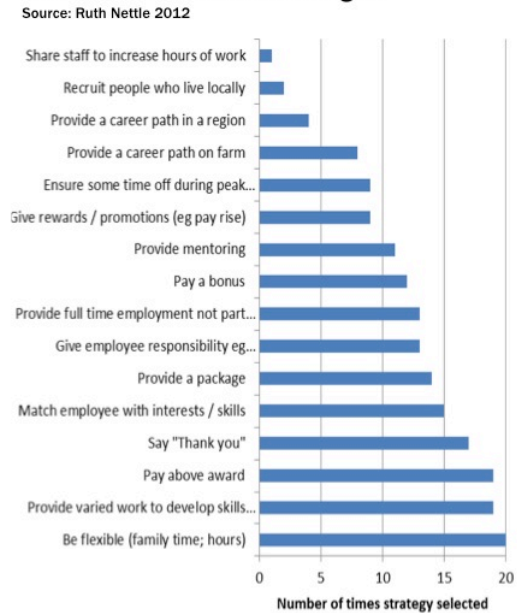
	Preparation	Establishment	In Season	Irrigation	Harvest	Post Harvest
Farm A	15%	4%	8%	40%	24%	9%
Farm B	14%	7%	3%	39%	27%	10%
Farm C	4%	5%	21%	0%	54%	16%
Farm D	7%	1%	4%	70%	14%	3%
Farm E	5%	2%	4%	62%	19%	7%
Farm F	32%	7%	7%	9%	38%	7%
Farm G	12%	4%	4%	51%	21%	8%
Farm H	19%	2%	6%	52%	13%	8%



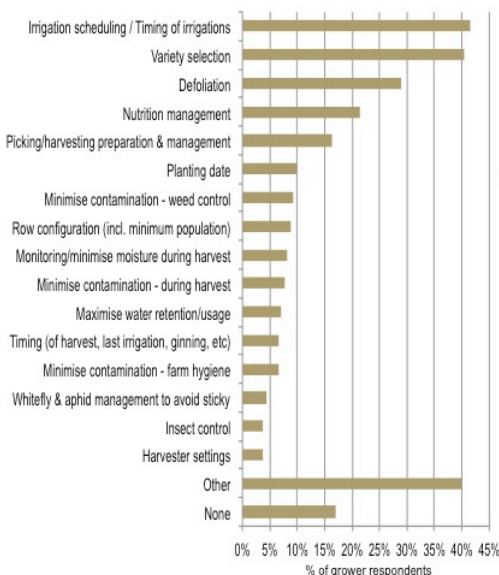
Characteristics of cotton growing workforce, 2011 Source: Ruth Nettle 2012



Most effective retention strategies Source: Ruth Nettle 2012

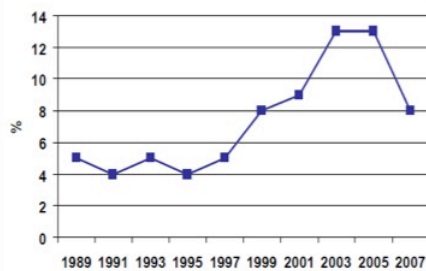


Strategies used to manage for fibre quality 2011 Grower Survey



"Other" included: Avoid stress (5 respondents), Best practice agronomy (6), Maximise Yield (3), Fertiliser/nutrition choices (4), Minimise/eliminate tillage (2), Rotations (3), Nature (weather, etc) (3)

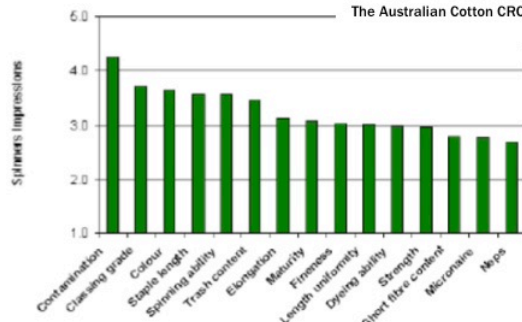
Quality discounts can be substantial, with a major impact on profitability.



Did you have any quality issues in 2012-13?

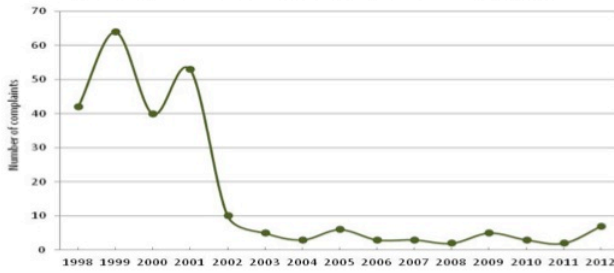
Perceived degree of contamination of Australian cotton from ITMF Contamination Survey from 1989 to 2007 The Australian Cotton CRC Mill Survey 2007

Spinners impressions of Australian cotton fibre quality (1 bad 5 good) The Australian Cotton CRC

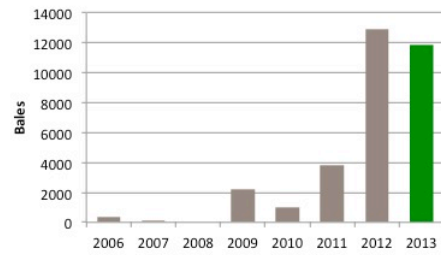


BUILDING A FARMING FUTURE - HOW DO YOU CONTRIBUTE?

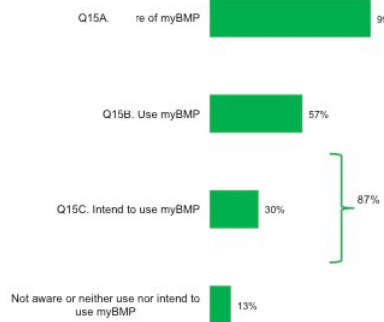
Data shows there have been less complaints to NSW EPA about cotton



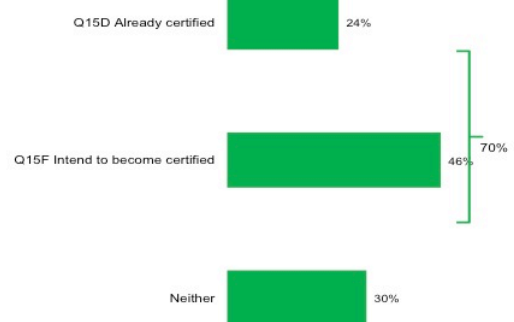
BMP Certified Bales Shipped



Awareness & use of myBMP Source: Environmental Audit 2012

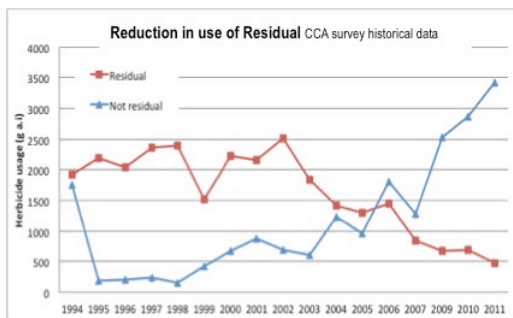


myBMP certification Source: Environmental Audit 2012

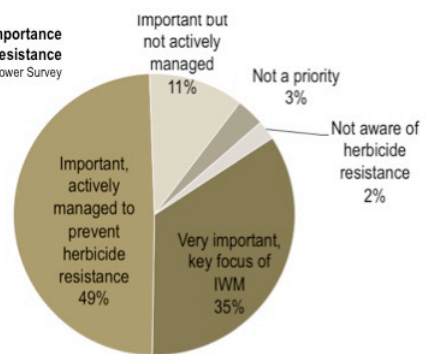


BUILDING A FARMING FUTURE - HOW DO YOU CONTRIBUTE?

WEED MANAGEMENT



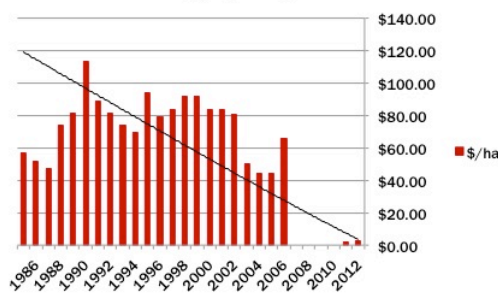
Growers' perceived importance of herbicide resistance 2011 Grower Survey



Change in practice has included a dramatic reduction in chipping

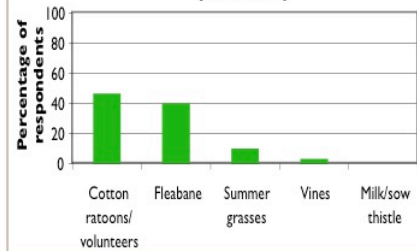
Source: Boyce Cotton Comparative analysis

Chipping Cost \$/ha



Source: CCA survey 2011

Weeds with the greatest impact on clients' profitability



WEED MANAGEMENT

Is there a shift in weed species?

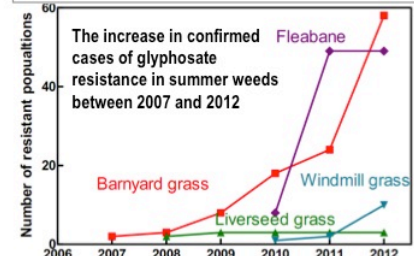
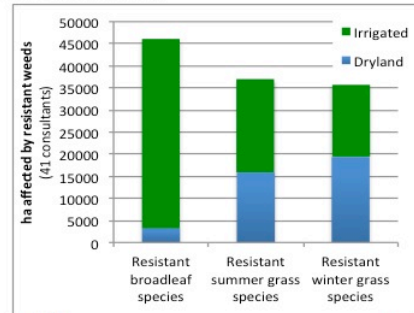
Source: Research surveys and 2011 Grower survey

2001 Surveys		2010/11	Weeds increased over the past 5 years identified by growers in 2011
Charles et al. 2004 Irrigated cotton	Walker et al. 2005 Dryland cotton	Werth et al. 2011	
Peachvine	Bladder ketmia	Flaxleaf fleabane	Barnyard grass
Bladder ketmia	Sowthistle	Sowthistle	Ryegrass
Nutgrass	Pigweed	Peachvine	Feather top rhodes
Awnless barnyard gr	Caltrop	Australian bindweed	Windmill grass
Rhynchosia	Dwarf amaranth	Dwarf Amaranth	Butter cup
Annual verbine	Barnyard grass	Bladder ketmia	Bellvine
Volunteer cotton	Peachvine	Caustic weed	Phalaris
Physallis	Australian bindweed	Emu foot	Polymeria
Fierce thornapple	Caustic weed	Awnless barnyard gr	Umbrella grass
Native sensitive plant	Liverseed grass	Burr medic	Anoda weed
Australian bindweed	Boggabri weed	Native sensitive plant	Deadly nightshade
Annual polymeria	Malvastrum	Chinese lantern	

Have the weed challenges on your farm changed?

Area thought to be affected by herbicide resistant weeds on farms advised on by 41 consultants

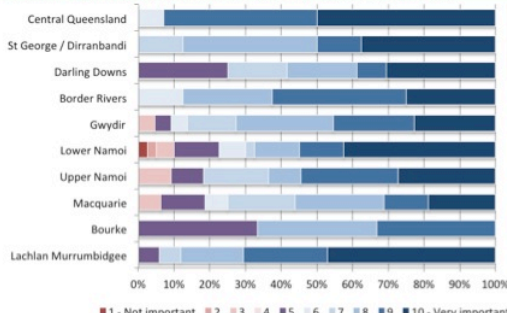
Source: 2012 CCA Survey



Source: Glyphosate Resistance Register Summary 2013
Australian Glyphosate Sustainability Working Group

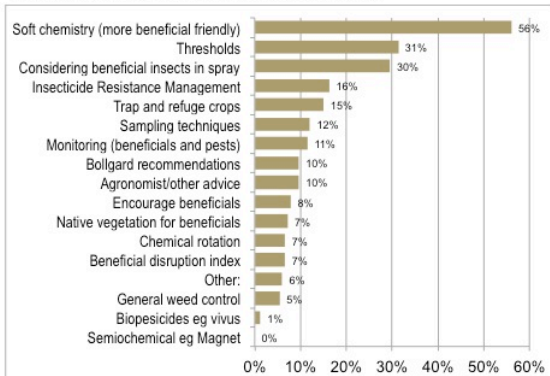
INSECT MANAGEMENT

Growers' perceived importance of IPM Source: 2011 Grower Survey

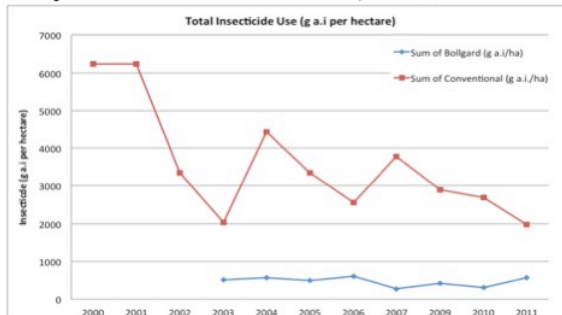


The 2011 grower survey identified that the majority of growers place a high importance on IPM. The main economic benefits of IPM were considered to be less sprays, financial savings and environmental or social benefits.

