

COMMISSIONED PROJECT 2012–13

Moving in and out of cotton

Identifying farming systems issues in southern NSW
irrigation areas (Proposal 1)



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Moving in and out of cotton – Identifying farming systems issues in southern NSW irrigation areas (Proposal 1)

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List of Acronyms

NSW DPI – New South Wales Department of Primary Industries

CRDC – Cotton Research and Development Corporation

GRDC – Grains Research and Development Corporation

CSIRO – Commonwealth Scientific and Industrial Research Organisation

ACRI – Australian Cotton Research Institute

BOM – Bureau of Meteorology

RDE – Research, Development and Extension

WUE – Water Use Efficiency

IPM – Integrated Pest Management

GDD – Growing Day Degree(s)

DD – Day Degree(s)

CA – Cotton Australia

CSD – Cotton Seed Distributors

CGA – Cotton Growers Association

ACCA – Australian Cotton Comparative Analysis

GVB – Green Vegetable Bug

DAFF – Department of Agriculture, Fisheries and Forestry

MIA – Murrumbidgee Irrigation Area

List of Definitions

myBMP – web-based program providing access to the latest industry science and information

CottonInfo – Cotton extension funded by CRDC/CSD/CA

CottASSIST – Set of web tools to help growers/agronomists with cotton management decisions

Executive Summary

In 2012–13 NSW DPI undertook a nine month benchmarking project in the southern NSW irrigation production region commissioned by the CRDC.

The aims of this project were for key NSW DPI agronomists to further develop technical skills in cotton growth and development and provide linkages to industry partners in the new production areas of NSW. CRDC required NSW DPI to add value to existing projects, build grower participation in the southern region, provide economic insights and develop agronomic management information for cotton industry extension services.

This project facilitated linkages to other projects focused on water use efficiency benchmarking (NSW DPI), cotton comparative analysis (Boyce Chartered Accountants) and growing day degree modelling (CSIRO).

NSW DPI facilitated data collection on eight farm sites. Activities focused on collecting temperature and plant growth data to help validate day degree modelling for southern NSW, collecting WUE data, agronomic management of crops, facilitating field days and meetings with growers and coordinating the development of future research, development and extension issues.

Major recommendations from the project are:

1. Establish a RDE committee to coordinate on-farm activities with CA/CRDC/CSIRO/NSW DPI/CSD/Companies/GRDC.
2. Improve the availability of local soil temperature data from early September to mid November – more detailed sites should be made available.
3. Establish on-farm trials that are linked to trials conducted on research centres (ACRI, Yanco Agricultural Institute) with coordinated scientific input.
4. Establish a set of standard trials (on-farm) coordinated across different locations to track and measure where the nitrogen (N) goes under different timing regimes to help develop best practice rates.
5. Provide on-going encouragement (by CottonInfo staff) to southern growers, advisors and financial institutions to collect data for ACCA (Boyce CA).
6. Encourage CRDC to utilise the opportunity to link NSW DPI expertise in IPM to the cotton industry in southern NSW.

Six major RDE issues were prioritised by industry in April 2013. These were plant stand establishment, plant steering options (Pix® options), nitrogen fertiliser management, weed management and glyphosate resistance, and the presence of national research in the south.

Background to Southern NSW Irrigation Areas

- Cotton production is relatively new in the Murrumbidgee Valley and has a significant production base in southern NSW (53,400 ha in 2011–12) (Table 1). It has had a long phasing in period since research and production was initiated in the 1960s and 1970s.
- The average yield over the last three seasons was 10.8 bales/ha.
- The 2011–12 season had the highest average irrigated yield of all production areas in Australia.
- The current 2012–13 season has a harvest area of 41,000 ha with a potential total yield of 450,000 bales.
- Current prices for cotton are close to \$490/bale, above the long-term average of \$460/bale.

Table 1 Area and yield of cotton in southern NSW 2009–12.

Year	Area (ha)	Average yield (bales/ha)	Total bales
2009–10	3300	12.1	40,000
2010–11	23,000	9.6	220,000
2011–12	53,400	10.8	576,200

- The southern NSW area (Hillston, Condobolin, Griffith, Coleambally and Berrigan) is climatically different to northern NSW. It has a shorter growing season and increased solar radiation. Within southern NSW, each of the five valleys has different management requirements, particularly sowing time.
- Cotton production in southern NSW is underpinned by access to both ground and surface water. New water products which allow leasing of temporary water and forward selling of cotton for up to three years in advance will result in a stable production base of around 30,000 ha in most years.
- Large scale irrigators in southern NSW are committed to cotton production. There has been a preference for maize (long-term experience and ease of growing) but opportunities are limited by available contracts to supply limited market tonnage requirements. Small scale irrigators within the Murrumbidgee and Coleambally irrigation areas are committed to rice when water is available but continue to review cotton options to maximise profit. A number of southern irrigators now grow all three crops—cotton, rice and maize—depending on water availability, current layouts, soil type and markets available.
- There is reasonable ginning capacity in southern NSW with gins at Hillston and Whitton. There have been preliminary discussions (June 2013) about a third gin at either Hay or Tabbita.
- Recently, a CottonInfo regional development officer has been appointed under a joint venture by CSD/CRDC/CA.
- The Lachlan and Murrumbidgee Valley Cotton Growers Association (CGA) has a major goal of increased presence or linkages to national and local RDE projects. Currently, CA representation is limited to one local northern grower (CA Research Advisory Panel – farming systems).
- New RDE projects for southern NSW are urgently required in 2013–14. Issues can now be aligned to what RDE level(s) are most appropriate as prioritised by CGA and research organisations working together and in partnerships.



