



Cotton Catchment Communities CRC

CRC 1111

# FINAL REPORT

## *Part 1 - Summary Details*

Cotton CRC Project Number: 5.02.37

## **Project Title: IPM Target Pest Lead**

**Project Commencement Date:**

**Project Completion Date:** 30/6/2012

**Cotton CRC Program:**

## *Part 2 – Contact Details*

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**Signature of Research Provider Representative:**

### ***Part 3 – Final Report Guide (due at 31<sup>st</sup> May 2012)***

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

#### ***Background***

1. This project commenced in 2010, with the appointment of Sal Ceeney as the Target Pest Lead to provide extension support to industry on managing key insect pests. The 2 day per week, part time position, supported key cotton entomologists, Lewis Wilson, Robert Mensah, Mary Whitehouse, Melina Miles, Zara Hall, Moazzem Khan and more recently Paul Grundy. The role was established to increase the effectiveness and efficiency of knowledge exchange from key researchers to cotton growers and consultants through a streamlined delivery service. Working with regional extension specialists and entomologists the position assessed and monitored arising pest issues and provided information updates to clients on an as needed basis. The project was linked to the myBMP program to ensure that industry best practice was being promoted throughout as well as to ensure the practices outlined in the myBMP program were up to date and consistent with best practice recommendations arising from current research. Ian Taylor was appointed to the Target Pest Lead Position in November 2011 to provide ongoing support to the role while Sal Ceeney undertook Parental Leave

#### ***Objectives***

2. The two main objectives for the project were:
  - Target 1.01 At least 50% of cotton Ha adopting industry best practice on recommended sampling and thresholds
  - Target1.02 At least 50% of Ha selecting chemistry to conserve beneficial insects.

The two main targets were amended to better reflect current industry position following an industry survey indicating that demonstrated that the cotton industry has been meeting the target of 50% of the industry following IPM guidelines. The two main project objectives became:

- Greater than 50% of growers/consultants adopting the CPMG sampling and thresholds for insect pests. This will result in an improvement of the confidence that growers and consultants have to follow industry recommendations on when insect control may be necessary and can be measured by a reduction in the number of insect sprays applied 'below threshold'.
- Greater than 50% of growers/consultants using published IPM guidelines to select chemistry that conserves beneficial insects. Examples may include a reduction in the reliance of one type of chemistry (e.g. fipronil) for mirid control. Or this may be a reduction in the amount of broad spectrum early season sprays that are disruptive to beneficial insect populations.

In addition to the two main targets additional objectives built into the project agreement for Ian Taylor included:

- Update cotton Tale No 5
- Co-ordinate with CRDC, CCA and Cotton Australia to determine if another CBT survey was required
- Review the Target Pests Marketing Campaign
- Review Strategies To Manage Sucking Pests in Cotton
- In conjunction with Susan Maas, amend the Cotton Pest Management Guide for 2012.
- Co-ordinate early season bug checker information workshops with Melina Moazzem and Paul.
- Establish and run a twitter network
- Attend industry meetings as required.

### *Methods*

3. A detailed marketing Campaign was developed for this project: Details are included below:

#### **Measurement of Targets and Benchmarking;**

The primary quantitative forms of measurement will be through the annual CCA survey and myBMP. Follow up of the impact of individual activities (such as grower meetings) will also be conducted.

The CCA survey will give the primary quantitative data for the targets as it covers a large percentage of the industry (71% in 2009/10) and targets consultants, who are often the primary decision makers and enforcers of IPM on cotton growing farms.

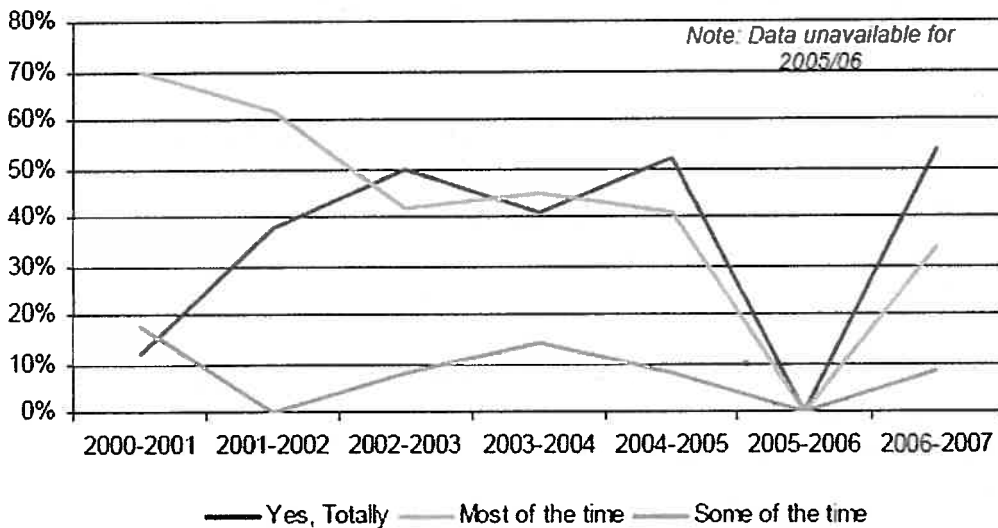
The CCA survey was redesigned for the 2010 season to ensure data was being gathered to specifically address whether the targets are being met.

myBMP data will be used to collect information on grower's adherence to IPM strategies, however given the timeframe of the target (to 2012) may only cover a small percentage of the industry in the next 2 years.

Follow up of individual activities will be used to gauge the success of individual activities and as a way of obtaining more quantitative data, or a feel for what is happening 'on ground' in terms of grower and consultant attitudes towards IPM. Quantitative data will also be collected as part of the CCA survey and will be used to obtain a wider view of consultant and grower attitudes towards IPM, rather than just relying on qualitative data alone.

Where are we now?

The figure below from the 2006/07 survey shows levels of IPM adherence over time.



Since 2003, the industry has been meeting the target of 50% of the industry following IPM guidelines. This will continue to be measured through the CCA survey. As an overall industry measure this is useful, however if we look more closely at specific IPM issues, the targets are not always being met.

Survey work conducted by Mary Whitehouse (CSIRO) for the 2006/07 season showed that 60% of mirid sprays were being applied below the industry recommended thresholds. Of these sprays, there was a high dependence on the use of fipronil for 63% of sprays, with many fields receiving more than one application of this insecticide in a season.

Although the industry has been at 50% IPM adoption since 2003, as a benchmark of success it is hoped that this steadily improves and becomes consistently higher than 50%.

This will be defined by:

- Greater than 50% of growers/consultants adopting the CPMG sampling and thresholds for insect pests. This will result in an improvement of the confidence that growers and consultants have to follow industry recommendations on when insect control may be necessary and can be measured by a reduction in the number of insect sprays applied 'below threshold'.
- Greater than 50% of growers/consultants using published IPM guidelines to select chemistry that conserves beneficial insects. Examples may include a reduction in the reliance of one type of chemistry (e.g. fipronil) for mirid control. Or this may be a reduction in the amount of broad spectrum early season sprays that are disruptive to beneficial insect populations.

### 3.1 Key drivers to change practices:

#### 3.1a Knowledge

In order to change practices, growers must be able to recognise when change is needed by having knowledge of the issue and how it affects their business. Widespread knowledge of what IPM is and why it is important is a key driver to getting growers and consultants to recognise that IPM practices are important to their business.

#### 3.1b Methods

Once it is acknowledged that change is needed, growers need to be given the tools to implement these changes in their business.

### **3.1c Benefit**

A key driver in implementing change is the benefit gained. By improving IPM, cotton producers need to see an environmental, social and economic benefit.

The recent emergence of secondary pests in Bollgard II cotton has, and will, be a key driver to improving IPM in Australian cotton systems.

The spread of Silverleaf Whitefly throughout the industry, particularly when many growers expected it to be a warm climate pest, has seen IPM re-emerge as a major consideration for cotton growing.

The potential economic costs to both growers and the industry mean that effective management of SLW is vital. Given the pests ability to become resistant to insecticides used for their control, an effective IPM strategy is the key to successfully, and economically, controlling the pest.

The recent incursion of mealybug in the Emerald district is another pest that requires good IPM for control and is a further driver for the practice of good IPM in the industry.