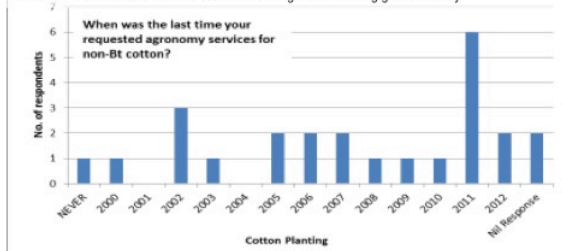
IPM strategies used by growers Source: 2011 Grower Survey



Change in insecticide use over time Source: CCA survey historical data






Use of Conventional Cotton 2013 CA general meeting grower survey



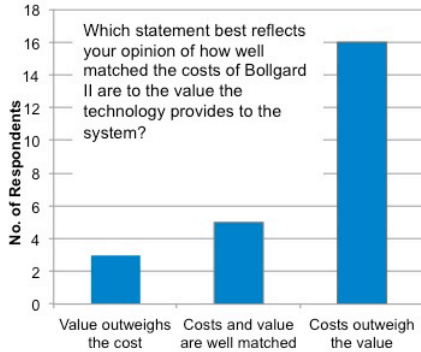
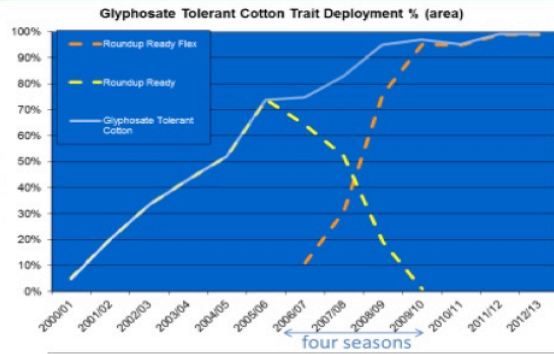
BIOTECHNOLOGY

Current status of Bt resistance

Source: CSIRO resistance monitoring program
How many moths out there carry a gene for resistance to the Bt toxins?

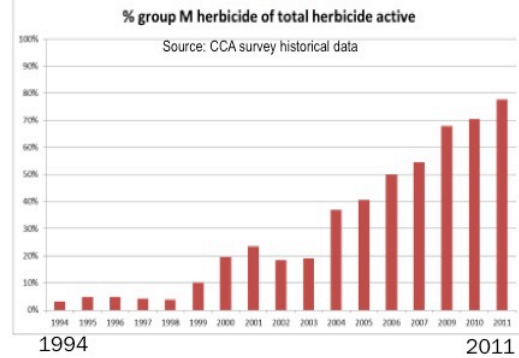
-  Cry1Ac: 1 in 2000 (both spp.)
-  Cry2Ab: 1 in 5 (both spp.)
-  VIP3A: 1 in 20 (*H.armigera*)
1 in 100 (*H.punctigera*)

Where do you see biotechnology in the future?



Respondent Comments:
 "This is only for this time when we have so much Bollgard. May change if the valley used 50:50."
 "Mixed irrigation / dryland farms . Costs and value are well matched for Irrigation farms."
 "Convenience outweighs the Cost - partial value I know."

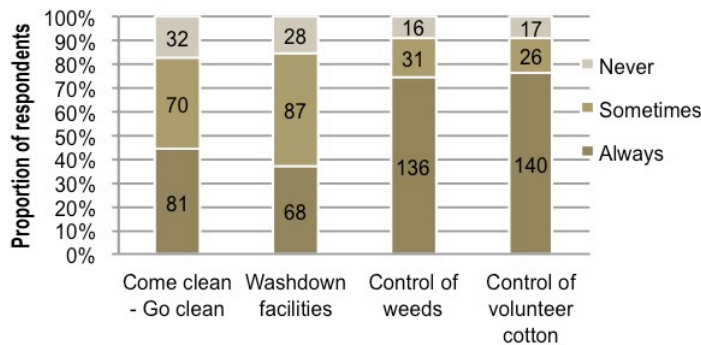
Source: May 2013 CA general meeting grower survey



DISEASE AND BIOSECURITY

Frequency of use of farm hygiene practices for preventing disease and weed spread

Source: Grower Survey 2011



VOLUNTEER & RATOON COTTON

Ratoons and volunteer cotton were identified in both the CCA survey and the most recent grower survey as the most difficult to manage weed.

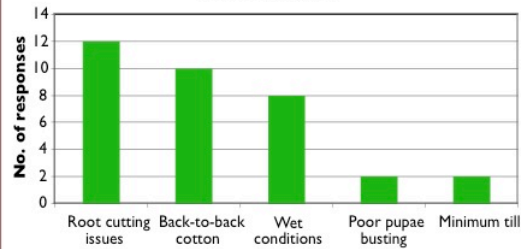
A recent survey of 10,500km of roads & drains in Qld found cotton in all regions, with 85% within 5km of cotton fields. Half the plants were carrying CBT.

Occurrence of volunteer cotton plants surviving from the previous season on farms in NSW and QLD in the spring of 2010 Source: Annual disease survey

Spring	Along roads, fences & channels	In rotation crops & fallows	In current crop (stub regrowth)	TOTAL
2010	53%	17%	47%	73%
2011	44%	26%	43%	64%
2012	44%	21%	43%	29%

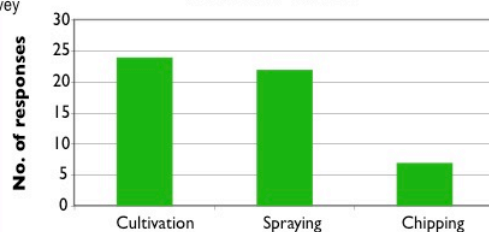
Source: 2011 CCA Survey

Conditions that create the highest risk of cotton ratoons



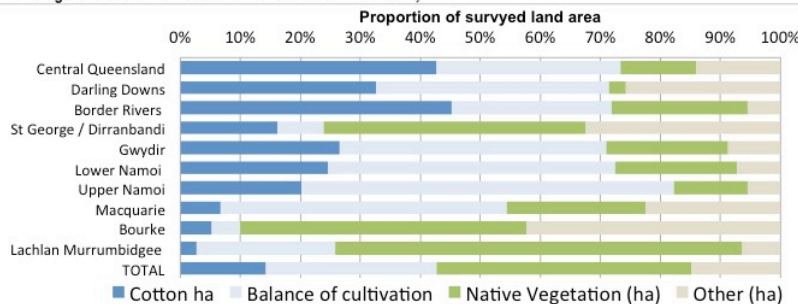
Source: 2011 CCA Survey

Most effective methods used by clients to control volunteer cotton



NATURAL ASSETS

Average land use mix on cotton farms Source: 2011 Grower Survey



Natural assets management in the past 5 years Source: 2011 Grower Survey

	% Growers who revegetated	% Growers actively managing	Revegetated Area (Ha)	Area managed (Ha)	% Growers with riparian zone	Average (km)	Range (km)	Riparian zone actively managed (avg km)
Central Queensland	7%	36%	4	261	57%	4	2 to 11	4
St George/Dirranbandi	6%	50%	20	47,846	63%	16	0.2 to 60	20
Darling Downs	6%	28%	3	812	56%	4	0.7 to 10	4
Border Rivers	50%	38%	1,107	900	75%	8	2 to 20	6
Gwydir	23%	59%	561	6,003	77%	14	3 to 44	6
Lower Namoi	13%	38%	838	17,546	60%	8	0.5 to 30	9
Upper Namoi	27%	45%	224	1,233	73%	6	2 to 10	4
Macquarie	13%	31%	120	3,380	69%	10	3 to 20	6
Bourke	0%	67%	0	5,100	100%	23	10 to 40	
Lachlan Murrumbidgee	29%	41%	145	13,242	53%	7	2 to 15	7
Totals	15%	40%	3,021	96,323	63%	9	0.2 to 60	8

The 2011 Grower Survey identified:

- Around 40% of cotton farm area is dedicated to native vegetation.
- 63% of farms have a riparian zone ranging between 2 and 15 km in length (on average 7 km).
- 70% of cotton growers have river frontage and 75% of growers are actively managing their riparian zones.

Tactics used by growers to manage riparian areas include:

- Fencing & selectively grazing
- No grazing at all
- Control of weeds and pests
- Provision of alternative water points for stock
- Maintain filter, buffer strips
- Planted native trees and other vegetation.

Source: The Australian Cotton Water Story, 2012

NATURAL ASSETS

The third environmental assessment represents the continuation of a 21 year commitment of the cotton industry in undertaking comprehensive independent environmental assessments, a process unique in agricultural industries in Australia.

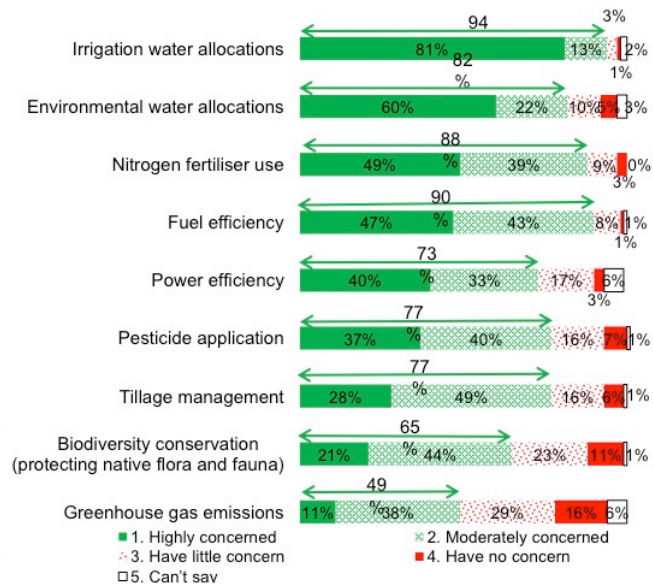
Cotton growers have improved soil, riparian and native vegetation management which is contributing to improved biodiversity and delivering important ecosystem services.

Source: Cotton Industry's Third Environmental Assessment, 2012



Industry concerns about environmental issues

Source: 2012 Environmental Audit



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Australian Government

Cotton Research and Development Corporation

Cotton Research and Development Corporation

CRDC is a research and development partnership between the Australian cotton industry and the Australian Government. ABN: 71 054 238 316

Our vision: A globally competitive and responsible cotton industry

Our mission: Invest and provide leadership in research, innovation,

knowledge creation and transfer

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Appendix B3. Cotton Think Tanks - planning notes

Cotton Think Tank 2013

How can research and extension help improve input efficiencies and returns from cotton production in your region?

Explanatory notes for the Cotton Regional Development Officers, Cotton Australia and Panels
1/3/2013

Description

The Cotton Think Tank in your region is a chance to bring together growers and consultants to work out the priorities for local research and delivery.

The 2011 Grower survey, CCA consultant surveys, Boyce Cotton Comparative Analysis and other benchmarks show a huge range in how cotton inputs are managed.

Through CRDC funding, this information has been reviewed and can be presented in each region to prompt a facilitated discussion of:

- Why do practices and inputs vary so much across farms?
 - Does this variation highlight potential for local research and delivery?
- Can better returns be made from management of water, nutrition, labour, energy and other inputs?
- How can research, development and delivery in your region best help improve the margins from cotton growing systems?

The Cotton Think Tanks will explore in greater depth the research and delivery needs for the issues raised in last year's Blueprint for Cotton workshops.

Purposes:

1. Provide Cotton Australia's panel representatives with broader understanding of the issues and priorities across their region and other regions.
2. Identify priority issues in each region to help guide local research and delivery efforts.
3. Provide feedback to industry from the grower & consultant surveys and encourage participation in future surveys.

Process

Flexible to suit what works best in each region.

It could be done as a workshop or focus groups of 1-2 hours.

It could fit into a planned meeting (eg CGA) if preferred.

Key findings from industry surveys will be presented by Guy or Ingrid Roth who will facilitate discussion from this. Paul Fisher from Boyce may be able to present findings of the 2012 Cotton Comparative Analysis.

A collation of key survey data about cotton growing practices and returns will be prepared for circulation. Key points from these will be presented to prompt a facilitated discussion of local issues. The focus would be on 2-3 key topics in detail (eg nutrition, water) followed by an open session about other issues.

NB people who want to have input but can't attend the local meeting could receive the collation of survey data and a set of questions to allow them to give input by email/post or phone discussions with their local RDO.

Participants

Again this is flexible to suit local preferences.

Aim for 5-20 growers and consultants.

It will be important to include local Cotton Australia panel representatives.

It is hoped that the CGA can be engaged in the process, but this will vary in different regions.

What will happen afterwards?

A report of the key needs identified will be prepared for the CGA, the panel representatives, the Regional Development Officer and CRDC. We will work with the RDO to develop this. This will be the beginning of the process to understand and target local needs.

Regions?

Any region that is interested – focus on those regions where there are RDOs

A workshop is already planned for CQ on 16 April to work through the detailed survey that we did with the CHCG&IA in 2012.

Planning

It would be great if RDO's together with their local Cotton Australia Regional Manager and in consultation with the panel representatives and CGA can organize the meetings for their region.

Timing

Workshops can be run between March and May 2013 – ideally before the Cotton Australia panels meet at the end of May. Realistically this will mean March or May in most regions to avoid picking.

NB On 25/26 March and 1-3 May we could only do Namoi or Gwydir meetings.

Contact

Ingrid Roth

02 6792 5340

0428 195 485

ingridroth@roth.net.au

Guy Roth

0417 223 179

guyroth@roth.net.au

THANKS!