- A new background paper is attached—*Growing cotton in southern NSW* by Kieran O’Keeffe, Regional Development Officer, CottonInfo (adapted from Cotton Conference 2008 paper by James Hill, former Cotton Development Officer, NSW DPI). See Appendix 2.
- The major agronomy research issue is management of plant growth and use of Pix®.

Project Milestone Reports

In 2012–13, 13 farm sites were selected to value add to current CRDC projects focused on WUE, cotton comparative analysis and growing day degree modelling (Figure 1).

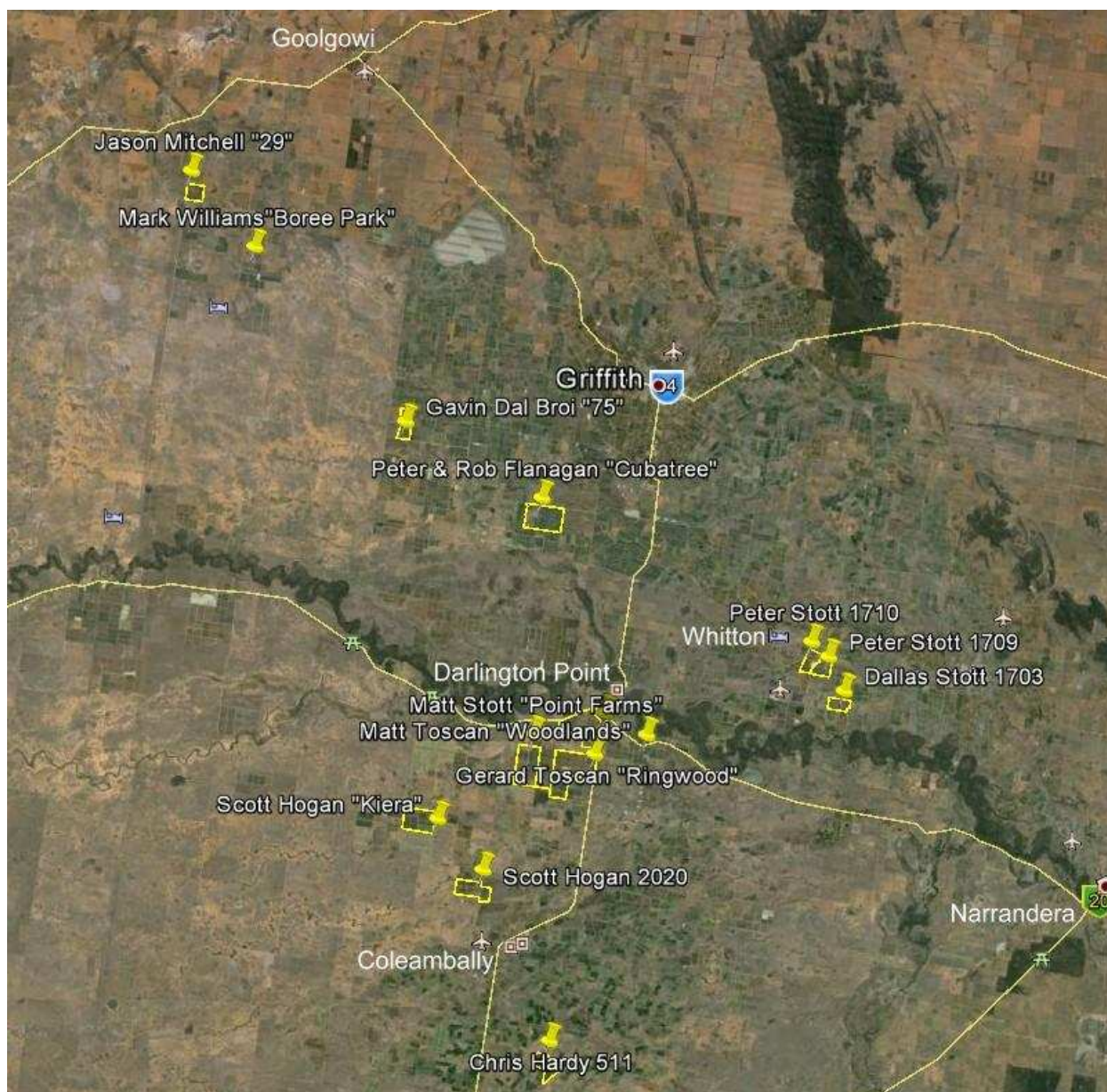


Figure 1 Location of the 13 farm sites.

Source: R Hoogers, NSW DPI 2013.

1. WUE Benchmarking in Southern Irrigation Areas (in conjunction with NSW DPI)

Reduced water allocations have resulted in irrigators needing to use their water more wisely. They continue to aim for maximum return per megalitre. There is also increasing pressure from the Australian public on irrigation industries to measure these improvements in water use efficiency. The cotton industry has borne heavy criticism for its water use and has therefore been proactive in assessing its water use efficiency.

In order to rectify the lack of ‘robust benchmarking data’ in 2008 NSW DPI gained funding to benchmark irrigation water use for the 2006–07 cotton season using WaterTrack Rapid™. The process is simple and quick and more importantly, utilises a consistent approach allowing on-farm water use to be compared across the industry. The calculation of the water use indices has been standardised and defined enabling meaningful comparison.

CRDC required data collection to be extended to the western and southern production areas to further enable the irrigation industry to show the rate of improvement in water use efficiency and to also identify potential performance targets.



At a grower level, irrigation benchmarking is also necessary if an enterprise is going to improve its water use efficiency. Being aware of how you are performing compared to your region or industry enables continuous improvement of water management.