Environmental benefits are gained through IPM by not only potentially reducing the number of insecticides applied to cotton but also the nature of these sprays, so they are less disruptive to non-target pests and the environment.

Social benefits are also a driver of IPM as the reduction of the number of insecticides and the number of broad spectrum sprays applied improve on farm O,H&S conditions for farm workers and improve the cotton industry 'reputation' in the wider community.

## **3.2. Strategies to achieve change**

### **3.2a Knowledge**

*Provide up to date, easy to understand information on IPM.*

IPM information will be distributed via a number of pathways including print, media, grower meetings and workshops.

Information on the IPM is published each year in the Cotton Pest Management Guide (CPMG).

A series of Cotton tales will be produced during the season dealing with relevant IPM issues including pest pressure considerations for the season, Cotton Bunchy Top and aphid control and management of SLW.

Valley specific grower meetings will be held throughout the industry highlighting IPM issues. An IPM short course will be held in Southern NSW targeting new growers and consultants to the industry to introduce them to IPM in the cotton industry.

### **3.2b Methods**

*Provide easy to understand tools for doing best practice in insect management*

The tools required for IPM have been available for the industry for a number of years in the form of published IPM guidelines in the Cotton Pest Management Guide. These guidelines include thresholds, sampling, control measures and the impact of control on beneficial populations. Recent and continued improvements to the CPMG, particularly ensuring it is widely

available prior to planting, will see it continue to be the major IPM tool for growers and consultant.

Practical demonstrations of these tools will be given to new growers and consultants to the industry in Southern NSW via the IPM short course.

### **3.2c Benefits**

#### *Highlight benefits of best practices*

A series of case studies, to be published in major media including Spotlight magazine and the Australian Cottongrower, will highlight grower and consultant experiences in implementing IPM in their businesses, including successes and failures.

#### *Reinforce best practices behaviours*

The myBMP program will be used to reinforce best practice behaviours by allowing growers to benchmark their IPM performance against the industry standards.

### **3.2 Market Campaign to achieve Change**

#### **3.3a Knowledge**

##### Valley meetings

- Sth NSW: IPM short course targeted at new growers to introduce the concept of IPM and deliver tools and information available.  
Delivery of an area early season meeting in established cotton growing areas (Hillston and Griffith) targeting consultants (primarily) and growers to discuss area wide IPM strategy; particularly targeting reduction in early season broad spectrum mirid sprays that are disruptive to Beneficial's.
- Macquarie: Delivery of an area early season meeting in established cotton growing areas (Hillston and Griffith) targeting consultants (primarily) and growers to discuss area wide IPM strategy; particularly targeting reduction in early season broad spectrum mirid sprays that are disruptive to Beneficial's.
- Upper/Lower Namoi, Gwydir and Border Rivers: continued reinforcement of IPM strategies for controlling primarily mirid and SLW. Delivery in these areas more difficult due to lack of extension staff, however utilise other industry channels such as CCA or CSD.
- Darling Downs/Balonne/Central Queensland: continued reinforcement of IPM strategies for controlling primarily mirid and SLW to be delivered at already established AWM meetings, or any other grower meeting (e.g. CGA meetings) by extension team.

Cotton tales as required looking at Pest Pressure for 2010/11, using IPM to control Cotton Bunchy Top, etc.

Delivery of pest information as required (e.g. in the instance of a new emerging pest or problem arises during the season).

#### **3.4 Methods**

Deliver the Cotton Pest Management Guide annually. Making it easy to use, available and in time for first plantings or 30 Aug.

### 3.4a Benefits

- Annual review of myBMP modules to update information and make easier and clearer to use; modules 2 Biotechnology, 3 IPM and 4 Pest Management Packagers.
- Promote the use of myBMP. This will be done through promoting myBMP as a source of IPM information for growers and as a benchmarking tool. myBMP will be promoted, as appropriate, through grower meetings and publications.
- 3 articles in Spotlight and Cotton grower Magazine; a series of grower case studies looking at:
  - The use of oils as an IPM tool
  - 'No spray BGII' highlighting the use of careful sampling and following thresholds so as to not spray BGII unless necessary. Benefits of preserving Beneficial's and reducing costs.
  - Getting it wrong - the high cost of poor IPM management using SLW as an example.

### *Results*

4. This project has contributed to numerous field days and has developed a number of articles for the management of key pests across the cotton region. Key outputs are summarised below:
  - a. Spotlight articles
    - i. Spotlight - Spring: Aphid Control – limited options require wise choices
    - ii. Spotlight - Spring: Early Season aphids – don't panic
    - iii. Spotlight – Winter: Alarming Potential For CBT Damage
    - iv. Spotlight – Winter: Growers Warned To Act Now Against Next Season's Disease And Pest Threats
    - v. Spotlight – Spring: Broadmites ecology, damage, control
  - b. Australian Cottongrower articles
    - i. Silver Leaf Whitefly – wet conditions, late crops and displaced populations, by Ian Taylor, Richard Sequeira, Paul Grundy and Lewis Wilson, Apr-May 2012, The Australian cottongrower, pp 16-18.
  - c. Cotton Tales
    - i. Aphid management – Cotton Bunchy Top
    - ii. Early season aphid management
    - iii. Cotton response to flood
    - iv. Apple Dimpling Bug in conjunction with Julie Wise
    - v. Broad mites, ecology, damage, control
    - vi. Managing Silver Leaf Whitefly, -wet conditions, late crops and displaced populations
  - d. Flood Response Article
    - i. Development of 4 page brochure –Responding to late season Flooding was developed in February 2012. This brochure covered many aspects of cotton management post flooding and was distributed as a

- standalone brochure in Spotlight Magazine and also distributed by retailers to cotton growers and consultants.
- e. Cotton Pest Management Guide
    - i. Updated 2011/2012 Cotton Pest Management Guide. Revision of all information in pest section including major revision to IPM section. Update to insect and mite management for the 2011 Cotton Production Manual.
    - ii. Update 2012/2013 Cotton Pest Management Guide. All aspects of IPM and weed management.
  - f. Australian Cotton Production Manual
    - i. Updated 2012/2013 edition of the Cotton Production Manual.
  - g. Field Days and Expositions
    - i. Coordinated the Sthn NSW Cotton Expo. Lewis Wilson presented on IPM management in the cotton industry for new growers.
    - ii. Presented at Macquarie Cotton Growers pre-season meeting August 2011. Highlighted management of predicted key pests for the Macquarie this season – aphids, mites and slw. Presentation put together with Lewis Wilson. Small group – 12 growers, 3 private agros, 4 reseller agros however excellent discussion around CBT threat and likelihood of slw outbreak. Agros particularly well informed of risks and current best practice management strategies.
    - iii. Organise and co-ordinate field day on early season pest management and managing Pix for cutout (see photos below) with James Hill
    - iv. Participate in the opening of the new gin at Hillston in May 2012 (Photos below)
  - h. Other events
    - i. Take aerial photos of verticillium wilt affected fields at Breeza NSW (Photos below)
    - ii. Cotton Bunchy Top Survey was being administered through CRDC in conjunction with Susan Maas. No follow up required by.
    - iii. Strategies to manage sucking pests – A series of cotton tales focussing on aphid, SLW and broadmites were developed throughout the course of this project. Revisions to the Cotton Pest Management Guide for mirids, mites, GVB and pale cotton strainers have incorporated changes to thresholds and latest data from researchers working on these specific pest species.
    - iv. Meetings with all industry entomologists were undertaken during December and February 2012 to ascertain extension support required and extension priorities for insect management.
  - i. A twitter network has been established for use next season @CottonIPM has been established to enable more rapid response to critical issues and to enable the extension team to follow arising issues.

- j. Meetings were held with all cotton entomologists throughout Qld and NSW. During the meeting with the QDEEDI team now DAFF, the issue of the bug checker program was raised. Melina Miles and Paul Grundy had conducted this training in conjunction with Mike Stone earlier in the season. There was no requirement for an additional training program to be run, however it was suggested that maybe a back to basics course be developed for training new agronomists and bug checkers into the industry. Outcomes relating to this will be dependent on the structure of the D&D team post Cotton CRC.