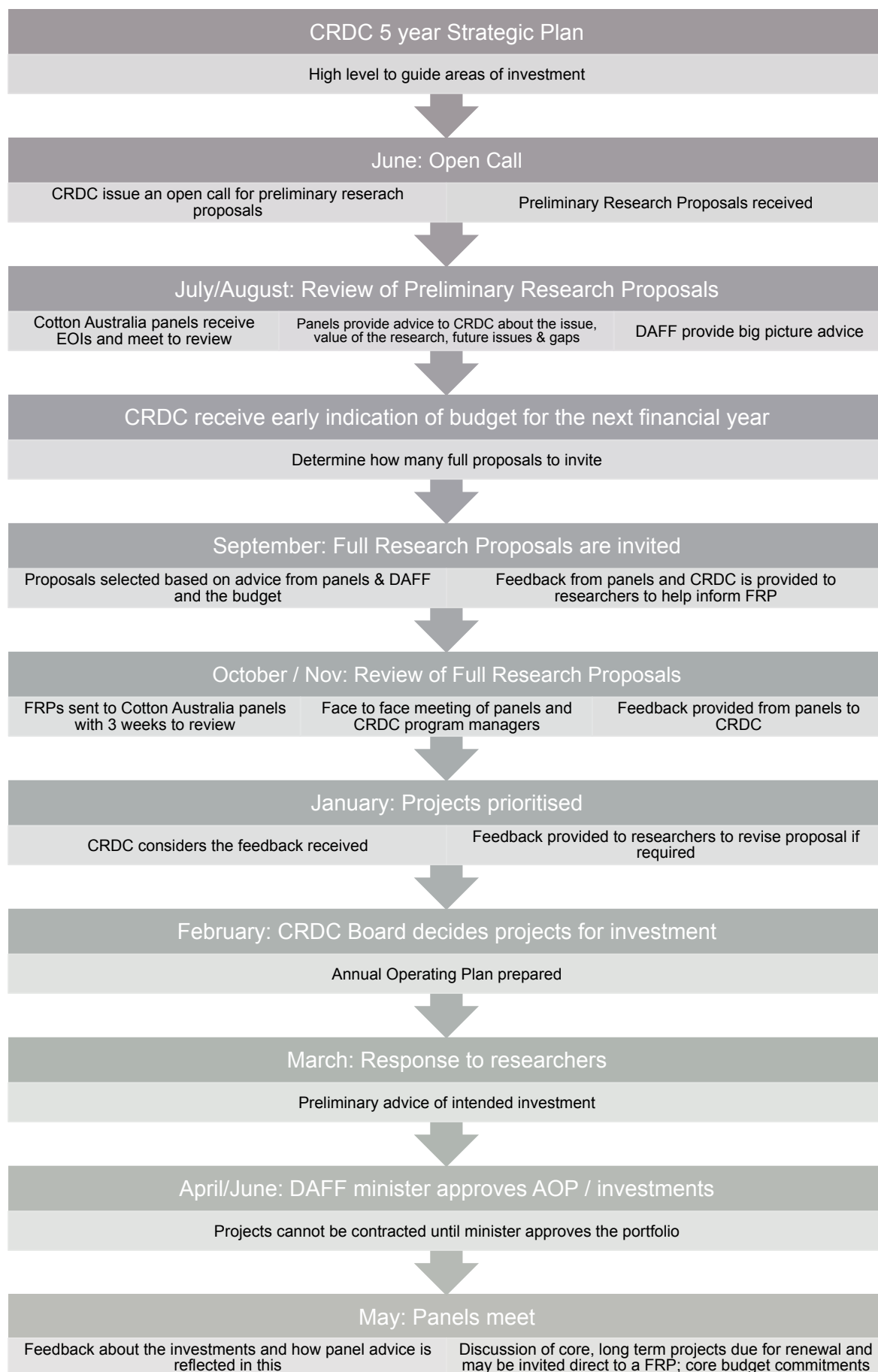
Thank you for your help! We hope this process is really useful for you and that working through some data on practices will help best draw out the local needs.

We will work on having the collated survey information ready ASAP and circulate to you.

Let us know if there is anything in particular you'd like us to delve into.

Appendix B4. CRDC Planning Process

Cotton Research & Development Corporation Investment Planning Process



Cotton Research and Advisory Groups

Cotton Australia provides ongoing advice to the CRDC on research projects funded by the Cotton R&D levy and matched by the Australian Government. This is formally provided on all current and new research proposals, through Cotton Australia's four advisory panels; Value Chain, Farming Systems, Biosecurity and Human Capacity. *[from Cotton Australia website]*

Cotton Australia Research Advisory General Assembly is made up of representatives of CGA's and merchants and a representative from each the CCA and CSD. Each of these members can elect to join a panel/s.

Cotton Australia Research Advisory Panels

Value Chain	Biosecurity	Farming Systems	Human Capacity
Bob Dall'Alba – Lead Lyndon Mulligan Damien Erbacher Greg Morris Wayne Towns Nigel Corish Tobin Cherry Tony Bailey	Damien Erbacher - Lead Bill Tyrwhitt Andrew Greste John Cameron Nev Walton Andrew Parkes Neek Morawitz Matt Holding Rob Lowe Stephen Ainsworth	John Cameron – Lead Tony Taylor Joe Robinson Geoff Brownlie Rob Collins Hugh Ball Rod Smith Nigel Corish Rob Lowe	Phil Firth – Lead Andrew Greste Glenn Rogan Barb Grey Toby Moore

TIMS Committee

The Transgenic and Insect Management Strategies Committee (convened by Cotton Australia) provides key advice in the area of crop protection resistance management. TIMS' main role is the development, review and oversight of the Insect Resistance Management Strategies.

Role	Representative	Representing	Area of Responsibility
Chair	Andrew Parkes	Cotton Australia	Independent - from any region
Northern Area	Damien Erbacher	Cotton Australia	Biloela, Central Highlands, & Dawson Valley CGA's.
Darling Downs	Neville Walton	Cotton Australia	Darling Downs CGA
Western Area	Greg Morris	Cotton Australia	Bourke CGA, Dirranbandi CGA, Mungindi WU&CGA, St George CGA
Central North Area	Tony Taylor	Cotton Australia	Gwydir Valley CGA, Macintyre Valley CGA, Walgett CGA
Central South Area	Andrew Greste	Cotton Australia	Lower Namoi CGA, Upper Namoi CGA
Southern Area	Bill Tyrwhitt	Cotton Australia	Lachlan CGA, Macquarie CGA, Tandou
Herbicide Tech Panel Chairman	Cleave Rogan	Cotton Australia	Transfer of recommendations to and from Herbicide Tech Panel
Northern CCA	David Parlato	CCA	Central Highlands, Dawson & Callide Valleys plus Darling Downs
Central CCA	Rachel Brimblecombe	CCA	Gwydir, Macintyre, Lower and Upper Namoi Valleys
Southern CCA	Campbell Muldoon	CCA	Macquarie, Lachlan, Murrumbidgee, Tandou
Western CCA	Jamie Street	CCA	St George, Dirranbandi, Mungindi, Walgett and Bourke regions
	Lewis Wilson	CSIRO	
	Tracey Leven	CRDC	
	Robert Mensah	NSW DPI	
	Paul Grundy	QLD DAFF	
	Melina Miles	GRDC	
	Vacant	Pulse Australia	

Appendix B5

Cotton research and extension think tank

Gwydir valley 18/3/2013

Panel representative: Tony Bailey
 Participants: Michael Seery, Stu Doyle, Rob Holmes, Nick Gillingham, Mike Stone
 Apologies: Angus Doolin, Simon Doolin, Will Kirkby, Hugh Ball, Stu Gall, Doug Marshall
 Convenors: Ingrid Roth, Sall Dickinson

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
			Key elements of cotton growth = Sunlight X water X N
Soils & systems	Nutrition X soil condition X canopy management in BollgardII	Research case studies that measure the impacts/losses from 6+ farms using their own management practices - development extension activity. (This is the key project area for this group – drawing together many of the other issues)	Contact Mike Stone, Rob Holmes and Stu Doyle are keen to work with CRDC to develop this idea further
	Soil Structure	Recognising the value of good soil structure and avoiding compaction – revisiting the old information eg do soil pits again as many people weren't around when they were last done	Need people with passion – succession & quality
	Back to back vs fallow root system development and nutrition	Big difference in back to back vs fallow this year, plant demand in the heat. Compare the root system development in fallow vs back to back cotton, how to fix it and how to manage for it. eg influence on fertiliser timing	

Nutrition	Efficiency and timing of fertiliser	There are gaps in efficiency / timing – but there is a limit in what are farmer can actually do – often limited by practicalities of weather, workload, equipment. Fertiliser rates tend to be on the safe side due to the risk of possibly not being able to get more on later because of weather.	<ul style="list-style-type: none"> • Increase in fertiliser rates driven by increase yield and also because its harder to get response • Nutrition is the big issue for RDE – need a revamp • Variation in fertiliser rates <ul style="list-style-type: none"> ○ because nitrogen is used to fix problems ○ 2011 was a wet year so people would've used N to get a response after flood or very wet weather ○ there is a high variety of soils and past fertiliser histories; eg there is new country and other that is not responsive to P ○ use as little as possible to be efficient • It would be interesting to compare 2011 rates with what was done this year <ul style="list-style-type: none"> ○ Used less fertilizer this year because roots were deeper and weren't needing to use N for recovery from wet conditions • The high % of water run urea - 2011 was very wet – growers were forced to water run N that year because couldn't get gas on – had to either water run or fly on (costly) • We are tending now to put more fertiliser on early. • Need to get research out in the field • What is the succession plan for nutrition research? • How will all the research Rocky has done be available once he retires? Don't want to lose it.
	Nutrition basics	Revisit and review the basic nutrition work - there is generational change in the industry and the system has changed.	
	Nutrient balance	Using a test kit to measure how much N comes out a tail-drain in tailwater – where is that going? Will the N return to the crop or be lost? Management impact of the losses	
	Interaction between N and K and P	Will more N help to recover more P & K? When Nitrogen is more even across the season it seems to help to even out / reduce other impacts. Can we get better efficiency of P& K fertiliser if we have better N nutrition?	
	Nitrogen management extension / development and case studies	Project to work closely with 6 farms using their nutrition programs – track & measure where the N goes There is a lot of information but it needs more work. Extension / development program on N nutrition. What is creating the high yields? Field is ahead of the research. Do something for nutrition similar to the Limited Water decisions book that James Quinn did. Ie gather a dozen farmers ideas together in a book	

Crop Protection	Cotton volunteers	Control in back to back cotton. Volunteer cotton is our own problem, no other industry will do this - so needs to be a focus of cotton RDE Volunteer control – difficult to do and not a high priority amongst everything else. Experienced operators on farm is a limitation – practicality rather than knowledge is the limit.	
	Herbicide resistance	A big issue – important to link with GRDC, not duplicate. Farm skills again a limitation - people keep spraying resistant grasses with roundup	
	Residual herbicides - extension	Understanding older chemistry as need residuals again for resistant barnyard grass. Need to communicate the information about the chemical options.	
	Weeds research	Be sure that Graham Charles, etc are well connected with on-farm practice so relevant option are being used in trials.	
	Planting window	Why is there a planting window in Moree? Cannot see any scientific basis for this for resistance management when early crops can end up being picked v late.	
	Whitefly, aphids, mites	Products are coming – commercial activity	
	Cumulative and combined pest thresholds	Need to review the thresholds so can be sure they are economic when you consider the combined impacts of multiple pests	<ul style="list-style-type: none"> • Constantly changing dynamics with new sucking pests appearing
	Conventional cotton	Interest in growing more conventional, limited by varietal performance. Concern about relying on a small number of insecticide choices (due to product not being available) may lead to resistance if there were significant areas.	<ul style="list-style-type: none"> • Some growers say now they will always grow some conventional • But easy to say now when it has been a light insect year • Complex of IPM, beneficials, now relies on a very narrow spectrum of insecticides (supply, not registration gaps) • Happy to go 50% BGII : 50% conventional but are limited by varieties – need a conv/RR variety that is equivalent to the current best yielding BGII varieties • This would save on licence fee in a light insect year • Conventional agronomy can be simpler than BGII

Varieties	Conventional varieties	Performance equivalent to leading BollgardII varieties	
	Root disease resistance		
Farm hygiene	Come Clean - Go Clean reinvigorate the campaign for farm hygiene	A bit complacent about farm hygiene Reliant on plant breeding for disease management, most farms now have some fusarium. More concern about spreading resistant weeds seeds on shared machinery, vehicles – this is a bigger driver than disease.	<ul style="list-style-type: none"> • Have become complacent • Resistant weed seeds is more of a driver than disease
Canopy management	Pix for canopy management and/or harvesting management	Case studies Does shortening of nodes and decreasing the number of nodes actually decrease boll load?	
Water	Neutron probe alternate	A tool that can do the job of a neutron probe but can stay in the field like a C-Probe. Especially for timing 1 st & 2 nd irrigations	<ul style="list-style-type: none"> • Neutron probes are more useful than c-probes for timing the 1st and second irrigation – some use them both • Neutron probes difficult to use – need this functionality in an easier tool • Interested in the work with temperature sensors & C-Probes
	Storage losses	Important - If there's an option?	<ul style="list-style-type: none"> • Big issue but have tried a lot of things – is there anything that can be done?
Energy	Pumping costs	More efficient pumps	<ul style="list-style-type: none"> • Biggest cost is water pumping • Old infrastructure is a limitation to energy efficiency but the cost of efficiency gain is prohibitive when it involves redesigning farm layouts, recirculation systems, etc
	Contact Nick Gillingham	Better use eg turning on & off is v expensive	
Reassessing yield targets & adapting management	Match late season management to a reassessed yield target	A matrix to help when deciding what to do when something goes wrong – eg in an average season, if a field is behind need to reassess – do you cut inputs or throw everything at it to fix it?	Currently we rarely give up on a crop – we keep adding more inputs – but is this realistic & economic? The thinking is to keep trying to recover a crop (double or nothing!)
	Floods and extreme wet weather	Case studies <ol style="list-style-type: none"> 1. Maximise yield on best crops 2. Maximise profit in limited situation 	

Fibre quality	Better weather forecasting	Would help with timing decisions	<ul style="list-style-type: none"> • This is why whitefly is such an issue – can't afford honeydew as the colour discounts are too high • Rain at harvest – balance carefully to make the best decision for moisture, management decisions rather than a research need. • Better weather forecasting would help • Need to be careful of moisture with round bale pickers • Practically, if the season all comes together close then contract pickers are in short supply and you don't want to risk losing the picker so go ahead when moisture is still high • Round bale pickers tend to keep going in conditions that could be too moist
	Hormone drift	Affects defoliation > more trash in cotton	
Pickers	Moisture	Encourage people who are new to round bale pickers to be careful of the moisture levels	
	Soil compaction	Concern about impacts	
Weather forecasting	Improved weather forecasting	Would help nutrition, picking, irrigation and other decisions	
Natural Assets	Round up drift onto trees		Sall talked about growers in Mungindi being interested to know more about their native vegetation and its condition
myBMP	Incentives	Need a way to get people on board eg discount on seed from CSD for BMP growers	<ul style="list-style-type: none"> • Don't use it for information • Yes there is a lot of information in there now but people are blasé about it • Need a good reason to sit in front of a computer to do it • Discussion of role of BMP in markets • Some mills pay a premium for BMP cotton
Labour and skills			<ul style="list-style-type: none"> • People skills is a limitation to getting best efficiencies in farm practices. • It impacts on profit but the decisions about retaining people vs causal and strategies are a personal situation not an industry issue. • Training is not the answer – no need for a training package, do own training on farm so it is specific. • Farms employ a lot less people now as the labour need has reduced dramatically with round bale pickers and no chipping.
Futuristic research	Drones on cotton	Do a seminar with someone who can present a summation of “what is the capability? What might they offer for cotton?” Cotton Conference or CCA forum	<ul style="list-style-type: none"> • Avoid repeating what's happening • David Lamb (UNE) is working with Keytah and John Deere are doing a lot on this too

Extension methods	Local trials & trial books	Recommence the regional Trial Books Also need some local trials - eg like the IDO trials that James Quinn used to do – don't think there are many happening in the Gwydir at the moment	<ul style="list-style-type: none"> • Revisit the older research • There is really good quality older research that is not always easy to find
	Ipad resources	Make the information resources available through ipad accessible tools	<ul style="list-style-type: none"> • Most still have their COTTONpaks
	Small group discussions	Have these discussions with a series of small groups across the valley	
Grower Survey	Worth doing this again	Nutrition rates - It would be interesting to see how 2013 compares with 2011 Best field vs worst field Give growers an individual report that highlights their point compared with others	

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning.