In 2012–13, data has been collected from eight sites to obtain WUE comparisons (see Appendix 1). Individual findings have been returned to growers. The highlights for each property are summarised below:

1. Poor soils (sodic red topsoil), yields rose using ‘bankless bed’ layout, furrow water level rose to gain gravitational push of water and improved WUE. The layout was developed some years prior so soil was consolidated. The highest average yield of this family’s many farms was achieved in this field. Most of this high yield is believed to be attributed to excellent early establishment and accurate scheduling in a very long dry summer. WUE was slightly low due to higher water use, lack of recycling and lower than required flow rates from the water supply authority.
2. Traditional clay soil, high yield, high WUE, consolidated ‘bankless bed’ layout. Furrow water control greatly improved establishment when irrigating up. Scheduling can be further improved.
3. Traditional clay soil, freshly land formed to ‘bankless bed’ layout, high WUE, improved establishment with irrigating up. As above, scheduling increased from four to seven days and can be further improved by managing paddock and soil variation once soil and layouts consolidate.
4. Better soil (grey self mulching clay), good layout on conventional siphons into bed layout, high WUE (as high as possible).
- 5/6. Conventional furrows layout. A dry subsoil following a wheat crop increased water volume used on establishment. Available flow rate was an issue, good use of C-probes to manage a highly committed farm schedule, average WUE.
7. All ‘bankless beds’ on good soil 60 cm bed. Yields of 9.8 to 9.9 bales/ha were below the grower’s expectations. This was attributed to whole farm scheduling issues, pumping issues and a lack of flow rate to keep up with the long hot summer.
8. All siphons on good soil, typical 1:1500 slope with 500 m runs of two row cotton beds.

Key findings for southern NSW are:

- The 2012–13 season was hot and mostly dry increasing irrigation frequency—those growers efficient at irrigation scheduling (and not over-committing land) and/or having high flow volumes achieved the best results. Rainfall did not provide growers much assistance in 2012–13. In general, any rainfall contribution to soil moisture should be ignored to ensure growers do not delay irrigation water coming onto farms when the shortest frequency is required.
- From the 2013 WUE measurements in the south (see Appendix 1) irrigators on ‘bankless beds in bay’ systems have attributed higher yields to improved early establishment. They also believe early establishment is more successful with ‘bankless beds in bay’ than siphons, especially with poor and problem soils.
- Observations in this year’s WUE study have indicated the ability to irrigate more easily (and with less labour) resulted in more accurate scheduling and correct timing of irrigation and subsequently more reliable yields. The ability to automate these systems is also a labour saving device that needs to be quantified. This layout is expensive but reduces labour input considerably.
- ‘Bankless beds in bay’ layouts also provided exceptional WUE on poorer red soil by optimising establishment techniques when sowing early (mid September) and having high water flow in furrows. Irrigating up can be refined further with improved soil temperature forecasting (14 days ahead).
- Overall, whole farm water scheduling can be improved and is critical for managing poor red soils compared to more forgiving grey clays. The 2012–13 season has provided base area estimates for water volume availability required when scheduling in hot years.

2. Cotton Comparative Analysis in Southern Irrigation Areas (in conjunction with Boyce Chartered Accountants)

Boyce Chartered Accountants has produced the annual Australian Cotton Comparative Analysis (ACCA) since the mid 1980s. It is widely regarded as an independent benchmark study for the industry that shows the income and expenses of growing fully irrigated cotton on a per hectare basis.

It can help farmers identify relative strengths and weaknesses and can be used as a management tool to implement change and identify where effort should be directed on a day to day basis. It has also provided all industry sectors with an annual review of the average farm net profit/loss.

In 2012, the total number of bales in the sample was just over 550,000, approximately 11% of total cotton production. Only a few growers from southern NSW were included in the analysis and were combined with other valleys due to low participant numbers. The record size of the crop and the resulting delay in ginning made participation by growers difficult.

In 2012, the following industry highlights were identified:

- The value per bale is increasing ever so slightly—no real growth after inflation
- There is significant growth in costs per hectare
- These two statistics confirm decreasing terms of trade for the industry
- The yield per hectare is increasing but at a reduced rate (see Appendix 2)
- The operating profit per hectare for the average grower is relatively static
- The operating profit per hectare for the top 20% of growers is increasing

In 2012–13, CRDC engaged this project to help Boyce gain increased data sets in the (newer) western and southern irrigation production areas. Boyce is clearly affiliated with the industry and support must be continued. Ideally, 6-10 cotton enterprises are needed to have a meaningful enterprise comparison in local areas.

This project identified and encouraged five growers to participate in the 2012 annual data collection. It proved difficult for Boyce staff to collect 2012 data. However this project recommends 2013 data collection can be further supported by:

- Selecting and endorsing eight growers via CGA that will contribute to an extra ‘southern’ column in key tables. Annual data collection is seen as a long-term partnership as it time consuming and demanding on Boyce staff and clients. Time is needed to engage client bookkeepers/accountants and benefits have to be seen through discussion and influence on farm enterprises. A strong commitment and desire from clients is required for successful collection. Each situation must be negotiated as they are likely to vary.
- CottonInfo staff providing on-going encouragement to southern growers, advisors and financial institutions. It is suggested a dedicated CGA/CottonInfo workshop be planned in November each year that is linked to profit. It would provide quality information on financial returns (Boyce), productivity (previous year yield analyses) and marketing.
- CottonInfo staff reviewing or developing a template to collect data in combination with bookkeepers/financial institutions to support data collection on dedicated farms.

3. Analysis of Crops Entered in CGA Crop Competition 2013

During May 2013, 12 crops were inspected for the local crop competition. This proved an excellent tool to further develop RDE issues and complemented discussions at the cotton ‘research and extension think tank’ held at Griffith in April 2013. It remains essential to investigate high yielding crops and this activity will be continued by CottonInfo staff. Additionally, CottonInfo will use this and other opportunities (e.g. scientific visitors) to bring together agronomists to review crop progress and management.