Extent of verticillium wilt in cotton fields at Breeza NSW during 2011/2012 cotton season.



Mike Bange discussing Pix application at Griffith field day 12 January 2012



Lewis Wilson providing advice on early season thrips damage



Engaged discussion among growers and consultants in Griffith



Excellent turnout with approximately 90 growers and consultants



Some parking lot!!



Getting some shade among the cotton

a.



Cotton Australia CEO Adam Kay opening the field day meeting celebrating the building of a new gin to support growers in southern NSW



Touring the new Gin complex



John Deere's new six row round module picker and baler on display at the front of the new gin



Cotton Australia's James Houlahan giving a briefing to growers on the transport of round bales

### Outcomes

5. This project has contributed to the adoption of improved management practices for controlling cotton insect pests and also to the alignment of management practices with the myBMP framework.
  - a. Specifically detailed management notes have been produced for:
    - i. Aphids
    - ii. Aphids and their interaction as vectors for Cotton Bunchy Top
    - iii. Apple Dimpling Bug
    - iv. Broadmites
    - v. Flooded- cotton both mid and late season management
    - vi. Silver leaf whitefly – late season build-up of whitefly as they disperse from defoliated crops or sprayed out weeds following extensive rain across cotton growing areas.

Two primary objectives were established for this project:

- Target 1.01 At least 50% of cotton Ha adopting industry best practice on recommended sampling and thresholds

- Target 1.02 At least 50% of Ha selecting chemistry to conserve beneficial insects.

These objectives were refined however as the industry has been at 50% IPM adoption since 2003, as a benchmark of success it is hoped that this steadily improves and becomes consistently higher than 50%.

The revised objectives became:

- Greater than 50% of growers/consultants adopting the CPMG sampling and thresholds for insect pests. This will result in an improvement of the confidence that growers and consultants have to follow industry recommendations on when insect control may be necessary and can be measured by a reduction in the number of insect sprays applied 'below threshold'.
- Greater than 50% of growers/consultants using published IPM guidelines to select chemistry that conserves beneficial insects. Examples may include a reduction in the reliance of one type of chemistry (e.g. fipronil) for mirid control. Or this may be a reduction in the amount of broad spectrum early season sprays that are disruptive to beneficial insect populations.

The principal project targets have been achieved as is evidenced by the 2011 Cotton Practices Survey conducted by GHD Hassall in conjunction with the Cotton CRC Development and Delivery team. In this survey the majority of growers and consultants indicated that they selected soft chemistry that were more friendly to beneficial insects, further the majority of respondents indicated that they considered beneficial insects when making any spray decisions. The majority of respondents sampled and used industry recommended thresholds when making spray decisions, with many monitoring both pest and beneficial numbers to help determine the most appropriate management strategy. These practices align with those recommended in the Industry's myBMP program and reflect the success of the development and delivery team's efforts in promoting use of industry recommended best practices.

In relation to the use of published guidelines and those specifically published in the Cotton Pest Management Guide - this is more difficult to assess. The Cotton Practices Survey doesn't specifically ask whether consultants and growers use published IPM guidelines or sampling as described in the Cotton Pest Management Guide. The survey does however provide an indication of the most important information sources for respondents. Agronomists and consultants are described as the most important information source with 132 responses while the Cotton Pest Management Guide is 5th on the list with 16 responses. While growers obviously rely heavily on consultants, and consultants rely on other consultants and consultant networks, we are unable to clearly determine whether consultants derive their thresholds from the guidelines published in the Cotton Pest Management guide. Anecdotally, however when writing the 'Managing Silver Leaf Whitefly, -wet conditions, late crops and displaced populations' Cotton Tale, consultants that we spoke to, relied on the SLW matrix contained in the Cotton Pest Management Guide for control decisions. This indicates that at least for some issues, the Cotton Pest Management Guide is a ready source of information.

## *Conclusion*

This project has provided valuable information on both the management of key pest species and management of flooded cotton for the cotton industry during the period 2010-2012. Specifically, the information was provided to address important issues as they arose, supplementing information contained in the Cotton Pest Management Guide and the Australian Cotton Production Manual.

- Aphid abundance increased during the 2011/12 season due to host prevalence following above average rainfalls across cotton growing areas. This caused a great deal of concern throughout the industry as Cotton Bunchy Top had been widespread during the 2010/11 season and as aphids are the vector for this disease the probability of a major CBT outbreak was high. Three cotton tales addressing Aphid management and Cotton Bunchy Top disease were prepared by this project providing industry with detailed management information.
- Apple Dimpling Bugs were problematic early in the 2011/12 season. Also known as yellow mirids, growers were unclear as to whether these insects were likely to require control. Apple dimpling bugs have the potential to damage seedling cotton however they are also useful predators of *Helicoverpa* eggs and mites. In low numbers they are unlikely to cause a yield reduction but may cause pin squares to be shed and as numbers increase could affect yields particularly in short season areas. A cotton Tale was produced by Julie Wise in conjunction with this project to provide management guidance.
- Broad mites, typically a rare pest of cotton and more normally found in tropical/subtropical areas were observed in high numbers during the 2011/2012 cotton season. This was primarily thought to be due to the high humidity experienced throughout much of the season as well as the very high rainfall experienced. Broadmites are difficult to control in cotton as there are no acaricides currently registered for their control, however incidental control of Broadmites has been observed when growers applied abamectin for control of two spotted mite. Additionally, petroleum spray oils provide additional control of a range of mites and insect pests.
- Significant flooding occurred throughout many cotton growing valleys late in the 2011/2012 cotton season. This presented enormous challenges to the industry particularly as cotton was at such a late developmental stage and thus management options were limited. This project led the development of a four page management brochure in conjunction with leading industry scientists, Mike Bange, Ian Rochester, Lewis Wilson, Paul Grundy, Steve Yeates and Graham Charles, reviewing physiological responses, nutrition, pest and weeds issues that may need to be addressed following such an event,
- Silverleaf whitefly also became problematic late season 2011/12. The build-up of SLW at this time in the season was atypical, and primarily resulted in the movement of adults into late maturing cotton crops following control of alternative hosts (weeds) in fallow fields when rainfall events began to

diminish. Guidelines for SLW control published in the Cotton Pest Management Guide primarily use the threshold matrix to predict expected population increase resulting from resident populations. Because SLW numbers in this case were primarily coming from non-resident populations the same set of assumptions hence control recommendations were no longer applicable. A Cotton Tale and subsequent article published in the Australian cottongrower magazine were developed with key scientists, Lewis Wilson, Richard Sequeira and Paul Grundy to address this challenging problem.

### *Extension Opportunities*

- (a) This is an extension/adoption project. All activities detailed in this project contribute to industry extension

### *Publications*

1. A. Publications relevant to this project.

#### Non-peered reviewed articles

a. Spotlight articles

- i. Spotlight - Spring: Aphid Control – limited options require wise choices
- ii. Spotlight - Spring: Early Season aphids – don't panic
- iii. Spotlight – Winter: Alarming Potential For CBT Damage
- iv. Spotlight – Winter: Growers Warned To Act Now Against Next Season's Disease And Pest Threats
- v. Spotlight – Spring: Broadmites ecology, damage, control

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- i. Development of 4 page brochure –Responding to late season Flooding was developed in February 2012. This brochure covered many aspects of cotton management post flooding and was distributed as a standalone brochure in Spotlight Magazine and also distributed by retailers to cotton growers and consultants.

#### Presentations (conference, field days, workshops etc.)

- a. Coordinated the Sthn NSW Cotton Expo. Lewis Wilson presented on IPM management in the cotton industry for new growers.
- b. Presented at Macquarie Cotton Growers pre-season meeting August 2011. Highlighted management of predicted key pests for the Macquarie this season – aphids, mites and SLW. Presentation put together with Lewis Wilson. Small group – 12 growers, 3 private Agros, 4 reseller Agros however excellent discussion around CBT threat and likelihood of SLW outbreak. Agros particularly well informed of risks and current best practice management strategies.
- c. Organise and co-ordinate field day on early season pest management and managing Pix for cutout (see photos below) with James Hill
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#### ***Part 4 – Final Report Executive Summary***

This project has provided valuable information on both the management of key pest species and management of flooded cotton for the cotton industry during the period 2010-2012. Specifically, the information was provided to address important issues as they arose, supplementing information contained in the Cotton Pest Management Guide and the Australian Cotton Production Manual.