Was this meeting useful and what suggestions do you have for the research planning process?

Meeting was a useful way to get idea together. This group is only a small sample of the valley but it worked well having a small group.

To get broader views, repeat this with several small groups across the valley – up to 10-12 people in each group so there can be good discussion like today.

Research forum for the Gwydir? Sall: do we do a large forum with researcher presentations to get feedback from growers

This would be a way to present research. You won't get the discussion/feedback so much in a large forum.

Role of Panels

Tony: The panels don't do this type of discussion.

Panels are reactive not proactive – we can only review the projects that are put forward, and this is frustrating.

There needs to be something like today's discussion so growers can put forward ideas to say what is needed – so then hopefully better projects will be put up that look at what growers need.

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

For the key projects area of nutrition X soils X canopy I will talk with CRDC and see if they can organize a session with Mike, Rob and Stu and relevant researchers to work that project concept up in more detail.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Ingrid Roth ingridroth@roth.net.au 02 6792 5340

Cotton research and extension “think tank”

Griffith 4 April 2013

Participants:

Growers : Gavin Dal Broi, Mark Williams, Scott Hogan, Rob Houghton, Mick Storrier, Matt Mitchell, Peter Toohey
Consultants/Agronomists : Alan Jones, Michael Taylor, Steve Phillips, Nick Hutchins, , Jorian Milliard, Pat McGuinness, Tom Webb, Chris Andigetto,
Heath McWhitter, Richard Malone, Mat (CGS)
Industry : Rob Hoggers, Carlos Rahme, Jennifer Moffatt, John Sykes, Brian Halse, Linda McKellar.
Apologies: James Hill, Tim Commins, Keith Burge
Convenors: Kieran O’Keeffe, Guy Roth

Summary of priorities

- **Seedling vigour and emergence**
- **Plant management options (Pix options)**
- **Nitrogen fertiliser management**
- **Weed management and glyphosate resistance**
- **Presence of the national research in the south**

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		
Soils & systems	Rotations * soil condition	Rice paddock conversion and management to increase yield.	
Nutrition	Manures	Understand how to better use manures. And their pros and cons.	
	Nutrition extension	Gather all the current information and package	
	Benchmarking	Benchmarking soil data and availability of nutrients and products.	
	P	Ok	
	K	Need some extension of various on farm trials in relation to K	
	Nitrogen management	Set of standard trials (on farm) coordinated across different locations track & measure where the N goes. Understand full N cycle – timing, recovery, losses, and economics, timing of availability, pre and post planting options, and best practice rates options.	
	N testing	Tissue testing questions. Need an in crop N meter?	

Crop Protection	Fleabane Weed	Major problem and need options for management. Costs.
	Herbicide resistance	<p>A big issue – important to link with GRDC, not duplicate and learn from others in Australia and USA.</p> <p>Glyphosate management and resistance management.</p> <p>What is the cost of losing glyphosate?</p> <p>Educate growers and agronomists with options. Need a BMP.</p> <p>Need options if resistance develops</p>
	Grass control	Control of summer grasses
	Insecticide Mode of Action	Need to lengthen life of products
	Green Vegetable Bugs	Developing thresholds for GVB
	Wireworms	Seed treatment versus liquid / granular.
	Thrips	Thrip thresholds and effects if any on maturity, yield and quality and the different application strategies.
		Trial Success Neo under permit for control
	Refuges	Options, what is the best attractant as a refuge in the south.

Varieties	Better Seedling Vigour	<p>Timing and weekly differences within valley for highest yield</p> <p>Late planting versus pix usage</p> <p>High seedling vigour Index and greater transparency on this.</p> <p>Controlled germination test @ 12 deg C versus the standard 16 deg C for different varieties.</p> <p>More practical use of soil temp data for planting that is more specific for southern options, rather than the northern rule of thumb.</p> <p>Seed treatment impacts on establishment and better options. (eg cruiser vs. liquid lorsban vs. granular insecticides)</p> <p>Screening trials for new varieties</p> <p>Watering up versus pre irrigation</p> <p>Pop up fertilisers /Growth regulators on seedlings</p> <p>Pre versus Post emergent herbicides on vigour/yield.</p> <p>Beds versus hills</p> <p>Print seedling vigour on bags</p> <p>Seed coatings P & Zn</p> <p>Seedling disease</p> <p>Packaged info for the five different locations in the southern regions.</p>
		Varieties that yield as well with less micronaire issues
Farm hygiene		Not raised.
Canopy management	"Plant Steering" & Pix™ Management	<p>Comparison of pix cut out dates in relation to and the effect on boll size, yield, earliness, cut out date, quality and yield</p> <p>Management to manipulate first fruit set, eg low rates of pix early 6 leaf stage</p> <p>Cut out timing (nodes not producing)</p> <p>Irrigation methods are different, ie overheads, are there different management options</p> <p>Variety responses locally, not Wee Waa.</p> <p>Want on farm trials linked to core research. ie trail replication in the south.</p> <p>Interaction of N status.</p> <p>Variable rate application</p> <p>Application at node 15 versus 19 2-3 l/ha.</p> <p>Complex interaction with temperatures and crop stage.</p>
	Growing Degree days	Solar radiation versus GDD as the best growth indicator for management.
	Crop senescence	Early crop senescence is it a micro nutrient?
Water	Scheduling	Irrigation scheduling * probe * 4-5 soil types to work out the size of the bucket. ie plant available water. Different to up north.

		Irrigation scheduling tool iPhone app to manage soil variation.
		Bankless channel layout – waterlogging.
		Irrigation structures for WUE
Energy		Not discussed.
Reassessing yield targets & adapting management	Plant Establishment	Wireworms building up. Need knowledge on product vigour 2 weeks and 3 weeks for establishment, liquid versus seed dressing Different approaches within a farming system in combination with variety trials (CSIRO/CSD)
Fibre quality	Better weather forecasting	Would help with timing decisions
	Hormone drift	Affects defoliation > more trash in cotton
Pickers	Not raised	
Weather forecasting	Improved weather forecasting	More accurate weather 7-14 days for plant steering.
Natural Assets	Not raised	
myBMP	Not raised	
Labour and skills	Human Resources	University of Melbourne provided over view on CRDC funded human capacity study. Emerald and Gwydir case studies have been done. Wanted to know if southern areas were keen to be part of project. Response was yes and project will follow up.
Futuristic research	Not raised	
Extension methods	Local trials & trial books	Recommence trial books or gathering of this sort of information in another forum. A southern presence was needed with linked research at key sites. On farm trials recorded and reported annually, info packages on key areas, list of R&D projects. “Narrabri” research needs to be re done in south. The “south” is really five different valleys and should not be treated as one. Temperatures and soils vary considerably.
	Small group discussions	Meeting was a useful way to get ideas together. Should have other agronomy meetings eg consultants get

		together. Important to see some follow up to this meeting
Grower Survey	Worth doing this again and get plenty of southern input	
Economics	Farm economics	The Boyce data was discussed briefly and handout provided. Will follow up this winter for more southern data.

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning. Each person tabled two priorities. These were then grouped into some key areas that were explored in further detail, primarily by a round table discussion.

Suggestions do you have for the research planning process?

Meeting was a useful way to get ideas together. Should have other agronomy meetings eg consultants get together. Important to see some follow up to this meeting.

It was stressed that a southern presence was needed with linked research at key sites. On farm trials recorded and reported annually, info packages on key areas, list of R&D projects.

It was stressed that the “south” is really five different valleys and should not be treated as one. Temperatures and soils vary considerably.

Summary of priorities

- **Seedling vigour and emergence**
- **Plant management options (Pix options)**
- **Nitrogen fertiliser management**
- **Weed management and glyphosate resistance**
- **Presence of the national research in the south**

BACKGROUND--SOUTHERN NSW

- Cotton production is relatively new (53,400 ha in 2011/12) but it has had a long phasing in period (research/production initiated in the early 1970's).

- The southern NSW area (Hillston/Condobolin-->Coleambally/Berriquin) is climatically different and is regarded locally by growers as 5 different "valleys". It is regarded as very different to the Namoi Valley and further north.
- There is no local RDE reference group but a local grower sits on a CA Research Advisory Panel (farming systems).
- There is a strong and active CGA group and recently an industry development officer (Kieran O'Keefe) has been appointed by CSD/CRDC/CA.
- The CGA has a major goal to achieve increased presence or linkages to national and local RDE projects.
- There is potential to initiate R,D or E projects through negotiation with research scientists employed by CSIRO and NSW DPI in partnership with CRDC (and GRDC).
- It is important that issues be aligned to what R, D or E level(s) are most appropriate, prioritised and opportunities for partnerships to be developed.
- Five major issues have been prioritised by industry in southern NSW in April 2013. Ongoing activities with industry via CGA should continue and opportunities followed up by a small RDE committee to focus contact with CA/CRDC/CSIRO/NSW DPI (and GRDC).
- A few discussions today to put forward at a CGA meeting of another active CA panel member possibly an agronomist.
- Useful recent paper: Cotton Conference paper 2008, James Hill, former Cotton Development officer, NSW DPI.

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Guy Roth, guyroth@roth.net.au, 02 6792 5340, 0417 223 179

Cotton think tank – Research and Extension needs for the Macintyre 9/4/2013 and 1/5/2013

Panel representatives: Nigel Corish, Tony Taylor
 Other Growers: Toby Makim
 Crop Consultants: Helen Crossley, Brendan Griffiths, Tim Richards, Fred Ghirardello
 Industry: Bec Fing, Amy Billsborough, Sall Dickinson, Robert Mensah
 Convenors: Ingrid Roth, Alice Devlin

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
Systems & soils	Systems Interactions N X Soil X Irrigation X components of yield & quality Identify the drivers of high yielding patches in fields	What is the impact on yield and quality of nutrition, irrigation, soils management strategies? Financial value of a rotation? Good patches within a field (high yielding) – what is actually contributing to the higher yields? (Soil tests don't give an answer)	Many have had forced fallows during drought – difficult to break that back-to-back to get in a fallow rotation when water is available – Much of this is debt driven. What is the value of the rotation? consider benchmarking. N X water is a perennial issue
	Yield maps Better use	How to make better use of yield maps to be able to predict what to achieve in a crop	Not clearly anyone's role to interpret yield maps – consultants don't have the time. Growers are getting yield maps but relatively little is done with them. Technology for precision ag has developed and diverged, implementation has gone nowhere. Powerful data limited by IT handling - It's very clunky to share with someone and download over slow speed connections, there is commercial incompatibility between machines (improving) Contact: Tim Richards
	Root development, soils & management interactions	Impacts of system on root development Soil type X sub-soil constraints X field history X nutrient use	

	Soil compaction (part of the above larger Q)	<p>What is the damage? What are the effects? How to avoid compaction \$ value/ cost of a rotation in treating compaction Links to precision ag for within field knowledge and management Matching land preparation systems to the new round bale pickers</p> <p>How to treat really deep compaction</p>	<p>Compaction is understood but there is complacency about its importance. Need good soil scientists. It will become a big issue</p>
Managing for weather	Predicting heat or waterlogging stress and responding	<ol style="list-style-type: none"> 1. Better forecasting of weather to predict when stresses will occur 2. Tools to reduce the impact of weather induced stress on quality & yield <ol style="list-style-type: none"> a. Nutrition - including understanding plant uptake of and response to N and other nutrients after a waterlogging event b. Pix (rate, timing for stress mgmt) c. Irrigation timing (reasonably well understood from S.Yeates work) d. Other agronomic tools 3. Management tactics before and after a heatwave <p>Understand also how practicalities can limit ability to respond quickly eg how to prepare a crop if you are about to get inundated</p>	<p>Links with the day degrees model work</p> <p>This draws on all the systems work – it is these stresses that are critical to predict & manage well to achieve yield & quality.</p> <p>Waterlogging has the big impact</p>
	What is the optimum planting time/growing window with new BRF varieties?	<p>When is the best time to plant BRF varieties? Can we plant later (late October/early November) to avoid the heatwave period?</p> <p>Ozcot modeling or review of variety trials could help to work this out.</p>	<p>These varieties keep growing longer, can we avoid the heat wave periods?</p>