The data collected during the process showed the following trends:

- Nitrogen budgets are on the high side with many crops in the 240–250 kg/ha range. Some are closer to 300 kg/ha of N. It was common to use poultry and cow manure as part of the nitrogen budget. Split application is common with up to half applied as water-run urea.
- Most crops had at least two applications of insecticide but some had as many as six.
- Target pests included thrips, mirids, GVB and mites. The late use of 500 ml/ha of dimethoate with the first defoliation pass was a common recommendation by one consultant.
- It was evident from talking to growers that some are aware of *myBMP* but they need guidance in registering and being actively involved in the program.



This project recommends linking NSW DPI expertise in IPM to the cotton industry in southern NSW. There is IPM expertise at Yanco that has not been tapped by the southern cotton industry and there is a good opportunity linkage between northern entomological research and southern IPM research needs. There is potential to run southern trials of northern research to evaluate best-bet IPM practices and testing northern set thresholds particularly where there is significant doubt of applicability in the southern region e.g. thrips.

4. Crop Growth and Development–Day Degrees (in conjunction with CSIRO and DAFF)

Written information is available on crop growth stages and cotton sustainable yield potential. To complement this information there is a good understanding of cotton plant growth stages by consultants to discuss management options in southern NSW. A new grower's guide (*Growing Cotton in the South*) from CSD is now available.

In 2012–13, collection of day degree data proved interesting at field days for all participants to reflect on seasonal comparisons and to stimulate discussion.

The accuracy of estimated day degrees (CottASSIST website) based on northern research in the 1970s is questionable. Plant growth in southern NSW is different and requires further physiology research. A long-term industry issue is the production of small boll size and lower micronaire value (being produced from more bolls). See Appendix 2 *Growing cotton in southern NSW*.

In southern NSW (compared to western NSW), use of Pix ® is an accepted annual practice to manage plant growth (see earlier comments on high N use) to ensure earliness of picking. Pix ® application is always a major discussion point in southern NSW as there is interest in the timing for cut out (including application by calendar date) and in split application, beginning at low rates in late December depending on vegetative growth rates.

This project checked for the date of first square, first flower and first boll (See Table 2). Findings included:

- The normal range of day degrees from first square to first flower is 300–350. In southern NSW the average was 360 day degrees at seven on-farm sites (range 306–424).
- Overall in southern NSW during 2013 the day degree figure was over-estimated by the CottASSIST model for time to emergence, to first square and first flower. The model then under-estimated the time to open boll. The slowing in development as the season progressed could be due to the very hot conditions during January and February.
- The day degree requirement of flower to open boll is estimated by the model as 750. The sites averaged 856 day degrees with a range of 809–881.
- The one-off temperature measurements in 2013 for southern NSW indicated that temperature (and day degree accumulation) did not vary greatly to the CottASSIST model but the variation in key development stages does need further investigation. Data needs to be compiled over a number of years, in different localities and linked to an experienced scientist to ensure there is rigorous validation of the CSIRO model.
- With an early to mid October sowing, a southern NSW grower can expect the first square to be produced in early December, the first flower in early January and the first open boll in early March. There will be slight variation around these times due to a number of seasonal factors that influence the day degree requirement. These factors include internal assimilate competition, pest attack and soil conditions.



Table 2 Summary of day degree data compared to CottASSIST predictions for seven farms in southern NSW (2012–13 season).

Farm	Plant date	Nodes to first square	Days <11°C in first 20 days after sowing cold shock	>36°C hot days in Jan	Emergence		First square		First flower		Open boll	
					Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
Hardy	1-Oct	10	9	11	140	189.2	559.3	687	901.5	959	1754.3	1709
Stott	8-Oct	11	9	11	98.8	189.2	543.3	681.8	897.3	953.8	1743	1703
Askin	23-Oct	8	11	10	92.3	116.4	498	598.6	804.3	870.6	1672.3	1620.6
Toscan	23-Oct	10	11	10	115.8	126.8	541.3	619.4	855	891.4	1737	1641
Dal Broi	16-Oct	10	9	11	106.8	126.8	516.3	624.6	941	896.6	1750.8	1646.6
Mitchell	20-Oct	10	8	12	87	126.8	444.5	619.4	805	891	1686.3	1641
Flanagan	10-Oct	10	12	9	91	152.8	536	650.6	960.8	922.6	1813	1672
Average		9.9	9.9	10.6	104.5	146.9	519.8	640.2	880.7	912.1	1736.7	1661.9

This project identified that the use of tiny tags to collect temperature data will be most useful from early September to November when located at key locations in the five southern valleys. This would aid sowing time recommendations where ‘early’ sowing is crucial in southern NSW. Soil temperature data availability and forecasting needs to be improved through coordinated websites led by CSD and possibly BOM.

Future Agronomy Research Issues Identified

Members of the cotton industry participated in a cotton ‘research and extension think tank’ at Griffith on 4 April 2013. It was attended by seven growers, 12 consultants/agronomists and five industry representatives. Five RDE agronomy issues were developed and are listed below. The meeting was updated with the presentation *Cotton Farming Practices—a snapshot of trends from industry surveys* (prepared by Ingrid & Guy Roth).