- Aphid abundance increased during the 2011/12 season due to host prevalence following above average rainfalls across cotton growing areas. This caused a great deal of concern throughout the industry as Cotton Bunchy Top had been widespread during the 2010/11 season and as aphids are the vector for this disease the probability of a major CBT outbreak was high. Three cotton tales addressing Aphid management and Cotton Bunchy Top disease were prepared by this project providing industry with detailed management information.
- Apple Dimpling Bugs were problematic early in the 2011/12 season. Also known as yellow mirids, growers were unclear as to whether these insects were likely to require control. Apple dimpling bugs have the potential to damage seedling cotton however they are also useful predators of Helicoverpa eggs and mites. In low numbers they are unlikely to cause a yield reduction but may cause pin squares to be shed and as numbers increase could affect yields particularly in short season areas. A cotton Tale was produced by Julie Wise in conjunction with this project to provide management guidance.
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incidental control of Broadmites has been observed when growers applied abamectin for control of two spotted mite. Additionally, petroleum spray oils provide additional control of a range of mites and insect pests.

- Significant flooding occurred throughout many cotton growing valleys late in the 2011/2012 cotton season. This presented enormous challenges to the industry particularly as cotton was at such a late developmental stage and thus management options were limited. This project led the development of a four page management brochure in conjunction with leading industry scientists, Mike Bange, Ian Rochester, Lewis Wilson, Paul Grundy, Steve Yeates and Graham Charles, reviewing physiological responses, nutrition, pest and weeds issues that may need to be addressed following such an event,
- Silverleaf whitefly also became problematic late season 2011/12. The build-up of SLW at this time in the season was atypical, and primarily resulted in the movement of adults into late maturing cotton crops following control of alternative hosts (weeds) in fallow fields when rainfall events began to diminish. Guidelines for SLW control published in the Cotton Pest Management Guide primarily use the threshold matrix to predict expected population increase resulting from resident populations. Because SLW numbers in this case were primarily coming from non-resident populations the same set of assumptions hence control recommendations were no longer applicable. A Cotton Tale and subsequent article published in the Australian cottongrower magazine were developed with key scientists, Lewis Wilson, Richard Sequeira and Paul Grundy to address this challenging problem.

**This Cotton Tale has been developed by Ian Taylor, Richard Sequeira, Paul Grundy and Lewis Wilson.**

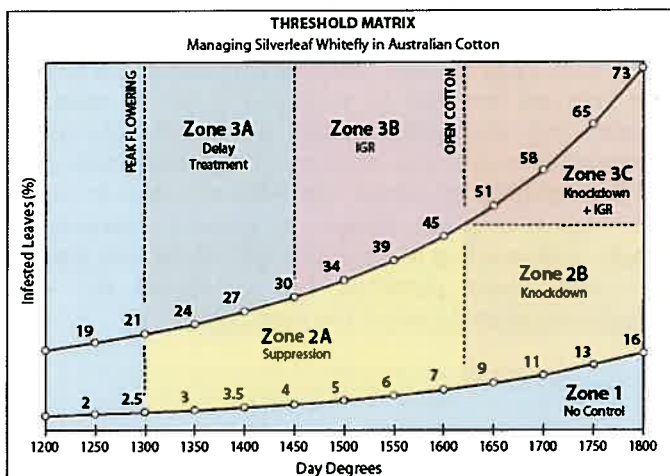
## Managing Silverleaf Whitefly (SLW) – Wet conditions, late crops and displaced populations

Whitefly numbers have been increasing in most cotton growing regions during February. However, infestations are variable - some fields recording zero leaves infested while others are 80% infested. Though cool conditions mean fewer generations of whitefly have developed, the regular rainfall has maintained widespread growth of suitable hosts which has probably sustained widespread low whitefly infestations. Now, as these hosts mature and as fallow fields and pastures are sprayed with herbicide it is likely that whitefly are seeking more palatable hosts such as cotton. The migration of SLW from surrounding weeds, sprayed out crop lands or defoliated crops poses an additional challenge for crop managers particularly for those crops already delayed by flooding or wet weather.

Management of whitefly this season will be challenging due to the wide spread of crop maturity both between and within each region. The flooding and inundation that has occurred in both November and again in February means some cotton crops will mature on time, while others may have been set back by as much as six weeks due to flooding/waterlogging and cool overcast conditions.

Temperatures during the last two weeks have remained in the low to mid thirties and hence we expect whitefly numbers to increase in crops and as whitefly continue to migrate from senescing or herbicide treated alternative hosts.

The threshold matrix should be used to guide whitefly management decisions for crops that are on time, or close to it (the day degrees calculator found at <http://CottASSIST.cottoncrc.org.au> can assist with assessing whether crops are maturing on time). Refer to pages 26 - 28 of the 2011/12 Cotton Pest Management Guide for control recommendations using the threshold matrix. This matrix provides an excellent measure of projected population build up and action thresholds for crops that are on time and not subject to mass SLW



migrations from surrounding areas.

## What if my crop is late?

Control of whitefly in later maturing crops is more complex. Whitefly that may occur in these crops are likely to be a combination of both the resident population and those that have dispersed from earlier maturing defoliated crops or sprayed out winter cropping lands. In these instances the threshold matrix **MAY NOT** be an accurate predictor of SLW population build up. Firstly, the day-degrees that a crop accumulates may no longer align well with the matrix if it is late developing due to flood damage. Secondly, the matrix is predicated primarily on SLW populations having built up in the crop without additional mid to late season influxes from surrounding areas. Agronomists and consultants will need to adjust their management strategy to one that accounts for open bolls and honey dew build up as opposed to the direct use of the chart.

A crop manager faced with these scenarios should aim to avoid honey dew contamination of open bolls. This means that high populations of displaced whiteflies prior to open bolls can be tolerated. The delay of treatment for as long as possible on late crops may also be advantageous as cooler temperatures in March/April will slow whitefly population growth and further reduce their capacity to generate honeydew. **Purposeful treatment delay** also allows more settling time for the likely inward flow of whiteflies before treatment is applied. Treating too early maybe partially ineffective due to further crop re-invasion by adult whitefly as the treatments efficacy declines and hence increases the risk of having to retreat.

For developmentally delayed crops or those fields that suffer influxes control decisions should be primarily based on four factors being:

- 1) Presence of whitefly and open bolls
- 2) Expected time until defoliation leaf drop
- 3) The rate of honey dew accumulation on the crop canopy and lint
- 4) The likely efficacy and residual impact of the chosen insecticide.

Product choices for SLW are primarily limited to knockdowns such as Pegasus (Diafenthiuron) and Pyrethroids (Bifenthrin) or the slower acting IGR's such as Admiral (Pyrproxifen) and Movento (Spirotetramat). Resistance is a threat to these products, so follow the IRMS. Admiral can only be applied once.

Crops with very low whitefly populations, <10% infested, and little honeydew at boll opening should not require control. However numbers and honeydew should continue to be monitored and if there is a sudden increase in whitefly, due to an influx from neighbouring fields control with a knockdown may be

warranted. Crops with moderate to high numbers at boll opening >30% infestation, may require treatment. Treatment options will depend on the origin and numbers of SLW, level of honey dew and rate of change and time left till defoliated leaf drop and relevant product withholding periods (WHP's).

If numbers are moderate to high and defoliated leaf drop is 3 or more weeks away an IGR may be the best control option as Pyriproxyfen has excellent residual and will mostly prevent the continued build up of resident and immigrant SLW. The Central Queensland experience strongly suggests that Pyriproxyfen (Admiral®) works even better at lower autumn temperatures than it does in summer and is capable of cleaning up dense whitefly populations on late cotton very effectively with a single application. Again, continue to monitor whitefly numbers and honeydew. If adult numbers begin to rebuild a knockdown may be required – use the threshold matrix as a guide.

If the crop is less than 2 weeks from defoliation and an influx of adult SLW occurs, a knockdown type product may provide better value, keeping in mind relevant WHP's. Again monitor honeydew and revise control decisions accordingly. In each scenario, if whitefly numbers are beginning to recover and cause honeydew close to defoliation then consider defoliating a few days earlier. Once defoliant is applied adult whitefly will generally leave the crop and falling leaves will take the nymphs with them.