	Crop recovery limitations	How economic is it to try to recover a stressed crop? What works and what is too costly for the risk?	If the crop doesn't yield and you keep throwing everything at it then you're losing money. Depends a lot on cotton price – at a high price it's worth the extra inputs to try to regain yield. At lower price it's probably not worth the risk.
Nutrition	Input – output balance in high yielding crop	Is current practice sustainable in the patches within a field that are high yielding? Plant segmentation work How to best manage a high yielding system?	eg a field is being fertilized for 10 bales/ha but some patches are yielding 18bales/ha – is it sustainable? Most would do they same nutrition program across the farm
	Soil specific nutritional needs	Local trials and recommendations	Now doing more upfront N application because of practicality of getting it on
	Nitrogen efficiency	When to best put it on? How to get the most out of what is applied?	
	Sulfur	Are we approaching a need for sulfur applications? Communicate Dave Lester/Mike Bell work on Sulfur	
	Nutrient leaching head ditch to tail drain	To what degree is the yield differential caused by nutrient leaching down the rows and/or waterlogging & denitrification near the head ditch? How can this impact be reduced? How can yields at the top end of the field be improved?	Yields are significantly better at the tail drain end of fields than the head ditch end. This is thought to be caused by nutrient run-off down the row. Some have measured nitrogen loss into tailwater. (Have also seen insecticide movement down the field)
	Nutrient application and placement	Where to place fertilizer to minimize losses Spreaders vs direct drill Alternate furrow side-dressing to avoid the water-run side Would this be done using isotope N to track movement?	To reduce N loss in tailwater, now side-dressing only on the dry side of the hill (ie the side where water is not run) Timing is influenced by the season. eg The 2010-11 season was very wet before planting – hard to get N on pre-plant therefore more put on in season. Trend back to placing more N upfront (about 2/3rds of nutrients up-front). More interested in placement than timing to minimise loss
	Increase petiole testing in season	For better tracking of N needs at 700 day degrees and beyond	

Crop Protection	Herbicide resistance	Early detection & management needed Awareness campaign to increase the perceived importance Demonstrate / communicate the impact that resistant weeds have on yield (seeing this in patches of resistant grass weeds) and costs	Has been a real issue for a while in dryland with resistant grasses Volunteer cotton the biggest issue in irrigation
	Volunteer cotton		Not getting value from RR technology as paying a licence fee and then needing to manage it as a conventional crop
	Whitefly	Getting the balance right in control decisions <ul style="list-style-type: none"> Understanding actual impact of honeydew, etc How much is too much? Strategies – there are very different approaches, which ones work? <p>High cost of sprays. Very difficult to follow different whitefly treatments through to fibre quality</p>	Always need to think of secondary pests Whitefly harder to decide on strategy because impact is not on yield but one honeydew/quality down the track. Sometimes if you do nothing, whitefly just go away – what is the best strategy?
	IPM		Why do the ‘older’ valleys have more people that say IPM is not of importance? Maybe because not an area of concern. Robert noted that Fipronil may be lost (is on ‘watch’ list) – this would set back IPM.
Varieties X genetic traits	Bollgard 3	Refuge requirements: What will be the options? Can it be better?	
	Pupae busting	Alternative to cultivation for dryland cotton	
	GM Technology costs	The costings of RR and Bollgard technology is too high.	Now that you need to cultivate for RR volunteers the \$ savings of using Roundup Ready are not as great.
	Liberty Link limitations	It’s not available in a good performing variety. The risk of drift on neighbours is concerning – would need to all grow LL or RR – potential for an area wide approach.	Until there are better varieties with

	Conventional cotton (non-Bollgard)	Varieties are the limit to growing conventional cotton – there are not any good conventional RRF varieties. eg 71RRF has a bad disease and fibre package	Have grown conventional this season with 6 sprays. It's a cycle – breeders won't produce conventional varieties because there's not market demand but if there were better varieties then more people would grow it.
Farm hygiene	Herbicide resistance needs to be a driver for better hygiene		Have become slack since Fusarium has not been an issue. ~75% indicated in 2011 survey they always control weeds – don't believe this is true – they'd like to but are ignoring problem areas
Water	Bankless channels	Continuing interest in this as an option to reduce labour	It is very hard to retrofit bankless channels into an existing furrow development. eg popular in Griffith but that is because they are setting it up that way to start with. Is overhead an option form reducing labour cost? No – limits yield in some soils as it's hard to keep the water up. Need a reliable water supply to justify the cost
	Tailoring water application to optimise yield & quality	Frequency X volume X timing – impact on yield & quality	Have gone full circle – back to more frequent irrigations - but for shorter duration, optimize for BGII plants
Energy	Benchmark fuel efficiency	Look at comparison of total fuel use and electricity usage on farms. Energy demand comparison of different irrigation types	Improvements are largely a commercial / financial decision and its easy to do the numbers. Old pumps use a lot of energy. There is value in changing to new pumps – but the capital cost is high. Conversion to gas etc is a commercial decision not an industry research need
Fibre quality	Honeydew	How to manage honeydew when it is there	
	Plant breeding	Plays the major role in improving quality	
	Mic in hot season	How close will we be to being over mic? What could we have done to manage for this?	OK so far tsi yera
Pickers X quality	Moisture with round balers	How late at night / how wet to pick? How best to determine / measure moisture levels	Moisture meters not very accurate, looking at dewpoints, etc. Brendan Griffiths has trials looking at this this season.

myBMP	<p>Communication about the tools / resources that are there</p> <p>BMP information app</p>	<p>Uptake is the big issue - It will take time</p> <p>Look at developing an integrated app or computer platform to revamp the information side of BMP – like the new ClimAte app (this is really good, has integrated and given new life to some useful tools that were almost lost)</p>	<p>People are still scared by what it used to be People won't spend the time if there is no benefit. Personally see value in it but many think of it as a 'big process' outside of the farm.</p> <p>Not used or regarded as an information source</p>
Labour and Finance	<p>Benchmark:</p> <ul style="list-style-type: none"> • Inputs costs • Fuel • Labour • Debt 	<p>Understand the influences that machinery, labour and debt have on management decisions</p>	<p>Mactintyre was keen on benchmarking for IPM. Rubbish in- rubbish out with data is an issue; even so the principle of benchmarking was good - it achieved the need to rethink pest management IPM is not the issue now but could use benchmarking to rethink input efficiencies</p>
Extension methods	<p>Local discussion about production issues</p>	<p>Growers don't come together to talk about their season/production the way they used to</p> <p>End of season review meeting has been planned by the CGA & Bec (similar to what used to be done in the past)</p>	<p>Potential for CGAs to include production issues in meetings, or localized groups Change of guard with consultants /growers = differing needs Needs further discussion with growers about how to best target the extension effort Have not had an extension person in this valley for several years</p>
	<p>Standard trial protocols</p>	<p>What is the correct way that is suitable for everyone (scientists, Monsanto, Growers)? Clear guidance for growers wanting to do their own trials What are the required replications, best layout, monitoring requirements & techniques Design of trials for commercial & industry research so they are compatible</p>	<p>Concern that some trials are incompatible (eg resistance monitoring)</p>
	<p>Communication of on-farm trials</p>	<p>More discussion and communication of trials in the region</p>	<p>Waiting on Duncan to provide a collation on nutrition work</p>

Research Capacity	Compartmentalised research disciplines and short term contracts means there are not enough new career researchers and not enough systems work		Field is ahead of the research in areas such as N X water interaction
	Succession plan	Need to attract and retain younger researchers	Concerned that there were a group of younger researchers (Oliver Knox et al) who were doing really well and then have been lost out of the industry or moved to Monsanto.
	Local research & trials are needed	Lack of communication of the trials that do exist	CGA have really welcomed CRDC's investment in the RDO role so that there can be more local project work and to help grower/consultant interactions
Grower Survey	What are growers doing with their yield maps? How would growers respond if N cost went to ~ \$1500/tonne? Refuge & pupae busting options for Bollgard 3 Gather the survey input at a meeting? (may be too detailed?) Have an online option for filling out the survey		Send the summary data to growers. This is really powerful information

Comment about the research panels

The Farming Systems Panel has to review too many climate projects (sometimes half of the total projects) rather than actual farming systems – suggest to create a sub-panel to review these.

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning.

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

It would be good to have wider input from growers in the Macintyre – we'll follow up about this.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

THANKS FOR ALL YOUR IDEAS, Ingrid Roth ingridroth@roth.net.au 02 6792 5340

Cotton research and extension think tank

Breeza 11/4/2013

Participants: Angus Duddy, Jamie Burt, Rod Grant, Jim Hunt, John Hamparsum, Gordon Brownhill, Aaron Goddard, Mark Goddard, Dwayne Schubert, Kim Duver, Ian Carter, Sandy Young, Carol Sanson, Craig Charters, David Ronald.

Apologies: David Brownhill,
Convenors: Guy Roth, Kirrily Blomfield

Theme	Research, Development & Extension Issues Identified		Discussion of the 2011 survey results and other comments
	NB in bold are the highest priority issues		
Soils & systems	Wheel track Compaction	<p>Collect some basic yield data in wheel track rows and non-wheel track rows. Also need to look at rotation crops. Not too late to do this in 2013.</p> <p>8 metre vs. 12: tracks versus tyres</p> <p>Gantry systems (see Danish examples in the Land.)</p> <p>Picker compaction</p>	Some data from years ago, Breeza Station also has some more recent corn data
	Long fallow disorder	Why is cotton not growing so well after what should be an ideal rotation? Cotton, corn, faba bean or chick pea, cotton.	

Nutrition	Potassium	Lots of questions around K. Big variation in results, application strategies. Why?	Higher yields leading to higher rates.
	Testing	More opportunity for in crop testing (tissue etc.) and application methods to apply nutrients. Extension issue: Soil N testing and understanding data. Need an in crop N meter.	Zn is about the same Rising costs, big jump in 2011-12 also include energy cost spike. Data shows industry is all over the place. Risky looking at single year data eg 2011 some people were flooded and yields were low.
	N losses	Are the N losses (volatilization) as great in this cooler region compared to Narrabri and other warmer areas? In theory no, but don't have any data other than Narrabri etc., where all the research is done? If so opens up opportunities such as spreading urea dry.	Nutrition is not the most important R&D issue in this region.
		Weather * N placement * timing	
	General nutrition	More of an extension issue Role of other lessor researched minerals Interaction of macronutrients (N, P, K, S)	

Crop Protection	Cotton volunteers	Major problem and need options for management.	
	Herbicide resistance	<p>A big issue. Risk of over use.</p> <p>Glyphosate management and resistance management.</p> <p>Educate growers and agronomists with options. Need a BMP.</p> <p>Need options if resistance develops</p>	<p>Weeds leading up to planting a major challenge as well as in fallow paddocks. 24 D damage is problem We have the 24D tolerance gene, what happened to it and that work?</p> <p>Windmill grass, barnyard grass liver seed grass may have resistance. Need options.</p> <p>Heard about some research that showed one cultivation every five years really helped resistance management.</p> <p>Both a dryland and irrigation matter.</p>
	Pupae busting.	Change strategy and look for alternatives such as weed control. TIMMS to review. Zero till cotton	Can we change strategy, be more strategic with a later cultivation (for weeds). Getting some new tools like Magnet etc., different refuges.
	Weed seeking technology	<p>How to lower cost of weed seeking technology. Develop a tool for the mobile phone using their infrared sensors. Got to be an international effort.</p> <p>Are there gromoxone options ?</p>	
	Seed treatments	Seed treatment versus liquid / granular.	
	Insecticide drift	Need to re think how to target growers and their applicators (i.e. the driver) that don't attend Bill Gordon's training. Eg make it part of Chemcert etc.	<p>Need better knowledge on it. While recent focus has been on herbicides, is insecticide application still up to scratch?</p> <p>These days we are spraying our rotation crops more than cotton.</p>
	Refuges	Options, what is the best attractant. Growing cotton instead of pigeon peas.	

Varieties	Better Seedling Vigour	<p>High seedling vigour needed.</p> <p>Increase seed size for vigour</p> <p>Need new chemistry and seed treatment options. Will an early insecticide increase vigour.</p> <p>Look at interactions</p>	<p>Seed size seems to vary a lot.</p> <p>Poor germination of 74 variety.</p> <p>Reliance on nictocides will lead to resistance. Need an alternative.</p>
	Shorter season varieties	<p>Strong germinators, cool tolerant, faster finishers, good yield.</p> <p>Adapted to dryland</p>	
	Longer fibre length		
	Date for last effective Boll	Eastern side of the valley for newer varieties ie 71 & 74.	
Farm hygiene/ Disease	Verticilium wilt	Verticilium wilt is getting worse. Why? Happened over the last 4-5 years. Is it rotations? Is bore water quality stressing the plants and causing this?	
	Black root rot	Impact of BRR on earliness.	
Canopy management	Growth regulators	<p>Comparison of timing, pix cut out dates in relation to and the effect on boll size, yield, earliness, cut out date, quality and yield. Look at different varieties, split applications, and day degree variation in the valley.</p> <p>Earliness is a major thing to look at.</p>	
Farming	Farming systems	Cotton has a very narrow planting window (2 weeks) in the region, which other crops don't. Creates some	

systems		challenges. Crop rotations for dryland production.	
	Row spacing and configurations	Super singles, 60 inch. Looking for options to reduce compaction. Single .skip, double skip, solid. Considerable interest here in different configurations, fit with other crops, machinery etc.	
	Variety specific agronomy packages for the area	Similar to GRDC variety specific agronomy package for barley. Variety, row spacing, crop management, disease, planting, PGRs.	
Water	Probe data interpretation	Irrigation scheduling. Need extension effort to interpret capacitance probes and data. Lots of overhead systems and workshop needs to cover all irrigation types and all probes.	Upper Namoi we are part time irrigators. Very temperature driven. There is significantly more overhead systems now and future surveys should show that. Less water logging with these systems. Landmark has some good local data with these systems.
	Overhead Irrigation Crop Management System / Package	Develop crop management BMPs for the overhead systems. Lot more of these systems now.	
	Storage losses	Both seepage (extension) and evaporation (research). Erosion maintenance information.	Could you also apply a polymer to the leaf to save water?
	Water quality	Is water quality from bores affecting crop yields and or soil structure, eg in overhead systems. There is a lot more bore water use in recent years of poorer water quality.	
	Last irrigation	Do the losses of not having an irrigation in late Feb outweigh increasing fruit load. WUE of that last irrigation.	
Energy	Round bale transport	Transport of round bales. Need a trial daylight hours, 80 Km/hr. to cart 5 round modules on a road train to gin.	