1. Plant Stand Establishment

Growers clearly recognise there are different sowing time requirements (weekly) for each valley in southern NSW to achieve maximum yield potential. They require a practical package of information for each valley. Issues revolve around early establishment to achieve required plant population. There was interest in the following areas:

- late planting versus Pix ® usage
- high seedling vigour index (and greater transparency by CSD)
- controlled germination test at 12°C versus the standard 16°C for different varieties
- printing seedling vigour on bags
- more practical use of soil temperature data for planting that is more specific for southern options (rather than the northern rule of thumb)
- seed treatment impacts on establishment and better options
- screening trials for seedling vigour of new varieties
- watering up versus pre-irrigation

- pop-up fertilisers/growth regulators on seedlings
- pre- versus post-emergent herbicides on vigour and yield
- beds versus hills
- seed coatings of phosphorus (P) and zinc (Zn).

Additionally, wireworms were a concern and further information is required on various seed treatments (liquid or granular) and product residual effectiveness post application.

Most of these points have been, or continue to be, addressed by CSD. An increased number of soil temperature graphs will be available for southern growers this season. The variable nature of starting temperatures in spring makes this an on-going issue for growers. More research is needed with spray on polymers to increase soil temperatures at planting time.

This project recommends an emphasis on improving the availability of local soil temperature data from early September to mid November through more detailed sites (soil type and water management). Longer range forecasts (10 to 14 days) from BOM and other weather sites should be promoted as a management tool for deciding when to start or delay planting.

2. Plant Steering Options (Pix® options)

The management of plant growth using Pix® has seen southern growers and consultants develop keenly held attitudes. Management experience varies considerably from northern NSW and is complex considering new varieties, irrigation method (overhead, hills and 'bankless beds in bay'), paddock fertility variation (cut and fill) and radiation differences. Pix® application is now considered routine but there is interest in the following:

- comparison of Pix® cut out dates in relation to, and the effect on, boll size, yield, earliness, cut out date, quality and yield
- management to manipulate first fruit set, for example low rates of Pix® early six leaf stage
- cut out timing (nodes not producing)
- variable rate application
- application at node 15 versus node 19 (2–3 L/ha).

This project confirms there is a high requirement for on-farm trials that are linked to trials conducted on research centres (ACRI, Yanco Agricultural Institute) with coordinated scientific input.

3. Nitrogen Fertiliser Management

On rice farms, there is interest to convert paddocks to cotton as efficiently as possible. Available nutritional information is required that incorporates rice paddock histories.

On larger irrigation holdings, residual soil N can be high or excessive nitrogen can be applied to the crop (following successful grower experience with high N rates for maize) which will stimulate later flowering with the crop maturing in poor weather. Cooler weather will reduce boll size. It is possible that Pix® is being used to control extra growth from excessive N. However current management in southern NSW is effective and there is reluctance to change nitrogen management (unless validated locally).

Growers do not have a local information package that incorporates soil data to benchmark against current paddocks, practical information on the full nitrogen cycle (including losses, availability over time, timing, use of locally available manures, economics etc.) and nutrient analyses of all available products.

There does not appear to be any issues with phosphorus application although some on-farm trials are needed to validate potassium and zinc requirements.

This project recommends a set of standard trials (on-farm) coordinated across different locations to track and measure where the N goes under different timing regimes to help develop best practice rate options.

4. Weed Management and Glyphosate Resistance

There are two major issues surrounding the potential loss of glyphosate and the increasing problem of effective fleabane control.

This project supports research, develop and extension of maintaining glyphosate use which should be linked to GRDC projects so there is no duplication and lessons are learnt from others in Australia and USA. Further grower and consultant education is required based on a BMP and a range of options if resistance cannot be managed.

5. Irrigation Scheduling – WUE

As previously reported by Boyce, operating profit per hectare for the average grower is relatively static. Irrigation efficiency and therefore profit can be increased via improved layout (particularly for poorer soil) and increased volume availability at establishment and subsequent individual irrigations.

This project suggests that WUE can be improved and emphasis should be placed on the following:

- further advance 'bankless beds in bay' layouts for soil types that benefit from this design feature
- advance paddock layout design recommendations that incorporate a focus on soil type requirements
- review evapotranspiration (ET_o) data availability for simple on-farm use (utilising previous IrriSAT findings) and possibly linking to BOM website availability. This could also be developed as phone apps to schedule individual paddock irrigations and/or whole farm water requirements for all paddocks
- timing of the last irrigation to maximise WUE and reduce problems with a wet paddock and harvest delays
- identify key farms via CGA (irrigating cotton only) to benchmark WUE and gain efficiency insights across southern NSW. Hillston would be a key site in 2013–14. This may also necessitate linkages to Murrumbidgee Irrigation and Coleambally Irrigation to collect data.

6. Presence of National Research in Southern NSW

There have been five major agronomy research areas identified and a sixth area is the urgent requirement for an RDE presence in southern NSW.

This project recommends a new RDE subcommittee to be based within the Lachlan/Murrumbidgee CGA. Its basic role would be to coordinate on-farm activities and the development of new information for southern NSW through existing and new partnerships with CA/CRDC/CSIRO/NSW DPI/CSD/Companies (and GRDC).

A RDE subcommittee needs to have committed members. This project supports the following 'local' memberships: NSW DPI, CSIRO, CSD, CottonInfo and CA grower representatives from the Lachlan and Murrumbidgee valleys. The recommended chair is the president of CGA. Three meetings per year are recommended (pre-season, in-crop, final results and discussion). It also requires committed organisation. This project recommends NSW DPI supply executive officer support and CottonInfo supply support for information presentation in a simple annual update for growers and agronomists.

Recommended activities for the RDE committee are:

- prioritise and update research requirements annually with appropriate organisations
- ensure every research project is linked to engage input from appropriate research scientists
- compile and distribute a list of commercial and public research projects being conducted at the beginning of each year
- recommend on-farm location of trials to gain efficiencies and introduce increased crop data collection
- compile an on-farm trial report each year that highlights agreed changes to management recommendations
- maintain an overview on trials being conducted in other regions and discuss/recommend if replication is required in southern NSW.