In terms of monitoring honey dew, it is difficult to determine at exactly what point levels may become problematic once bolls begin to open. In CQ and during later outbreaks on the Darling Downs, honeydew was considered to be nearing levels that maybe problematic when leaves on the lower canopy start becoming heavily speckled with honeydew. If the leaves are at or get beyond this level and develop a honeydew "sheen" then corrective action is required immediately.



Honeydew sheen on lower leaves indicating corrective action is required

In some instances a crop will have an earlier and later maturing phase of bolls in the crop. It is important to manage whitefly to reduce the risk of contamination of the earlier bolls. The basic strategies outlined above should be used in relation to the earlier bolls eg, delaying the first treatment as late as possible, but not later than 5% open bolls. However, with ongoing monitoring of whitefly and honeydew as a guide, a second application of an insecticide from a different group may be required. Earlier defoliation may also be beneficial.



With heavy honey dew contamination and the appearance of sooty mould on bolls, growers should delay harvest.

If, despite efforts to manage whitefly, crops end up with significant honeydew contamination – e.g. lower bolls dark with sooty moulds - then picking should be delayed as long as possible to expose the lint to maximum weathering, especially rainfall, which will help reduce honeydew levels. The long range forecast indicates a high probability of rainfall late February and at various intervals throughout March. In general however the costs of preventing the problem will be far less than the potential grade penalties for weathered lint – so proactive management is the best option.

# Flood effects

On Farm Series: How To | Cotton Research & Development Corporation

February 20, 2012

## Responding to late season flooding

Flooding across many cotton growing valleys has had a significant impact on cotton growth. With the flooding coming at such a late stage in cotton development we discuss likely impacts and management options available for growers and consultants.

By Ian Taylor, Michael Bange, Lewis Wilson, Ian Rochester, Paul Grundy, Stephen Yeates and Graham Charles



Flooding affected many cotton fields in 2012

During the last week of January and first week of February 2012, significant flooding occurred across broad areas of southern Queensland and north-western NSW. The primary difference between this flood event and the 2010 floods is that this flood is later in the season when cotton is very advanced.

With many areas recording rainfalls in excess of 250mm, the Warrego, Paroo, Bulloo and Nebine catchments in Southern Queensland and the Namoi and Gwydir River catchments in NSW bore the brunt of this prolonged rainfall event. Compounding the flooding was rainfall received in

November 2011, elevating totals in many areas over 700mm for the four-month period. The result of this high rainfall was major flooding in many of the valleys. Some rivers exceeded historical flood records at many locations. By mid-February, many down-stream areas are yet to be affected although it is anticipated that a number of areas will become flood affected in coming days or weeks.

Research into the waterlogging effects on cotton late in crop growth has shown that only small impacts on yield may result if crops have established their boll loads.

Most of the affected crops were in the advanced flowering or approaching cut-out stage.

Under these conditions, options for establishing new growth will be limited.

Management should focus on nursing the surviving crop back to a point where it can support fruit retained on the crop which can have time to

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mature for the end of the season.

A range of responses to this event may have eventuated from complete crop failure to reductions in growth and yield. The effect depends on the severity (depth, water quality, flow) and length of inundation. Coupled with waterlogged soils, cloudy weather (low light) also causes further impacts on crops. Under these conditions, cotton plants are likely to cease growth (e.g. production of new nodes), and then shed squares and fruit as assimilate in the plant becomes limited.

In many instances, crops have reached the point (or it is rapidly approaching) when the last effective square that results in the last effective flower has occurred. While new squares can be produced, the risk of these not contributing to final yield is considerable. The time for a new square to produce a flower is on average 23 days while it takes 63 days for a boll on average to develop into a harvestable boll. As the season progresses these times (for nodes, squares and flowers to develop) increase as temperature and light decrease. Growers and consultants can determine squares and fruit that are likely to mature using the "Last Effective Flower Tool" in "CottASSIST". This resource is available online at <http://cottassist.cottoncrc.org.au>



Post-flood affected cotton will commonly show deficiencies of nitrogen and sulfur. Recovery of cotton from nutritional problems may be slow where the plants root system is impaired due to waterlogging. Photo courtesy Duncan Weir.

[www.crdc.com.au](http://www.crdc.com.au)



ABOVE LEFT: Cotton is more adversely affected by flooding at the tail drain end of fields due to more severe waterlogging.

ABOVE RIGHT: Damage from Broad mites, *Polyphagotarsonemus latus* has been observed in several regions during 2012 and may be prevalent on late maturing flood affected crops. Photo courtesy D. Astridge QDEEDI



Experienced growers and consultants of Bollgard<sup>®</sup> II crops are well versed in the high retention rates of these crops and expect some shedding of fruit later in the season as fruit loads exceed the capacity of the plant to support all the fruit that is set. In some instances, shedding on high retention crops may have been accelerated by the flooding, resulting in similar fruit loads to what would have otherwise occurred.

The most important action for growers and consultants is to determine the remaining boll numbers on their crops, assess whether crops have cut out or are on their way to cut out using nodes above white flower (NAWF), and monitor and manage regrowth. Resources should be tailored to meet the crops' demands. To man-

age regrowth, use of mepiquat choride (PIX<sup>®</sup>) should be considered.

### NUTRITIONAL CONSIDERATIONS

For crops to again access soil water and nutrition, surface roots will need to once again come into contact with oxygen once fields dry out. When this has occurred, the use of leaf testing may provide some guidance as to the plants nutritional requirements. Foliar applications of nitrogen, phosphorus, iron zinc, and boron may alleviate immediate deficiency symptoms and help nurse plants along. Irrigation schedules may also need to be shortened to avoid stress as overall root function maybe impaired. Chapter 3 of NutriPAK contains specific information relating to the application of nitrogen and foliar fertilisers, although information concerning nutrient requirements for late season flood affected crops is limited.

### MANAGING PESTS

Avoid overfertilising. This may induce unnecessary regrowth making defoliation more difficult, delaying overall maturity and picking, and could lead to further pest and disease issues later in the season;

Recovering crops can have delayed maturity and may also inherit pest problems from nearby fields that mature earlier. Be vigilant in sampling recovering crops so that emerging pest issues especially secondary pests such as aphids, mites and silver leaf whitefly are detected early and can be monitored and managed if required. Refer to the document

[↑ Front Page](#)[← Previous Page](#)[Next Page →](#)

“Strategies to Manage Sucking Pests in Cotton in a Wet Season”. [http://www.cottoncrc.org.au/industry/Publications/Pests\\_and\\_Beneficials/Aphids\\_Bunchytop](http://www.cottoncrc.org.au/industry/Publications/Pests_and_Beneficials/Aphids_Bunchytop)

Also be aware that broad mite has been detected in several cotton regions this year – information on this pest can be found in the Pests and Beneficials in Australian Cotton Landscapes Guide (p34) and recent Cotton Tales at [http://www.cottoncrc.org.au/industry/Tools/Symptoms\\_Identification\\_Tool/Cotton\\_Symptoms/Broad\\_Mite](http://www.cottoncrc.org.au/industry/Tools/Symptoms_Identification_Tool/Cotton_Symptoms/Broad_Mite)

As many crops prior to the flooding event had high retention, some caution on responding to shedding needs consideration. Only consider PIX when crops are recovered fully, as the use of this growth regulator may add additional stress, or have no effect. Multiple small doses maybe better than a single large dose. Healthy regrowth is an indicator that a crop is again accessing soil water and nutrition.

While the floods and rainfall that have inundated crops in February are different to flooding that has occurred in other regions in recent years, some of the information gained from these events may be of help in managing the current situation.

A series of case studies on flooded cotton recovery in central Queensland 2011 undertaken by Jamie Iker of Spackman Iker Ag Consulting in Emerald is available at [http://www.cottoncrc.org.au/Industry/Tools/Cotton\\_Seasonal\\_Prompter/Wet\\_Season](http://www.cottoncrc.org.au/Industry/Tools/Cotton_Seasonal_Prompter/Wet_Season) and provides some useful information for growers and consultants about the effects of flooding and cottons capacity to compensate when season length allows time for new fruit to be produced in time for harvest.