Reassessing yield targets & adapting management			
Fibre quality	Coal dust impacts		
	Round bale effects		
	Global perceptions	Global market perceptions of Aust Cotton.	
	Improve through management	Systematic approach to all management issues (extension) eg defoliation in cool areas.	
Pickers	Not raised		
Natural Assets	Feral pig control	Getting worse	
	Coal mining dust	Effect on cotton yield and quality (colour)	Any evidence from Emerald, Hewitt.
myBMP	Incentives	Finding the elusive financial incentive or cost reduction	Good resource for finding information. Eg recently used defoliation.
Labour and skills	Not discussed		.
Futuristic research	Hi oleic oil gene for seeds		Where is this at?
	Machinery	Eg Danish modifications creating wide gantry to reduce compaction.	
Seed	Transport options for seed	Fuzzy seed management transport. Need more markets and increase value for seed.	
Extension methods			
Grower			Important to look at surveys over several season to remove any seasonal bias.

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning. Each person wrote down 2-3 priorities and parked for later. The group discussed topics using the handout of survey data. At the end of meeting individual priorities written down earlier were cross checked with discussion, and some additional items tabled.

Suggestions do you have for the research planning process?

Appreciated the opportunity to have some input. Need to do the same for grains.

Meeting was a useful way to get idea together.

Summary of priorities

- Better seedling vigour and management options
- Herbicide resistance and herbicide tolerant cotton management
- Growth regulator research in local region
- Moisture probe data interpretation
- O/head systems agronomy package
- Farming systems, rotations, row spacings, machinery (need forum to discuss more)
- ????? (Nitrogen losses ?)

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Guy Roth, guyroth@roth.net.au, 02 6792 5340, 0417 223 179

Central Queensland Cotton RD&E Needs and Priorities CHCG&IA Research & Tech Workshop 16/4/2013

Meeting Conveners: Cameron Geddes*, Susan Maas
Facilitator: Ingrid Roth
Panel representatives: Neek Morawitz*, Damien Erbacher
Growers: Nigel Burnett, Andrew Geddes*, Graham Volck*, George Sypher*, Andrew Keeley*, Sam Millar*, Peter Galea, Catherine Galea, Dougall Millar*[?], Rob Ingram*, Craig Barsby*, Chris Ryan*, Chris McCullagh*, Ross Burnett*, Hamish Millar*
Consultants: Graham Spackman*, Jamie Iker*, Amanda Noone*, David Parlato*, Ellie Hampton, Darren Young*, Stewart Brotherton*
Research & Extension: Paul Grundy, Mike Bange, Stephen Allen, Steve Yeates, Lance Pendergast, Duncan Weir*, Geoff Hunter*, Geoff McIntyre, Gail Spargo*
Industry: Greg Kauter, Guy Roth, Liz Alexander*, Renee Anderson*
* would like to participate in the Research and Tech Group

Cam Geddes introduced the purpose of the meeting to be to have an open discussion about what is needed to improve the reliability of growing cotton in Central Queensland, drawing on the findings of the CQ Cotton 2012 survey undertaken by the CHCG&IA. Researchers have been invited to help inform the discussion.

Key issues for research, development and extension (RDE) are summarized in the following table.
Research presentations are attached with notes from the discussions.

The notes have been drawn from the meeting and supplemented from further discussions with a number of growers.

RDE planning process

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider (The Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning), to CRDC and to researchers to help them in preparing project proposals.

The CHCG&IA will also work with the issues to prioritise local RDE needs.

Any further suggestions or comments, please contact: Ingrid Roth ingridroth@roth.net.au 02 6792 5340 or Cam Geddes 0400 009 190

Systems & soils	Soil health & microflora and interaction with plant	Influence of rotations on soil health and to help improve nutrient availability	<p>“Rotations have a benefit on cotton crop but there is a greater benefit to income by spreading risk”</p> <p>Some of the consistently highest average yields at Emerald have had back to back cotton for many years (20+ years)</p> <p>Is yield driven more by timeliness and/or skills level of employees that by crop sequence?</p> <p>Other crops are much cheaper to grow, if they can be grown before or after a cotton crop they add income and spread risk. But, do they influence the cotton yield? eg by running out of time to prepare for cotton, excess stubble?</p>
	Rotations vs Back to back cotton	Are there actual benefits to cotton of growing other crops in rotation with cotton in the CQ environment? Is there proof?	
	Double cropping – managing risks	Double crop allows diversification to manage risks. But what is the risk that they limit the cotton yield?	
	Bed preparation and post harvest workings	Is there a more efficient way to prepare the beds and complete the end of season land preparation?	
Nutrition	Optimising N efficiency on clay soils – esp in wet seasons	Denitrification losses – how are they influenced by rainfall and irrigation? How much does urea leach out of clay soils and hills? Do we need 300 units of N? How much N is too much (eg delayed maturity for the same yield?)	<p>Some growers noted that nutrition is not the big issue accounting for the 30-40% variability in yield – 240N + P&K will be enough for the target yield –validate the lack of link between yield and fertiliser rates</p> <p>Other growers are interested in efficiency gains to cut costs by matching fertilizer rates to need.</p> <p>Why are NP&K rates per bale are high compared with other regions?</p> <ul style="list-style-type: none"> - the low yields of the 2010-11 and 2011-12 seasons are a key driver of this. - Don't have cool nights like other regions (high night temps increase N losses?) - We don't know what N was taken off, what residual there is <p>Yield maps are showing a large variation in yield from top of paddock to the bottom.</p> <p>We knew there were losses from headditch to taildrain but not aware of how much.</p>
	Map the N budget	Soil tests, petiole tests, seed tests, yield, run-off N, denitrification, etc to validate the N requirement	
	Quantify losses of N down the row and into tailwater - how much are we losing in each irrigation?	Is this yield difference driven by N losses? Is this run-off or denitrification with waterlogging at top of field? Quantify the changes in Nitrogen and yield between head ditch and tail drain ends of the field	
	Variable rate application	Quantify losses of N into tailwater Are variable rates needed along the row?	
	Spilt applications & water run N	Would applying all N as a sidedress be optimal? N losses from up-front application Split applications are used to manage risk but are they the most effective / efficient option? Running N in water – how best to get it on? The practicality of being able to do split applications vs the risk of putting it all upfront (due to rain etc) Better understand seasonal influence on in-crop applications	
The nutrition questions are primarily about the most efficient strategies for applications of nutrients (timing, method, form, etc)			

New & existing nitrogen fertiliser products	<p>Timing & placement</p> <p>Some hard data on new formulations (eg coated urea products) and nitrification inhibitors (eg Entec) - do they work to reduce losses and improve efficiency of uptake?</p> <p>Will coated urea allow us to avoid an extra pass?</p> <p>Can slow release urea reduce risks of side dressing to help early vigour?</p>	
P & K placement & rates	<p>Revisit some of the old data and/or clarify P&K needs given different background levels in soils</p> <p>What are efficient rates?</p> <p>Historically have applied K to prevent senescence - does it also have a wider role in yield?</p> <p>K placement and stratification in sub-soils</p> <p>Spreading and cultivating P&K in in-crop application</p> <p>Better understand the impact of K on plant growth.</p> <p>Need a trial in Emerald.</p>	<p>“There is a big difference in soil tests around the region but everyone is putting on the same rates”</p> <p>Why don’t we vary our fertiliser rates? There’s not much variation in rates between old and new soils.</p> <p>Industry has some K trials underway but none are in Emerald</p>
Root physiology X waterlogging X nutrition interactions	Root system development in relation to environment	Waterlogging can lead to P&K deficiencies because there are less roots and plant is taking up sodium instead
Soil tests interpretation & use	<p>Research into matching soil levels of nutrients with soil tests and fertilizer recommendation and application</p> <p>Increase the use of regular soil testing</p>	We all soil test, get different results but put on the same rates.
Placement of trace elements	Micronutrient research – are there deficiencies?	
Composting	Would be interesting to see compositing data	If have easy access cheaply then make use of composts & manures
Emerald based nutrition trials & extension	More information and trials relevant to soil types and climatic conditions	<p>A lot of the work is not being done in Emerald. <i>“There is no other area like us, we are radically different”</i></p> <p>Burdekin fertiliser placement work is misleading for Emerald</p>

Crop Protection	Weed resistance to roundup (glyphosate)	Reduce reliance on glyphosate	
	Roundup Ready volunteers		
	Thresholds for beneficial insects for sucking pests		
	Refuges	Get rid of the 5% pigeon pea – can we use an alternative?	Pigeon pea costs and doesn't make any money
	Bollgard payment terms that limit the option to grow conventional cotton		
Waterlogging	Guideline for avoiding and ameliorating waterlogging	Best practice options for waterlogging, including: <ul style="list-style-type: none"> • What is the best bed shape & height to minimise waterlogging impacts? • Looking after surface roots • Cultivation risks & benefits • Nutrition top ups • Good drainage • Irrigation duration, run lengths, slopes • AVG growth hormone 	Cultivation does aerate soil but it can have a negative effect as it cuts off roots from plants that already have restricted root systems caused by the waterlogging. Foliar N and Iron are sometimes used – mixed responses AVG growth hormone – work was done with this in early 2000s – may be worth reinvestigating
Irrigation	Forecast in irrigation decisions	Balancing waterlogging vs water stress options in decisions about watering when rain is forecast Better linkage between rainfall forecast and irrigation decisions	
	Tools for irrigating in variable weather	Having the right tools when weather variation is the major limitation	
	Soil type specific irrigation deficits	Better information for using probes on different soil types.	
Energy	Energy cost for irrigation	Can we be more efficient in shifting water to reduce energy costs?	

Fibre quality	Better understand ginning	How is ginning influencing the quality?	Quality discounts are substantial
	Grades	Is there scope to improve the consistency and quality of ginning? Does this relate to skills in the gin and is there anything that can be done to improve skills?	Some cotton from the same fields are ginned at different gins or on different days in the same gin and come back with very different quality results. This can be a huge cost to CQ growers.
Yield Reliability, Inputs, Finance	Optimising returns	Improve yield, improve quality, reduce costs, optimize other crops in the system	
	Simplify inputs	Less machinery passes. eg use slow release urea in a single application to reduce the cost and risk of side dressing	
	Improving reliability	What is the influence of timeliness on yield? How does skilled labour (eg family members vs backpackers) influence management and yield?	There are farms that are consistently yielding well. There is also much variation between yields of different fields on a farm – does this relate to timeliness of operations?
	Managing for a yield target	What is a realistic target for CQ? Should we be using that as a budgeting tool? How do we adjust inputs (insecticides, fertiliser, water) accurately to account for a lower target?	Most growers are reluctant to reduce inputs in case of risk of yield penalty. Others see opportunities to be more efficient in matching inputs to requirements.
	Improve records	Better record keeping of crop inputs, yield and quality so that can track over time and look for areas to improve efficiencies.	Record keeping is limited on many farms and is perhaps getting worse due to time constraints. It will be difficult to optimize returns without good records.
Extension methods	Literature review of existing CQ research	eg planting date (Sands, Kelly, Sequira) 2 crops (Yule, etc)	
	Information from other districts can be counterproductive		
Research Capacity	Would like to see more local trials		
Grower Survey	Include the Best Field / Worst Field questions in the 2013 industry wide grower survey (at least for Emerald) so can compare two years of data		

Cotton think tank – Wincott Research and Extension needs

1/5/2013

Wincott Members: Michelle Smith (Goondiwindi) Alison Benn (St George), Sally Dickinson (Goondiwindi)
 Facilitator: Ingrid Roth

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
People	Understanding the information seeking preferences of men & women in the industry	<p>Are the information needs of men & women different?</p> <p>How do women and men want to receive information about cotton related issues?</p> <p>Possible approach: preparing a set of focus group questions for facilitated discussions in different regions (eg at the picnics)</p>	<p>Better understanding the differing information seeking styles will help:</p> <ol style="list-style-type: none"> a. Wincott to become more representative by better understanding the group they represent, and b. The D&D team to tailor their campaigns
People	Understanding decision making roles within the farm business	<p>Who is involved in decision making on farm?</p> <p>In what capacity? (sounding board, decision maker)</p> <p>In what type of decisions? (agronomy, financial, WUE changes, HR)</p> <p>How does this influence activities on the farm?</p> <p>How does this influence the audiences and drivers for Wincott and Development & Delivery efforts?</p> <p>Sectors include: Women, generational groups, staff, consultants</p>	<p>Purpose as above.</p> <p>There is a Gen Y affect in the workplace – people aiming for more work / life balance not longer days on farm.</p> <p>Some women in the business play a role in filtering information and flag/delete what goes through</p> <p>There is a wide range of ways that wives/partners are involved in the business (not at all, financial side, sounding board, agronomy, all aspects) – we don't have a real picture of this.</p> <p>Many women work off-farm (economic vs lifestyle choices?)</p>
People	Information channels and filtering on farm	<p>Who does information go to in the farm business?</p> <p>Does it reach others in the business?</p> <p>Is it filtered first? How?</p> <p>Eg are women missing out on information or is it going to them first and they are filtering it, etc?</p>	<p>Eg with a change from fax newsletters to email – does this cut women out? Or is it going to women who may filter it</p>
People	What is the role of family in farm businesses?	<p>To what degree are family members involved in cotton farming businesses</p> <p>Are they filling a labour shortage?</p> <p>Are they in decision making roles?</p>	

People		Are they in support roles? Do they take on HR or other roles that would otherwise be a gap? How does this influence farm operations?	
	Bookkeeping	What are people using? How can this be simpler and more useful?	Getting information onto the computer is hard.
People	Skills	The Wincott Skills survey showed interest in more information about computer systems, government subsidies, loan management and budgets.	A summary of the Wincott skills survey can be included as an appendix to the 2013 Survey report – provide Ingrid with a summary report by mid August.

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning.