Investment Opportunities

This project has discussed the following opportunities to gain an improved RDE presence in southern NSW:

- NSW DPI and Cotton Breeding Australia establish a long-term breeding site at Yanco. Expertise and technical support is required for conventional cotton (non-transgenic) production and is ideally located at the Leeton field site. A cotton farming rotation could be developed in the 2013–14 season to implement trials the following season. The attraction is a potential southern focus on breeding shorter maturing varieties.
- NSW DPI further utilise the Leeton field site for scientific trials linked to IPM and nitrogen management/Pix® trials. This also provides resources to other organisations operating from northern regions who require land and resources to manage trial sites and for NSW DPI to link their trials to on-farm sites.
- NSW DPI and CottonInfo provide executive support to an RDE committee, as above, to coordinate building RDE capacity in southern NSW.



Appendix 1 – WUE Measurements 2013

Table 1 WUE measurements in the Murrumbidgee catchment for the 2012–13 season.

Farm name	Longitude	Latitude	Town	Irrigation water used (ML/ha)	Rainfall (ML/ha)	Total (ML/ha)	Bales per ha	WUE (bales per ML)	Irrigation system
1703.00	34°34.947'S	146°14.989'E	Whitton	13.00	1.41	14.41	12.5	0.867	bankless beds
1709.00	34°33.050'S	146°13.950'E	Whitton	8.78	1.47	10.25	12.0	1.171	both
1710.00	34°32.225'S	146°12.808'E	Whitton	8.75	1.47	10.22	11.7	1.145	bankless beds fresh lasered
Boree Park	34°10.334S	145°35.296'E	Tabbita	9.33	1.41	10.74	12.0	1.118	siphons
Kiera	34°41.297'S	145°46.539'E	Coleambally	10.52	0.89	11.42	12.4	1.086	siphons
2020.00	34°44.700'S	145°50.790'E	Coleambally	10.04	0.89	10.94	11.8	1.079	siphons
75.00	34°20.052'S	145°45.459'E	Benerembah	9.85	1.41	11.26	10.5	0.933	bankless bank
29.00	34°06.080'1S	145°31.0336'E	Wah Wah	9.93	1.41	11.34	12.0	1.058	siphons
				10.03	1.30	11.32	11.86	1.06	Average

Source: R Hoogers NSW DPI 2013

Appendix 2 – Growing Cotton in Southern NSW

By Kieran O’Keeffe, Regional Development Officer, CottonInfo (adapted from Cotton Conference 2008 paper by James Hill, former Cotton Development Officer, NSW DPI).

Background

Cotton was first grown in the Riverina in the 1960s. A cotton gin was established at Darlington Point in 1964 and CSIRO conducted a cotton breeding program for many years at Griffith. Cotton was the first row crop grown on Ravensworth Station at Hay and Kooba Station at Darlington Point. The cotton industry did not continue to expand, mainly due to the lack of suitable varieties and seasonal rains during autumn which would have been detrimental for cotton harvest. Ironically, it was George Commins who started growing maize replacing cotton as a row crop in the mid-sixties at Kooba Station. George is the father of MIA cotton growers Roger and Tim Commins who have now grown cotton in the MIA for the past ten seasons.

Cotton returned to southern NSW in the mid 1980s (325 ha in 1986–87) when it was grown at Hillston by the Maillor family who continue to grow cotton today. The growing of cotton was confined to the Lachlan River valley at Hillston and then expanded into the Murrumbidgee valley in 1999 with a trial area of 400 ha at Twynam’s property Gundaline Station. Cotton was also being trialled at Lake Marimley north of Balranald at the same time. Up until a few years ago, large increases in the Tabbita, Griffith, Whitton and Coleambally districts meant the maximum area of cotton grown in the southern region was approximately 16,000 ha in 2000–01, with the majority of this area being grown in the Lachlan valley (Hillston).

The largest area (up until the last few years) for the Murrumbidgee was 6,700 ha in 2003–04 yet all of this cotton was grown around Hay and not in the Murrumbidgee Irrigation Area (MIA) nearer Griffith. This compared to approximately 6000 ha for the Lachlan valley for the same season. In 2007–08, due to reduced river allocations, the combined area for the Lachlan and the Murrumbidgee was 3250 ha (Lachlan 2450 ha and Murrumbidgee 800 ha) and this was all grown using irrigation bores. Tables 1 and 2 summarise cotton production figures in southern NSW for the past 10 seasons.

Table 1 Cotton production figures in southern NSW 2003–2009.

Year	Area (ha)		Cotton bales		Yield (bales/ha)	
	Hillston	MIA	Hillston	MIA	Hillston	MIA
2003–04	5904	6661	41,434	40,013	7.02	6.01
2004–05	4158	3252	36,998	22,792	8.9	7.01
2005–06	3751	3003	38,354	28,951	10.23	9.64
2006–07	2784	2276	33,384	23,816	11.99	10.46
2007–08	2784	2276	27,105	8467	10.86	11.36
2008–09	2034	1010	19,758	7635	9.71	7.56

Table 2 Cotton production figures in southern NSW 2010–2012 (Lachlan and Murrumbidgee combined).

Year	Area (ha)	Average yield (bales/ha)	Total bales
2009–10	3300	12.1	40,000
2010–11	23,000	9.6	220,000
2011–12	53,400	10.8	576,200

The 2012–13 crop has just been picked (end of June 2013) and is estimated at 41,000 ha with a potential of 450,000 bales.