### COME CLEAN – GO CLEAN

The wet and humid conditions prevalent in crops following inundation may lead to an increased incidence of boll rots.



Abnormal shedding of late squares and young bolls is a common response to the stresses of waterlogging or continued cloudy, wet weather and thereby reduce yield.

To minimise the probability that pathogens such as *Phytophthora nicotianae*, *Sclerotinia sclerotiorum* or *Fusarium* spp. which cause boll rots are present in flood affected fields, growers should ensure that they carefully manage regrowth. Growers and consultants are reminded though, that plants have been severely stressed and the addition of PIX is a further stress on the plant.

Growers should also enforce a strict “come clean go clean” policy for their farms. Flood waters are an ideal transport mechanism for fungal spores and it is easy to transfer spores deposited from flood waters to other fields and other farms. Also with the rainfall received, mud is readily transferred from one property/field to another and acts directly as an additional transfer mechanism. Information relating to boll rots and farm hygiene is available in the integrated disease management guidelines see the Cotton CRC website. All documents referred to in this article can be easily accessed on [http://](http://www.cottoncrc.org.au/Industry/Tools/Cotton_Seasonal_Prompter/Wet_Season)

[www.cottoncrc.org.au/Industry/Tools/Cotton\\_Seasonal\\_Prompter/Wet\\_Season](http://www.cottoncrc.org.au/Industry/Tools/Cotton_Seasonal_Prompter/Wet_Season)

### IMPLICATIONS FOR WEED MANAGEMENT

- 1] Flood waters may also bring an increased weed burden onto fields and may introduce new weeds. Growers should closely monitor any developing weed problems keeping in mind that flood affected crops may initially be relatively uncompetitive, especially if they have been partially defoliated. Portions of fields where cotton has died due to inundation and water-logging maybe particularly susceptible to weed incursions. This lack of competition, together with ideal conditions for weeds can lead to a rapid explosion of weeds. Of most concern, would be the introduction of glyphosate tolerant or resistant weeds, such as resistant awnless barnyard grass or feathertop Rhodes grass. These weeds will become major headaches in later years if they are allowed to set seed this autumn

*Growers should consider the following implications for flooded fields.*

- 2] A large flush of weeds is likely following flooding, and while these

“Management should focus on nursing the surviving crop back to a point where it can support fruit retained on the crop which can be harvested in time for the end of the season.”

- weeds may not adversely impact yield, they can still:
- a. Harbour a range of pests and diseases,
  - b. Set a mass of seeds which may cause problems over following seasons,
  - c. Cause difficulties with picking. Infestations of sesbania, noogoora burrs, thornapples and vines, for example, can be a real headache at picking, and
  - d. Contaminate lint.
- 3] Even where fields have not been flooded, growers may find that prolonged wet conditions have accelerated weed growth and it may be necessary to invest additional weed management measures over the next few weeks. Nutgrass, for example, can spread rapidly in wet conditions and in the next few months small infestations have the potential to explode.

Growers in the northern areas should be particularly vigilant for infestations of sesbania and bellvine. Heavy infestations may only become apparent after they push through the cotton canopy and are already relatively large

plants and difficult to control.

Where possible, growers should aim to control emerging weeds before canopy closure, as it will be difficult to achieve good spray coverage later in the season. High-clearance sprayers with shields can be valuable for applications following canopy closure, with Roundup Ready® Herbicide applications permitted to varieties with Roundup Ready Flex® technology up to 22 nodes of crop growth.

### IMPACTS OF WATERLOGGING ON COTTON GROWTH

Inundation and waterlogging have a number of impacts on cotton plants and soils. One of the most immediate is the adverse effect on soil oxygen content. Waterlogging of soils displaces oxygen held in soil aggregates thus halting the exchange of oxygen to cotton roots. Oxygen exchange in roots drives respiration in plants which provides free energy used for the maintenance and development of the plant. Oxygen is the ultimate electron acceptor in the electron transport train, when oxygen is unavailable oxidative respiration stops and plant

respiration becomes limited to glycolytic and fermentative metabolism which provides only 4% of the energy that the complete oxidation process provides. In addition to the physiological aspects of plant growth, waterlogging may also have a significant impact on nutrient availability and uptake. Access to nutrients such as nitrogen, iron and zinc become limited due to reduced oxygen availability. Additionally, some bacteria present in soils that usually utilize oxygen as the electron acceptor during respiration are able substitute nitrate nitrogen for oxygen. This results in the loss of nitrogen from anaerobic soils (denitrification) in the form of nitrogen gas (N<sub>2</sub>). Recovery of flood affected plants is complex.

The full effects of waterlogging are described in chapter 12 of NutriPAK which can be found on the Cotton CRC's website at [http://www.cottoncrc.org.au/industry/Publications/Agronomy\\_Nutrition/NutriPAK](http://www.cottoncrc.org.au/industry/Publications/Agronomy_Nutrition/NutriPAK) and Chapter 3.3 of WaterPAK which is available at [http://www.cottoncrc.org.au/Industry/Tools/Cotton\\_Seasonal\\_Prompter/Wet\\_Season](http://www.cottoncrc.org.au/Industry/Tools/Cotton_Seasonal_Prompter/Wet_Season) ■



Weeds will rapidly invade areas where cotton has been partially defoliated or killed, such as this field where 2 flooding events have killed most plants in the tail-ditch end.

### APHID MANAGEMENT

Cotton aphids are being reported from many areas and creating concern about potential for aphids to reduce yield, resistance levels and Cotton Bunchy Top Disease.

- *There are confirmed high levels of neonicotinoid resistance in aphids*
- *Preserving beneficials and good farm hygiene are key to effective aphid management*
- *If you suspect a spray failure do not respray with a chemical from the same group. Follow the IRMS guidelines.*

#### Decisions – do aphids require control?

When aphids feed they take in the sugars produced during photosynthesis and if they feed for long enough this translates into reduced yield.



Fig 1. Cotton aphid infested cotton leaf

A range of beneficials and parasites will help control aphids. If these are disrupted aphid populations may increase quickly and require chemical control.

Sample for aphids using the scoring system described on page 14-15 in the Cotton Pest Management Guide. Use 'look-up' tables in the Cotton Pest Management Guide to estimate the risk of reduced yield. An 'Aphid Yield Loss Estimator' tool simplifies the input of data and avoids having to use look-up tables. This is available on the Cotton CRC website: (<http://cottassist.cottoncrc.org.au/Aphids/Default.aspx>).

After first open boll the threshold is 10% of plants infested if there is honeydew present. This aims to avoid contamination of lint with honeydew as penalties for honeydew contamination are severe.

#### Selecting an Insecticide

- Neonicotinoids - in 09/10, 78% of the strains tested showed resistance to the neonicotinoid group (e.g. Shield®). Neonicotinoids may not provide effective aphid control. If a poor result is achieved do not respray with a neonicotinoid.
- Petroleum Spray oils (Canopy, Biopest) – high molecular weight oils will help suppress aphid populations if used regularly (e.g. alone or with other insecticides).

- Pirimicarb (carbamate) and organosphosphates (omethoate/ dimethoate) will provide control. The previous high resistance to these groups has virtually disappeared in recent years. However: note there is cross resistance between pirimicarb and OP's dimethoate and omethoate – overuse of either will rapidly reselect for resistance. Do not use more than twice and do not use consecutively (eg do not spray pirimicarb then dimethoate). If pirimicarb or OP spray fails don't use either again. OP usage to control aphids will likely disrupt beneficials, and flare other pests such as SLW. As pirimicarb is past its window in the IRMS approval should be sort to use it.
- Endosulfan will suppress aphids (see label restrictions on use)
- Diafenthiuron (Pegasus®) is available late in the IRMS. Adherence to the IRMS recommendation of maximum of 2 sprays is important as a few cotton aphid strains have been found to have low resistance to diafenthurion
- Spirotetramat (Movento®) is available for all of the IRMS with a maximum of two sprays allowed.

For more information refer to 2010/11 Cotton Pest Management Guide.