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

It would be good to have wider input from growers in the Macintyre – we'll follow up about this.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

THANKS FOR ALL YOUR IDEAS, Ingrid Roth ingridroth@roth.net.au 02 6792 5340

Cotton think tank – Research and Extension needs for the Macquarie

14/5/2013

Panel representative: Bill Tyrwhitt
 Growers: Brett Cumberland, Ben Egan, Rob Tuck, Sally Quigley, Barry Dugan, Gus O'Brien, Stu Denston, Sinclair Steele
 Crop Consultants: Craig McDonald, Ryan Pratten, Dave Klaare, Andrew Cooper, Claire Jenkins, Christie Chapman
 Industry: Sally Ceeney, Julie Wise (CA), Bob Ford (CSD), Luke Sampson (Monsanto)
 Other: Cathy Hertel
 Convenors: Ingrid Roth, Amanda Thomas

Theme	Research, Development & Extension Issues Identified		Discussion
	NB in bold are the highest priority issues		
Nutrition	Local NPK trials		
	Nitrogen: Rates, timing, method of application	1) Revisit old theories about nitrogen with modern crops 2) Not research, leave it to the grower	Defoliation problems from high N not so relevant now but people still work on that – its OK to put on plenty of N
	N losses and movement	Downfield movement of N in water is showing up more in the high irrigation seasons. Measure N down the field in soil & water through the season – how much is lost to denitrification, how much to water movement? What affect does N placement have? Do we use different rates down the row? Look at variable yields down the row.	Now tending to put more N on in-season rather than upfront
	Late applied N	How effective? How late can you go for it to benefit?	
	P&K removal rates		
	N P K Zn Bo long term rate trial	Need a replicated long terms trial over several years in the one field (needs to be high yielding and needs to be a field with secure water). P is the priority for long term trials Soil types vary – use EM survey first	Can't see responses in one season, needs to be long term
	Accuracy of petiole tests for P K Zn		Petiole tests not being used for P K Zn

Growth regulators	Mid-season pix trials	Test several applications at different rate at different day degrees. Recognise that each season is different, doing the trial in one season will be a benchmark to compare against	Every season changes so much and influences decision about pix – “this year it was gold, some years it’s poison”. Penalty if rate is too high. Tradeoffs in crop growth. Trials are so variable year to year
	Variable applications of pix in a field	Crop imagery to identify areas that need high rates of pix, interlayed with nutrition and soil	
	Cut-out pix	Is cut-out pix worth the cost? Leave some unsprayed sections of fields so can see impact	
Crop Protection	Weeds in general	Fleabane, windmill grass	
	Volunteer cotton		
	Glyphosate resistance	Prevent spread of resistant weeds (ryegrass, etc) Better options for control	Herbicide rotations not an option in crop
	Bollgard resistance	Off growers’ radar because it all works	
	Whitefly	1) Build experience & confidence – run a farm walk when whitefly are present, bringing in someone who has experience in managing whitefly and can help in understanding when to spray and when not 2) Basic education about whitefly identification 3) Thresholds suitable for this region	Not confident in managing it because don’t have enough experience with it locally People are confusing silverleaf and greenhouse whitefly
Prophylatic seed treatments – resistance risk & cost	1) Research alternatives to change insecticide groups in seed treatments – seed treatment rotations 2) Monitor resistance risk 3) Reminder that seed treatment is a use of that group of chemistry – need to rotate chemistries	There are not many options for secondary pest control. Neonicotinoids are a big part of it when you consider seed treatment and in-season use... and are under review in Europe	
Soils	Compaction under new pickers	Not the big issue but some growers are very wary about impact of new pickers and possible need to deep rip to bust compaction	
Farm hygiene	Relook at this but it’s not likely to change	Remind contractors (CA role and also for growers to ask for clean down before entry)	All a bit blasé Amanda is investigating regional washdown facilities

Water	Overhead systems	Pre-season field day for growers to talk about how to best manage them (August)	Difficult to manage, problems. Several farms have experience with them. Sceptical about profitability.
	Better forecasts		
	Storage loss amelioration	Keep going with research to try to find a cost effective way to reduce evaporation loss	
Energy	Pumping efficiencies		
Fibre quality	Checklist for growers relating to P&D sheet and marketing	Include in BMP	There was a call for help in better understanding the P&D sheet. Most felt this is done by asking the merchant. May need to educate growers, especially those who've been out of cotton for a while.
myBMP	Maintain - Keep resourcing it so it is there if we need it		BMP is good for the industry to show self-regulation. Unless there is a trigger (problem or incentive) we don't do it – no real need at the moment. A few are certified, Very few use BMP for information. "Bollgard killed BMP" OH&S module is useful – this is a minefield on farm There is so much else to do that we don't go looking at BMP unless it's an issue.
Extension	Trial book	Useful, local focus but include some trials from outside the valley	
	Soil pit field days?	Not the issue – have had a lot of soil pits Maybe to look at impact of new pickers	
	Area wide meetings?	Pre, mid, post season – depends on water	
	Field days	August – overhead systems field day Mid-season – whitefly farm walk Drones	
	Cotton Tales	E newsletter, include day degrees for different areas of the valley. Timing depending on what's happening	Note that can get this from CSD and there's a lot of info in CSD's Facts on Friday, Web on Wednesday
	RDE reference panel	Reform the research committee of the CGA	
Research capacity	Use Trangie Research station a lot more	Split views – some felt run some research trials on Trangie RS, others felt they'd not work there so do all on farm	Has a high security water licence so could reliably do longer term trials
Other	Alternatives to cotton eg hemp		

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

This will be drawn up together with other regions and provided to Cotton Australia for the panels to consider and to CRDC to review and send to researchers.

THANKS FOR ALL YOUR IDEAS, Ingrid Roth ingridroth@roth.net.au 02 6792 5340

Cotton research and extension think tank

Lower Namoi 21/05/13

Participants: Amanda Gilmour, Andrew Greste, Phil Firth, Rob Eveleigh, Katrina Murray, Mike Carberry, Claire Welsh

Apologies: Matt Norrie,

Conveners: Sandy Young, Geoff Hunter, Guy Roth

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
Soils & systems	See nutrition		Soil testing: Growers use them in conjunction with many other variables to make decisions.
Nutrition	Soil & tissue testing	More opportunity for in crop testing (tissue/leaf etc.) and application methods to apply nutrients. Soil testing N can be erratic.	
	Nitrogen	<p>More info on in crop N and responses</p> <p>More objective measurement, but return on investment is the better way to present data on whole N story.</p>	<p>Higher yields leading to higher rates.</p> <p>Older farming history of soils is also leading to higher rates.</p> <p>Rising costs</p> <p>Data shows Lower Namoi is perhaps one of the better regions. Very dependent on rotations.</p> <p>How do we (Australia) compare globally with our nutrition performance?</p> <p>Lot of management issues on different farms driving the timing of fertiliser application.</p> <p>Recognise that there are significant losses and opportunity for improvement.</p> <p>Like the seed N test concept.</p> <p>Use ROI rather N/bale.</p>
	Foliar fertilisers	Suspicious of foliar fertilisers. Need to revisit some older research and build confidence if they are of value with some on farm trials.	

Crop Protection	Cotton volunteers	Important problem and need options for management.	Cost of technology means growers are not using other options. Their weed budget is exhausted with the technology cost.
	Herbicide resistance	A ticking time bomb. Risk of over use. Research question: How often do you need to use an alternative chemistry to glyphosate to extend its life? How often and what frequency.	2,4 D damage is problem We have the 24D tolerance gene, what happened to it and that work? Barnyard grass, liverseed grass and black oats may have resistance. Need options.
	Fleabane	Research question: how low can the rate go to control fleabane? Need some trials with lower than label rates to evaluate control.	Many residuals will control it
	Channel Weed Control		Do we have a plan b – for the loss of Diuron ?
	Pupae busting	Change strategy or prove to us with objective data that we all need to it	There is good research, but we ignore it. BG3
	Ratoon Management options	How to kill ratoons?	
	Insecticide drift	Better knowledge of each specific variety to 24D (Group I) damage (we know some work has been done). ie long season varieties versus short season.	Prevention of 2,4D drift needs to continue.
	Whitefly	Managing Whitefly is a key challenge for region	
Varieties		Wireworm control.	Risk of losing nictocides will lead to resistance. Need alternatives.
	Dryland specific varieties	Need better specific dryland varieties	Dryland growers want better conventional varieties so they have a bigger planting window.
Farm hygiene/ Disease	Verticilium wilt	Verticilum wilt is getting worse. Need better resistance in varieties. Is verticillum related to sodicity?	Namoi is the home of verticilum. Varieties are not making the gains they should be.
	Black root rot	Important problem for plant establishment.	
Plant management	Monitoring plant stress and its response	Better tools and knowledge of how crop is responding responds to plant stress (ie heat, nutrition) in real time, so growers can make decisions if required.	
Water	Automation of furrow irrigation	Need to improve the remote control of irrigation	
	Storage losses	Evaporation Loss (need to increase research in this area.	Drainage losses are more a management problem rather than R&D.

	Off farm water storage More dams or alternative operations	Need research on how to store more water in the catchment. Has this been done in the Namoi?	
	Better forecasting ET		There was a project around this? What happened to it?
Energy	Rising electricity costs	Need to find ways to reduce costs.	
Pickers	Visual camera	Pickers needs a camera to record with GPS data what the tractor driver sees, so that when you are looking at the yield maps and other precision ag data a grower can visualize what the problem might be.	
Precision Ag	Yield predictions	Better calibration of NDVIs and some of these related technologies. Work has been done, but growers need confidence.	
Natural Assets	Not discussed		
myBMP	Not discussed		
Labour and skills	Not discussed		
Futuristic research	Plant sensors	User friendly tools better calibrated. Focus on things like water and nutrient stress.	
Extension methods	Very important to individualise methods	Focus on your own farm. Ask growers what they want to know.	Question for survey: simple question: one thing you want to know..... Many of the issues raised have very good research behind them which growers do not know about or do not believe.
Grower Survey			Important to look at surveys over several season to remove any seasonal bias.

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning. Each person wrote down 2-3 priorities. These were discussed. The group discussed topics using the handout of survey data.

Suggestions for the research planning process

Would be good to follow this up.

How do we get more growers involved ?

"I would also have to say that in the broader grower group most do not know the process of the Panels and what they do and more importantly how they as a grower would get research to focus on their issues".

Summary of priorities

- Monitoring plant stress and its response
- Herbicide resistance management options
- Storage loss (evaporation)
- Pupae busting – busted – need objective data to show the value on farm.
- Verticillium resistance improved
- Whitefly – management options
- Dryland growers want better conventional varieties so they have a bigger planting window.

Next steps

If I have missed anything or if you've had more thoughts about this, please call or email with your ideas.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Guy Roth, guyroth@roth.net.au, 02 6792 5340, 0417 223 179

Cotton research and extension think tank

St George 22/5/2013

Participants: Glenn Rogan, Kent Benn, Alison Benn, Jaye Bonthron, Jane Hill, Bec Lindert, Hamish McIntyre, Ian Brimblecombe, Richard Ross, Jason Speedy, Cleave Rogan, Scott Armstrong.

Apologies:

Conveners: Sally Dickinson, Guy Roth

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
Soils & systems		Soils not discussed specifically Review high yielding fields (6 bales +) and look for success strategies.	From a farming systems view why are some fields yielding so high (6 bales plus). It would be good to drill into this at a later stage. There are quite a few fields around the region. Look at water, N, trace elements, insects, temperature influence etc.
Nutrition	Testing	Long term research tool. Need an in field test for all nutrients that identifies the limiting nutrient that can be done twice per week. Sending samples to labs takes too long	Higher yields leading to higher rates. Scatter in data is not surprising. In some fields around St George, 100 Kg N getting the same yields as 300 kg N? Why? We do need to better understand losses. How much are we losing and at what rate per week? Where are the options for reducing losses like Entech, black urea, the waterlogging hormone up to? Do humic acids on the surface make a difference? Is there a process to take the bulk size out of manures and or gin trash? Is gin trash an option now as per in Griffith? Carbon farming info delivery. General interest on all other nutrients and crop responses.

Crop Protection	Cotton volunteers		<p>Major problem and need options for management. Has any survey data been collected on dryland paddocks to identify how much of a problem this is?</p> <p>Control of volunteers very important for other pest issues such as bunchy top and mealy bug.</p> <p>Road and channel control also an issue.</p>
	Herbicide resistance	<p>Need an industry standard like IPM years ago and a campaign around it with options.</p> <p>Need options if resistance develops</p>	<p>A big issue. Glyphosate management and resistance management.</p> <p>There is weed resistance to barnyard grass. Must get the message out re importance of herbicide resistance risks.</p> <p>Liberty link. Is there enough push from growers to encourage?</p> <p>Another issue is product labels and getting registrations especially for aerial application.</p>
	Pupae busting.	Need research to find a better way?	Is it possible to get some tools that eliminate the need for pupae busting?
	Green vegie bug	<p>Need more confidence in the threshold to not spray.</p> <p>(Applies to other secondary pests.)</p>	
	Helicoverpia		Why were insects so quiet this year? What impact is Bollgard having on the native populations? Are they still migrating from the west (follow up P Gregg)
	Refuges		How can you make a refuge profitable? Is P Pea best?