Why Southern Irrigation Farmers are Looking at Cotton

Dollars per Megalitre of Water

Reduced water allocations are driving farmers to look at improving their return per megalitre. Some southern irrigation farmers see cotton as an attractive option at above \$450 per bale, especially when seed price is factored in. The yields have been very high in the last couple of seasons across both valleys and the returns at 12 bales/ha compare well to other summer crops. Table 3 shows various yields for rice, maize and cotton. Growers and advisors must be aware that these figures are only a budget guide as there are many variables to consider including set-up costs and contracts secured. Expected income and variable costs such as chemical, fertiliser and water can dramatically change the bottom line. It is best to do your own figures.

Table 3 Gross margins and \$/ML comparisons of main summer crop options 2013.

Crop	Price (\$/t or \$/bale)	Yield (t/ha or bale/ha)	Income (\$/ha)	Variable costs (\$/ha)	Gross margin (\$/ha)	Water used (ML/ha)	\$/ML
Cotton	450	10	4500	3200	1725	10	173
Cotton seed	170	2.5	425				
Maize	270	10.5	2835	1805	1030	10	103
Rice	300	10	3000	1430	1570	14	112

Marketing

Growers like the fact that cotton can be sold on the futures market three years in advance. The full complexity of marketing and the ability to lock in a price that they are comfortable with before the bale price drops is something that will take time for new growers to fully appreciate. This is very different to all other summer cropping options which either offers an indicative price or a price for the particular growing season.

Ginning Capacity and Water Availability

Cotton production in southern NSW is underpinned by access to both ground and surface water. New water products which allow leasing of temporary water and forward selling of cotton for up to three years in advance will result in an estimated production base of around 30,000 ha in most years.

There is now good ginning capacity in southern NSW with gins at Hillston and Whitton.

Why Can Cotton be Grown Successfully in the South?

Varieties

Cotton growers are achieving excellent yields due to the fantastic work by seed breeders in producing new varieties. Careful management for earliness of these full season varieties is also required in southern NSW.

The two dominant varieties grown in southern NSW are 71BRF and 74BRF. Both of these varieties are full season varieties with Bollgard II® and Roundup Ready Flex® transgenic traits.

A late plant option is 43BRF which is a relatively early maturing variety with a compact growth habit. Long-term data from CSD trials in the Lachlan, Murrumbidgee and Macquarie have shown 71BRF and 74BRF are close to equal in yield potential with 43BRF about one bale/ha less in yield (Tables 4, 5 and 6).

Table 4 A comparison of cotton varieties (Sicot 71BRF v Sicot 74BRF).

Variety	Yield (bales/ha)	TO %	Length	Strength	Micronaire	Uniformity
71BRF	11.67	37.7	1.22	30.6	4.0	81.8
74BRF	11.65	40.1	1.23	31.1	4.1	81.9
Difference	- 0.02	2.33	0.01	0.56	0.09	0.1

Table 5 A comparison of cotton varieties (Sicot 74BRF v 43BRF).

Variety	Yield (bales/ha)	TO %	Length	Strength	Micronaire	Uniformity
74BRF	11.73	40.4	1.22	30.8	4.2	81.5
43BRF	10.73	36.8	1.23	32.4	4.2	82.3
Difference	1.00	3.6	0.01	- 1.6	- 0.07	- 0.78

Table 6 A comparison of cotton varieties (Sicot 71BRF v 43BRF).

Variety	Yield (bales/ha)	TO %	Length	Strength	Micronaire	Uniformity
71BRF	11.1	38.1	1.19	30.8	4.1	81.2
43BRF	10.14	37.1	1.17	32.4	4.3	82.1
Difference	0.96	1.01	0.02	- 1.55	- 0.15	- 0.81

Source: CSD New Growers Guide 2013.

Transgenic Cotton Varieties

Another factor that has put cotton on the radar as a potential summer crop for Murrumbidgee irrigation farmers is the introduction of transgenic cotton varieties. New growers see Bollgard II® and Roundup Ready® technology as being one of the features that has attracted them to cotton. Previously, growers thought the high dependence on insecticide sprays and therefore the application issues would have prevented cotton production in the Riverina. This is due to the large areas of vineyards and horticulture in the area including vegetables, fruit and nuts. Ironically, many of these industries were using the same products that the cotton industry was using prior to transgenic varieties and are continuing to do so.

The transgenic varieties have resulted in high fruit retention and reduced tipping which in combination with variety improvement and excellent management has meant very impressive yields. It has also resulted in earliness which is vital for cotton to succeed in the south.

Change in Season

In recent years the average day degree accumulation has been considerably higher in most seasons compared to the average (Tables 7 and 8) and there has not been an early autumn break meaning that it is staying dryer for longer. This is one of the reasons yields have increased as a lot more top crop is being finished and the majority of harvest has not been affected by any significant rain events.

Table 7 Temperatures and day degrees at Griffith (Murrumbidgee Valley).

Season	DD 1/10–31/3	Hot shock days	Cold shock days
2004–05	1896	38	51
2005–06	2205	47	42
2006–07	2172	54	41
2007–08	2099	29	32
2008–09	2057	32	41
2009–10	2193	38	26
2010–11	1868	17	45
2011–12	1871	15	39
2012–13	2099	35	44

Average day degrees: 1832

Average hot shock days: 21.4 (>36°C)

Average cold shock days: 54.3 (<11°C)

Table 8 Temperature and day degrees at Hillston (Lachlan Valley).