Fig 2. Cotton bunchy top affected plant

#### COTTON BUNCHY TOP (CBT) -

CBT is a viral disease that is spread by cotton aphids. Symptoms include reduced plant height, leaf size, petiole length, internode length, boll size and potential yield.

#### **What are the factors that have made 2010/11 favourable to CBT**

**HOST** ✓ CBT is commonly observed in volunteer cotton plants surviving over from the previous season.

**VECTOR** ✓ An abundance of suitable aphid hosts in spring allowed aphids to establish colonies on seedling cotton.

**ENVIRONMENT** ✓ Disease spread is favoured by climatic conditions which are suitable for aphid reproduction, feeding and spread.

Areas at high risk will be those where there are CBT affected hosts near cotton crops. In this case manage aphid populations to avoid a high proportion of plants carrying them (e.g. < 10-15%).

### Broad mites

In recent weeks some consultants have reported finding broad mites or yellow tea mites (*Polyphagotarsonemus latus*) in cotton crops in the Gwydir and Macintyre valleys.

Typically broad mites are a tropical pest however they may be found in subtropical and temperate regions during periods of high humidity such as those experienced recently. Broad mites feed on a wide range of crops including capsicums, potatoes and cotton. They are tiny (adults are approximately 0.2-0.3mm long) and very difficult to see even using a x10 hand lens. However, a sign that they are present is usually distortion of leaves and the underside of these leaves having a 'wet' appearance even though it is dry. Symptoms may resemble those of 2,4-D damage with leaf margins curling downwards or upwards and leaves becoming hard and brittle.



Shiny wet appearance of leaf under-surface due to broad mite damage. *Photo courtesy D. Lea*

Eggs are laid on the underside of leaves, are oval translucent and covered with five or six rows of white tubercles. The life cycle from egg to adult is between 6 and 9 days and includes two nymphal stages. Adults are white-yellow with males being extremely active and fast moving. Broad mites will spread from plant to plant by walking, although they are quite happy to hitch a lift on the legs of other small insects such as silver leaf whitefly.

In tropical regions severe infestations of broad mites have resulted in seed yield losses in cotton of between 11 and 54% when plants have been infested early and outbreaks remain uncontrolled. In Australia, broad mite populations can increase rapidly during favourable conditions particularly when humid conditions prevail. During periods

of low humidity it is unlikely that populations will be sustained for long periods. Early infestations of broad mite can seriously stunt plant growth and may result in patchy yield loss across fields. At present, the majority of cotton crops have set fruit and reached cut-out so the risk that infestations of broad mite will cause yield reductions is diminishing rapidly. Furthermore with humidity levels forecast to decrease to quite low levels we do not expect populations of broad mite to increase much beyond those encountered in crops at present.



Broad mite adults, nymphs and eggs on under surface of leaf. *Photo courtesy D. Astridge QDEEDI*

Broad mites are usually suppressed by natural enemies including lacewing larvae, predatory mites and minute pirate bugs. If other pests require control use selective options that conserve natural enemies. Addition of a petroleum spray oil may also help suppress the broad mites. Currently there are no acaricides registered for control of broad mites in cotton and it is doubtful that likely yield losses would warrant application for a minor use permit. It is however expected that growers applying acaricides such as abamectin for control of two spotted mite are also likely to control broad mite.

### Cotton response to Flood

Thanks to Michael Bange, Greg Constable & Susan Maas for assistance with this article

After experiencing the biggest flood since Burrendong Dam was built on top of nearly 13 inches of local rainfall over the past month I thought it would be useful to have a look at industry experience from flooding at this stage in the season.

The big questions have been:

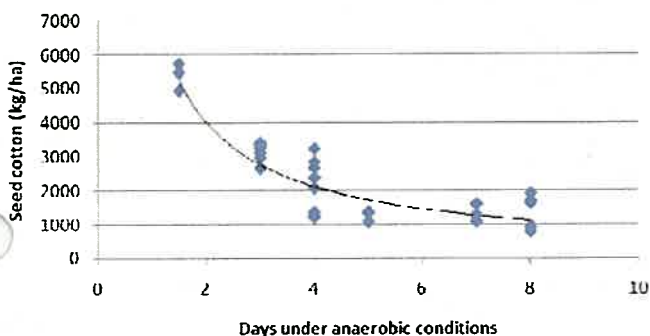
How long can cotton survive submerged under water?

What impact will the waterlogging have on yield?

How should I manage the crop from now on so that it reaches its best yield potential?

In a Namoi survey conducted in 2000, Dr Pongmanee Thongbai recorded soil oxygen in flooded fields. Below is a plot of days in zero oxygen (anaerobic) conditions during and after flooding versus hand picked yield (Seed Cotton Yield in kg/ha). Cotton in this flood was at pre flowering. This graph highlights the range of impacts that inundation can have on yield.

Seed Cotton Yield (kg/ha)



Anerobic growing conditions will continue until some of the fine roots at the soil surface are no longer in saturated soil. Drying hills are sufficient to relieve anerobic conditions even though water remains in the furrows.

For crops that are not killed outright, the situation is the same as waterlogging. There can be reduced growth directly from lack of oxygen at roots and indirectly from lack of N due to denitrification losses. Sometimes there are negative interactions with nutrients such as Fe and P. Many crops will recover naturally. Crops need sunshine on the leaves & oxygen at the roots.

Where there have been nutritional disorders with N and Fe, foliar sprays have been used but it needs to be emphasised that the foliar spray is only trying to address a problem that has already occurred – the crop will not necessarily be as good as it would have been. A crop will

use something like 5 kg N/ha/day and 10 g Fe/ha/day, so rates of foliar sprays should consider those demands (some foliar sprays only have a few hours of nutrition).

With a lot of damage occurring at tail drain ends, management of uneven plant stages will be a particular challenge. The use of cutout rates of Pix late in the growing season may be an option to assist with evenness of maturity.

For crops coming out of water logging and no longer inundated, management of the vegetative growth is going to be an issue. Refer to Cottassist Crop Development Tool, to help with PIX decisions.



### Waterlogging

Thanks to Stephen Yeates, Michael Bange & Ian Rochestor for their assistance with this article.

The major and immediate effect of waterlogging is blocking transfer of oxygen between the roots and the soil atmosphere. Plant roots may become so oxygen deficient that they cannot respire. As a consequence, root growth and absorption of nutrients is decreased leading to less overall plant growth. Water logging is accentuated by rainfall after irrigation, cloudy conditions, and inadequate land preparation. Symptoms of waterlogged cotton include a general yellowing of the crop and stunted growth. Waterlogging can increase sodium uptake which may then affect the uptake of other nutrients and the growth of the plant.

In addition to the physiological impacts of waterlogging on the crop there are also significant impacts on nutrient availability and uptake. The availability of Nitrogen (N), Iron (Fe) and Zinc (Zn) (reduced) and Manganese (Mn) (increased) are directly affected by the decline in soil oxygen, and uptake of N, K and Fe by the roots is also impaired.

### Nitrogen

Denitrification of soil mineral N, may result in less N being available to crop even after water logging has ceased. Foliar N is more effective in increasing the yields of waterlogged cotton when applied one day before irrigation under hot, sunny conditions. Application to a field that is already water logged will not necessarily alleviate existing damage. Growers may be tempted to apply more N fertiliser to replace what may have been lost – leaf testing will indicate if this is necessary.

Recovery from waterlogging and fruit shedding is easier to manage on younger crops. Crops suffering from a combination of early shedding and reduced N uptake can cut-out prematurely that is the flower will reach the top of the plant with very few bolls set. Adding N in this situation can cause a second flowering & significantly delay maturity.

### Phosphorus and Potassium

Waterlogging is possibly involved in premature senescence of cotton. Under waterlogged conditions, uptake of P and K by the cotton crop may be reduced, predisposing the crop to the premature senescence syndrome.

### Iron

The young leaves of iron deficient plants become yellow between the veins (chlorosis). The veins usually remain green, unless the deficiency is severe and the whole leaf may eventually turn white. Although the plant may contain high concentrations of iron, most of it is unavailable for chlorophyll production and the leaves lose their green colour. Foliar application of 200 g Fe/ha with a ferrous sulphate may return foliage to its normal colour within 2-3 days.