Varieties			<p>Poor germination of 74 variety. Long term concerns about seed size, and seed vigour. Will we need to look at other seedling vigour options like polymers etc. in the future? Seed germination stimulants and trials.</p> <p>Conventional variety trials.</p> <p>Growers Need variety choice, including BG111.</p> <p>Higher yielding ALS varieties.</p>
Farm hygiene/ Disease			<p>Need to manage. Control of volunteers needs more priority.</p>
Canopy / Plant management	Plant manipulation	<p>Use of “prep” and other plant hormones to manipulate plant management for input efficiency. Trials in St George this year show great promise.</p> <p>Pix use effects by growth stage and different retention rates and water stress. Is pix it needed?</p> <p>Plant physiology manipulation options, crop responses especially for limited water management.</p>	<p>Some crops have had 11 waterings while others 3 for same result.</p>
	Ratoon cotton	Can we have another look at Ratoon cotton. Has it got any scope?	
Farming systems	Precision agriculture	<p>More can be done with GPS type technologies. Linking of technologies, mapping, steering, software, BMP, farm records etc.</p> <p>It is a training issue focusing on raising awareness of latest advances.</p>	<p>Aerial industry needs to advance its variable rate application systems. Due to small market size this is proceeding slowly. There is a new development cost.</p> <p>Potential to link quality data with end purchasers with the new pickers.</p>

Water			
	Storage losses	Evaporation is a major loss that needs more research.	Information opportunity to view Polymers CRC progress.
	Bollgard	Irrigation for Bollgard efficiency.	
	Limited water		(see plant discussion)
Energy	Reducing costs	Look at ways to reduce costs	
Reassessing yield targets & adapting management	Limited water strategy	Considered research around when crops run out of water, especially early season, how they can recover. (I	Cotton recovery from limited water is not well understood. This year saw some great recoveries from crops that were written off by others (& the text book).
Fibre quality			Colour palettes of HVI classing versus visual classing. ASCA now going all HVI. Different colour palette. Why did that research stop?
Pickers	Not raised		
Gin Trash			Is gin trash safe for cattle again now ??? Seems to be a wasted resource. Not the pesticides used as in the past.
Natural Assets	Not raised		Energy high priority in the list in survey. Need to reduce costs and find alternatives.
myBMP			How does being certified add a price per bale?
Labour and skills	Not discussed		.
Futuristic research	Hi oleic oil gene for seeds		Where is this at?
	Drones	Drones or mini helicopters for crop monitoring.	

	Nanotechnology	Can it be used to ID cotton all the way down the value chain	
	Medical applications & building products	Explore the possibilities.	
	Gin trash to wood		Value adding
	Fibre “natural” delinting from the seed		Could this aid roller ginning?
	Hydrogen powered tractors	Reduce energy costs.	
Seed	Transport options for seed	Fuzzy seed management transport. Need more markets and increase value for seed. Exporting seed to Chinese dairy farms (Tariff problem as well)	
Extension methods			Look forward to working on things with Sally.
Grower Survey			Keep Boyce data going. We need better financial information and hopefully the Cotton info team can land some more participation. Some basic financials in grower survey would supplement that.
Market Research		Need market research, it is important to understand trends in cotton markets.	

Process

The research planning process was discussed, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning. A hand out was provided. Each person wrote down 2-3 priorities. These were discussed. The group discussed topics using the handout of survey data. At the end of meeting individual priorities written down earlier were cross checked with discussion, and some additional items tabled.

Suggestions do you have for the research planning process?

Need to follow up on some specific topics.

Several questions around if “locals” could put in R&D applications. There seem to be interest and might need a hand developing applications.

Summary of priorities

- Plant management research in local region. Use of “Prep”, WUE and limited water; Understanding fruit removal impacts, ratoon cotton, recovery from abandoned cotton, pix, etc.
- Nitrogen management (rates, timing, placement, losses, products)
- Herbicide resistance “IPM” campaign.
- High yielding cotton. So much we don’t know about some local fields that have yielded 6+ bales.
- Secondary pest thresholds. Build local confidence in them.
- Several suggestions on some “futuristic” research (drones, polymers, nanotechnology, delinting, hydrogen power etc.)
- ?

Next steps

If I have missed anything or if you’ve had more thoughts about this, please call or email with your ideas.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Guy Roth, guyroth@roth.net.au, 02 6792 5340, 0417 223 179

Cotton research and extension think tank

Dalby, Qld 19/6/2013

Participants

Growers John Cameron, Greg Bender, Glen Fresser, Jamie Grant, David Walton
 Agronomists Liz Lobsey
 Industry Marie Louise Offner, Duncan Weir
 Conveners: John Smith, Guy Roth

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
Soils & systems	Compaction	Compaction caused by new 7760 cotton pickers. Need to quantify. Deep compaction 40-70 cm that is unknown.	
	Ground preparation	Post picking ground preparation. Review options: root cutting, stewardship, managing ratoons, etc. Need some good learnings/BMPs.	
Nutrition	Fertiliser response trials	<p>Fertiliser application: timing pre & post plant, products, and application methods including liquid N performance & foliar as well as other methods.</p> <p>Need a well developed campaign for nutrition with robust economic information in extension materials. Simple and short messages about the range of issues. The main problem with nutrition is the message is not getting out to growers and commercial incentives such as 30 June discounts don't suit the crop management cycle.</p> <p>Agronomists and growers need footstep time in the paddock in both cotton and winter crops. Encourage this.</p>	2011 season was wet and there was significant flooding, which is why the Darling Downs yields were so low that year.
	Green Manure Crops	What is the role and potential of green manure crops?	
Weeds	Cotton volunteers	<p>Major problem and need options for management</p> <p>Control of volunteers very important for other disease and pest issues. It is also important to protect the life of the technology. Need an industry campaign on what to do or not do.</p> <p>Growers need a 100% control option for volunteers. At the moment there is not one. Where or what is the "antidote"? Need management options.</p>	

		Is there a field test to pick up volunteer roundup ready cotton plants?	
Insects	Ratoon management	Review of ratoon management practices, including self sown ratoons. These are very difficult to kill. A key message is do it right the first time as the cost of not doing it right is a lot more.	
	Herbicide resistance	Need stewardship to prevent resistance. Need an industry campaign. New weed management options are required other than Roundup Ready cotton	
	Refuge stewardship	This will require industry leadership with a capital L. We have too much refuge area in dryland, if you reduced it to 5% you would get more compliance, especially in dryland. Dryland Pigeon peas should be an option on the Darling Downs. There was a 3 year trial and data done by Monsanto on three local farms to support this.	
	Role of bio agents	Can “bio-agents” play a bigger role in conventional cotton IPM? What will be the options if neonicticides chemistry is lost?	
Varieties	More varieties		
Disease	Fusarium	Bioremediation – Alternative options could be looked at such as the “grass” they use in tomatoes.	
Nematodes	Nematodes	Are nematodes a rising risk in cotton?	
Water	Irrigation systems economics	Robust economics of sprinkler versus flood irrigation. Get the analysis down to one page. Simple messages. Been a lot done, but it has been adhoc and could be pulled together.	
	Better WUE accounting	Correct WUE accounting for every mm of water. This is good for dryland grain crops, but not irrigated cotton. Full accounts including fallow, rain etc.	
	Flood mitigation measures	Summaries of options, pros and cons, costs, eg gabions versus structures.	.
Defoliation	Timing	Information on timing defoliation is still an important message.	
Pickers	Compaction	Compaction 7760’s. Need to quantify. Deep compaction 40-70 cm that is unknown.	
Skills	Business skills	Need to develop the business skills of growers, agronomists and industry in general. People are not going to do a whole degree. Need short course	.

		options.	
	Consultants skills	Provide more training. There has been a huge turnover and capacity shift in the consulting sector. Can we improve their business skills?	
Extension methods	Simple messages	People are not coming to events to hear the message, so need to find a way to deliver the message. One page messages, KISS, include economics.	Need to retain open minds on new ideas.
	Bring back some excitement. Up the mojo.	Industry has reached a maturity phase and become complacent on some issues.	
	Younger farmers	Younger generation not getting to meetings. They are feeling pressured to do the farming. Need different tactics.	
	Cotton Conference	Forum on adoption and practice change. Get a good discussion going across the industry?	
	Business course	One week business course for younger growers and agronomists.	
Market Research	Marketing P& D sheet Review	CRDC should convene a review of the P&D grading system and sheet. This should be done in conjunction of the HVI colour testing review. It should be done ASAP and CRDC could foster that discussion.	

Process

The research planning process was discussed, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning. A hand out was provided. Each person wrote down 2-3 priorities. These were discussed.

Summary of priorities

- Marketing: P&D. Facilitate a review of cotton grading P&D ASAP.
- Fertiliser management extension (rates, timing, placement, losses, products)
- Herbicide resistance “IPM” campaign.
- WUE accounting. Every mm counts.
- Refuge Stewardship review.
- Practice change strategies. Bring back the excitement. Up the mojo.

Next steps

If I have missed anything or if you’ve had more thoughts about this, please call or email with your ideas.

These issues will be drawn up together with those from other regions and provided to Cotton Australia for the panels to consider and to CRDC.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Guy Roth, guyroth@roth.net.au, 02 6792 5340, 0417 223 179

Cotton research and extension think tank

Boggabri 20/6/2013

Participants

Growers: Peter Watson (hosted meeting), Darren Eather, Chris Goulden, , John Watson, Simon Kearney, Brendan Warnock, Thomas Swain, Mark Hamblin, Andrew Watson

Agronomists: Rob Weinthal, Chris McCormick

Industry: Sandy Young

Apologies: Rod Smith

Conveners: Kirrily Blomfield, Geoff Hunter, Guy Roth

Theme	Research, Development & Extension Issues Identified NB in bold are the highest priority issues		Discussion of the 2011 survey results and other comments
Soils	Wheel track Compaction	Round bale pickers replicated trial work to measure impacts if any. Simple measurements.	
	Carbon	Exhaust gases into ground and through irrigation water. Is this a good option or a snake oil? Is there a technical review of this?	
Nutrition	Fertiliser application options and crop need	<p>What fertiliser method has the highest NUE? (water, gas, solids, foliar, etc.). Need more information on different methods, rates, timing, crop use and losses</p> <p>Early season nutrition fruit requirement. What is it?</p> <p>Mid-season N options. What is the best option: which method of mid season N has the highest NUE? Eg</p> <ul style="list-style-type: none"> - Water run N26 or N42 - Water run Big N - Water run Urea - Surface soil applied N42, sometimes incorporated by cultivation, sometimes washed in by flood irrigation or overhead irrigation - Surface soil applied Urea, sometimes incorporated by cultivation, sometimes washed in by flood irrigation or overhead irrigation 	<p>Difficult to compare nutrient rates as growers do have different approaches in different rotations.</p> <p>Fertiliser Cost / ha would be an easy number to gather in a survey.</p>

	Plant nutrient testing	Petiole versus leaf versus sap testing.	
	P, K & Zn	Deficiency levels or potential in our region. Is it being affected by nitrogen and other strategies promoting root growth interactions? There seems to be a difference between the literature and field observations. Look down the soil profile as well.	
	De-nitrification	With yellow cotton where has the N gone in wet years? (Is it leached, volatilized, or still in the soil but not available). Should growers do any tests ?	
	Irrigation systems nutrition	Nutrition crop use patterns under different irrigation systems. le centre pivots versus surface irrigation.	

Weeds	Herbicide resistance	Growers should have a weed resistance management plan. It is a farm by farm problem, unlike insects which is more regional. Get on front foot before broadleaf weeds become resistant. Look at grains in WA, Vic, and SA. Cotton and grains industry needs to be more talking and on the same page. Need more options if resistance develops	
	Liberty Link cotton	Need liberty link (and other herbicide traits) in better varieties.	
	Novel weed control options	New way to control weeds, not tillage, or chemical herbicide. Eg Biological.	
	Dryland weed Stewardship	Need better stewardship	
Insects	Pupae control	Other strategies for pupae control are needed. Especially when wet, and for dryland cotton. Do you need to till the entire double skip area or just near the plants?	
	Conventional cotton	Should we try it?	
	IPM under laterals & pivots irrigation systems	How effective is Vivus etc under these machine irrigation systems?	
Varieties	Higher yielding cold	Better selection of varieties for the cold	

	climate cotton		
	Seed quality	Quality seed is critical for cooler regions	
Disease	Verticilium wilt	Need non breeding management options for Verticilium wilt. Need better resistance to Verticilium.	
	Early season diseases	What is the best practice for establishment re Rhyzoctina, pythium, BRR ?	
Plant management	Plant management	Interactions of Pix and timing * amount * frequency, N, water, etc	
Farming systems	Rotations	Review what is the limiting factor and why in rotations and fallows.	?
	Relay cropping	Planting cotton into wheat under laterals. Will it work?	
	Nitrogen response	Nitrogen response in the farming system, versus yields, crop history and soil type.	
	Overhead Irrigation Crop Agronomy Systems	Develop crop management systems for the overhead systems. Better scheduling for both cotton and wheat? IPM eg Vivus control of pests. Is overhead irrigation leading to increased sodicity or other potential issues?	Does wheat prefer a big lick or smaller licks of water
	Irrigation scheduling tools	Better tools for scheduling. Eg drones, Infrared etc	
	Timing early season irrigations	We have moved this forward but are we babying the crop these days? Is it better to be early or late ?	
	Irrigation strategies	High versus low deficit in the Upper Namoi.	
	Water quality		
Natural Assets	Glyphosate environmental impacts	Review of the environmental risk with the large use of glyphosate in cotton and grains.	
Labour	Not discussed.		.
Futuristic research	New weed control options	New way to control weeds, not tillage, or chemical herbicide. Eg Biological.	Where is this at?
Seed	Need more value from cotton seed.	Other <u>uses</u> of seed need to be found.	

Extension methods	Review summaries	Literature review of research done answering current questions as a starting point.	
	Weed resistance plan for your farm	Each grower should have a weed resistance management plan.	
Grower Survey			Ask about what % was roundbale picked versus conventional modules % Fertiliser cost per ha? Weed resistance? Do you have it?

Process

The research planning process was explained, noting that the Cotton Australia panels (formerly ACGRA) are the primary avenue for growers and consultants to have input to research investment planning. Each person wrote down 2-3 priorities and these were discussed.

Suggestions do you have for the research planning process?

Appreciated the opportunity to have some input. Need to do the same for grains.
Meeting was a useful way to get idea together.

Summary of priorities

- Nutrition and fertiliser management options (largely extension)
- Herbicide resistance prevention and new weed management options
- Machine irrigation systems agronomy (centre pivots, lateral moves, IPM, nutrition, planting into wheat etc.)
- Irrigation scheduling; new tools and plant response to timing and different deficit strategies.
- Pix application information
- Verticillium management

Next steps

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These issues will be drawn up together with those from other regions and provided to Cotton Australia for the R&D panels to consider and to CRDC. Then it is intended the priorities list goes to researchers to help them in preparing proposals for the open call in June.

THANKS SO MUCH FOR TAKING THE TIME AND FOR ALL YOUR IDEAS, Guy Roth, guyroth@roth.net.au, 02 6792 5340, 0417 223 179