Season	DD 1/10–31/3	Hot shock days	Cold shock days
C2005	2018	46	45
C2006	2244	60	38
C2007	2211	55	42
C2008	2174	56	29
C2009	2152	38	34
C2010	2252	42	24
C2011	1961	26	43
C2012	1968	16	34
C2013	2269	46	39

Average day degrees: 2023

Average hot shock days: 30.3 (>36°C)

Average cold shock days: 38.4 (<11°C)

Issues and Challenges Faced

Planting and Crop Emergence for Earliness

Planting can be a challenge in the southern area due to cold air masses that can feed in from the south throughout summer. It is vital that the crop has an even plant stand as the cotton plant in the south does not always have the same ability to compensate as in the warmer areas. A couple of the growers in the MIA pre-irrigated this season as a management tool to help achieve an even stand. The time interval between irrigation and planting allows the soil to heat up and therefore the seed is planted into a warm moist soil. There is reduced water logging as the seed is not submerged when watering up. Potential for more even germination as the field, depending on size, may be planted in one day. This compares to watering up which may take a few days. There will be a good germination of weeds therefore creating an opportunity to spray out prior to emergence. Wireworm control will be more effective as the main chemical used to treat wireworm is quite soluble and under dry conditions the product can be taken away from the seed when watering up thereby reducing efficacy.

A challenge of pre-irrigating is the different drying rates of different soils that make planting into even moisture across the block difficult. The hills can dry too fast therefore requiring the seed to

be planted deeper to chase the moisture. If the seed is sown too deep it is risky to flush as the seeds may not have enough energy to push out of the ground. One advantage of the bankless channel system was revealed this season when planting into moisture. The crop was sown into marginal moisture due to the cold southerly winds drying the hills out yet the bankless system allowed the block to be flushed five days after planting. The bankless system enabled the 40 ha block to be watered in 24 hours and the system allowed the water to continually sub up the hills as the level could be controlled. This is different to a siphon system where, depending on soil type, it can be impossible to re flush as the water just runs out of the furrow without subbing the top of the hill where the seed is.

Defoliation

It is vital that the crops are cut out on time so that earliness can be achieved. This year, crops were treated with mepiquat chloride growth regulator as early as mid January without any perceivable yield penalty. It is also essential that growers allow the fruit to mature fully to avoid low micronaire which can be an issue even when crops are managed well. The crops need to be set up so that defoliation can capitalise on the last of the warm weather.

Picking

The round module picker has changed the picking operation and since 2010 over 30 new pickers have come into the district. Over 90% of the crop is now picked by round module pickers.

Water Availability

Years when water availability is low are always a threat to stable summer crop production for all summer crops. Higher returns per megalitre from row crops are factored in when making planting decisions in lower allocation years.

Competition from Other Commodities

Rice is the main summer crop grown by irrigators in southern NSW with full production at around 100,000 ha or 1 million tonnes. The rice industry would like to have more stable production around 800,000 tonnes which fits in with their major markets. For this reason cotton is not viewed as a competitor to the rice industry but complementary to their business.

The cotton area will vary from 30,000 to 50,000 ha depending on price and water availability. Other summer crop alternatives such as maize and soybeans have relatively small domestic markets and in high water availability years make up around 20,000 ha of southern NSW irrigation production. Expansion of maize and soybean plantings will depend on the establishment of consistent export demand.

Cotton is seen by irrigators as another summer crop option. It has the advantage of being sold on the world market and can be forward sold up to three years in advance.

Crop Nutrition

Cotton crop nutrition is similar to other regions. Fertiliser rates and types depend more on soil type and cropping history. There are a couple of growers trialling alternative fertilisers including manures to try and improve the health of the soil and therefore nutrient availability.

Crop Rotations

Crop rotations vary yet most growers grow irrigated wheat after cotton followed by a fallow period and then cotton again. In the MIA, alternatives based on market price would include summer crops such as maize and soybean or winter crops such as cereals or faba beans.

Diseases

Diseases in the southern area include black root rot, pythium and rhizoctonia which can be a significant issue in cold seasons. Management tools include seed treatments and pre-irrigating

which enables sowing into moisture, or ensuring there is a warm weather pattern following the water up irrigation. A survey this year revealed that seedling mortality was 48% for the Murrumbidgee (compared to 41% average) and black root rot presence was 17%. Seedling survival is totally dependent on the timing with the weather patterns. Planting later is not always a guarantee as it is possible to get a frost even in November. In addition, if the crops are sown too late there may not be enough season length to finish them.

Insect Pests

With the introduction of transgenic technology and Bollgard II®, *helicoverpa* spp. is no longer the main insect pest of cotton. In the MIA, the main pest affecting cotton is the false wireworm. Due to years of returning stubble from summer crops (maize and rice) and winter crops (including cereals and faba beans) the false wireworm population can be large and the result of their feeding can be serious. The problem is magnified by the slow growth due to the cold therefore the plants are vulnerable for longer periods of time. Wireworms were one of the main reasons for attempting to pre-irrigate and plant into moisture. This practice, as discussed previously, allows the granular insecticide product to be placed with the seed therefore protecting the seedling.

The other main insect pests are mirids, yet with diligent checking can be controlled using the recommended insecticides. Growers are very conscious of what they spray to control secondary pests such as mirids as many of the growers in the MIA grow seed crops which rely heavily on bees making it essential to use selective chemistry where possible.

Mites can be another issue in the MIA especially when the maize crops dry off and become less attractive. For the last two seasons, growers have been happy to monitor mite populations yet have not had to control them. Other insects that have been an issue include aphids and thrips.

Conclusion

Cotton has been grown very successfully in southern NSW as demonstrated by the very high yields achieved in recent seasons.

Expansion will depend on water availability in combination with markets for all summer crops. Cotton crops have been grown successfully as far south as Jerilderie and Berrigan but the main increase in production area has been in the Murrumbidgee Valley.