### Nutrient monitoring and application

Petiole testing is not an option during cloudy, inclement weather. However, leaf tissue testing is the better option when weather conditions improve, to identify which nutrients may be lacking. Nutrilogic can help interpret results. (<http://cottassist.cottoncrc.org.au>)

Foliar fertiliser formulations that include N, P, Fe and Zn will probably be the most helpful, but best to wait until the sun shines.

### Irrigation Management

As the plant, and in particular the root system has developed during a very wet period, when the weather warms up and soils dry out, irrigation scheduling will need to be responsive to the potential smaller root system, with shorter and more regular irrigations, particularly during periods of heat. Use of probes for scheduling as well as responding to signs of stress in the plant is needed.

### Vegetative Growth Management

Due to the indeterminate nature of the cotton plant the vegetative and reproductive growth occur in parallel and it is important to keep the reproductive and vegetative growth in balance. Crops that are too tall and rank are difficult to manage and pick and will not yield at potential, however short determinate crops may be limited in yield potential and can struggle to compensate if fruit loss occurs during future cloudy periods.

It is important to closely monitoring vegetative growth rate (VGR), fruit retention & boll size. If excessive vegetative growth is detected, the use of mepiquat choride (PIX®) should be considered. Growth regulator applications combined with moisture stress can result in yield reductions. Multiple small doses of Pix are often better in these situations.



Flooded plants tail drain vs head ditch

***Cotton CRC researchers will be in the Macquarie on the 10<sup>th</sup> or 11<sup>th</sup> January to inspect flood affected cotton and discuss management options for the rest of the season for surviving crops. I will circulate more information once dates and venues are confirmed. If you have any specific questions or photos of affected cotton please send them through to me. I can pass on to the researchers so they can prepare some information for us before they come down.***

### **COTTON BUNCHY TOP (CBT) -**

#### **IS 2010 A HIGHER RISK?**

Greg Kauter (Cotton Australia) & Lewis Wilson (CSIRO) have suggested that 2010 could be the year for the re-emergence of Cotton Bunchy Top (CBT). So are they on to something?

#### **What Is CBT?**

First observed in 98/99 season, CBT is a viral disease that is spread by cotton aphids (*Aphis gossypii*). Symptoms include reduced plant height, leaf size, petiole length, internode length, boll size and potential yield. There is a 3-8 week lag between infection of plants with the disease by aphids carrying it and the development of symptoms. The impact on yield is related to the timing of infection and the proportion of plants infected. Earlier infection of plants has a greater potential to affect plant growth and yield than later infection. A higher proportion of plants infected in a given area is also more likely to result in yield loss. When only a few plants are affected (1-2/m), neighbouring plants will compensate by growing bigger & yielding more.

#### **What are the factors that suggest a problem is possible in 2010/11?**

##### **HOST ✓**

In the 2009/10 cotton pathology survey, Stephen Allen and team noted that in both NSW and QLD CBT was commonly observed in volunteer cotton plants surviving over from the previous season. Further, the abundance of volunteers was quite high because rainfall through summer led to poor volunteer management.

##### **VECTOR ✓**

There will be a lot of aphids in the air this summer coming off cereal and brassica crops – these species are not pests of cotton or vectors of CBT. However, there is an abundance of marshmallow and other host weeds for cotton aphid so there is potential for aphids to establish colonies on seedling cotton.

##### **ENVIRONMENT ✓**

Disease spread is favoured by climatic conditions which are suitable for aphid reproduction, feeding and spread. This milder and wetter than average winter has allowed for an increase in weed hosts that allow aphid populations to over winter.

#### **All the factors are present this season for CBT to be a potential problem. So what can we do to reduce the risk?**

- Control farm weeds that are aphid hosts
- Control volunteer & ratoon cotton
- Monitor cotton fields regularly from crop emergence for the presence of aphids
- Check aphid hot spots for CBT symptoms

- If CBT symptoms are present early in the season, consider removing isolated infected plants or selectively controlling aphids.

#### **Decisions – do aphids require control?**

If winged aphids are seen on cotton, verify which aphid species is present. A simple strategy to establish if the aphids are a cotton pest is to mark the area & return to several days later to see if a colony establishes and is reproducing (non-winged forms present) before considering control. Many winged forms of non-pest aphid species will settle on cotton and test feed, then move on when they find it unsuitable. Cotton aphids vector CBT and are the most common aphid pest, but green peach aphid and cowpea aphid may also establish though usually only briefly, and are not CBT vectors.

From seedling to first open boll, cotton aphid thresholds are based on the potential for aphids to reduce yield. Sample for aphids on the underside of mainstem leaves 3-4 nodes below the plant terminal. Use a 0 to 5 scoring system as described on page 14-15 in the Cotton Pest Management Guide and input this information into the aphid yield loss estimator on the Cottassist web site, or use tables in the CPMG.

#### **Selecting an Insecticide**

- Early season spray decisions should aim to preserve beneficials, particularly where SLW or mealybugs could be present. Softer options such as spray oils or pirimicarb should be considered first. OP usage to control aphids early season will likely disrupt beneficials, and flare other pests such as SLW
- In conventional cotton, application of endosulfan to control *Helicoverpa* spp. will suppress aphids
- In 09/10, 78% of the strains tested showing some neonicotinoid resistance (i.e. Actara®-Cruiser® or Shield®). This resistance may make the neonicotinoids unreliable for cotton aphid control, especially if a neonicotinoid seed dressing has been used. Do not use first foliar spray from same group as seed or planting insecticide.
- Diafenthiuron (Pegasus®) is not available until later in the IRMS & is therefore not an early season option. Adherence to the IRMS is very important. Some cotton aphid strains have been found to have low resistance to diafenthiuron
- Alternatives products available include endosulfan (limited availability), spirotetramat (Movento®), pymetrozine (Fulfill®).

#### **After open bolls**

Once bolls have opened the main risk from aphids is honeydew contamination of lint, the risk of yield loss from aphid feeding or infection with CBT is very low.

**For more information refer to 2010/11 Cotton Pest Management Guide.**

### **Pest Pressure Considerations 2010/11**

The abundance of vegetation in all cotton growing regions over winter and the warm, wet start to spring means there is potential for a large population of both insect pests **and** beneficials to be present this season.

#### **Helicoverpa Pest Pressure: Professor Peter Gregg, Cotton CRC**

Widespread rain throughout inland Australia has created an abundance of winter vegetation out to the Simpson Desert. There is a low density but very widespread population of *H. punctigera* present. The recent rains in inland Australia means we may not see a large early spring influx of *H. punctigera* as there will still be plenty of vegetation for them to breed on, however as temperatures warm up inland and vegetation dries off we can expect to see the population moving east by mid to late spring. The movement east may be staggered as there is plenty of vegetation in the western districts of NSW and Qld to host *Helicoverpa* along the way.

Locally, the widespread winter rainfall has provided plenty of hosts for *Helicoverpa armigera* to build up on.

#### **Sucking Pests: Dr Lewis Wilson CSIRO**

**Thrips:** potential for higher thrips pressure early season, depending on when other crops and vegetation dries down. Cotton usually recovers well from early season damage. Consider the effect on beneficials and Silverleaf Whitefly later in the season when considering control.

**Mites:** Mites move onto cotton from weeds in or around edges of fields. Good farm hygiene is essential. Monitor mite abundance, often early populations will decline due to predation.

**Aphids:** There will many aphids this spring coming off cultivated (crops) and non-cultivated (weeds) hosts. Most will not attack cotton. However, cotton aphid hosts e.g. marshmallow are also abundant. If winged aphids are seen on cotton, mark the area and return to it to see if a colony establishes and is reproducing before considering control. Also monitor these areas for cotton bunchy top. If aphids are present early in the season, follow the recommendations of the industry's IRMS and rotate insecticide chemistries taking into account the insecticide group of any seed treatment or at-planting insecticide.

**Mirids:** As with thrips and *Helicoverpa*, there is a large amount of vegetation that has hosted mirids over

the winter period both locally and in inland Australia so there is the potential for reasonable pressure.

**Silverleaf Whitefly:** There have been plenty of hosts for SLW to survive on over winter and conditions have been reasonably mild in most cotton growing regions so there is potential for higher SLW numbers this season.

#### **Strategies**

Overall, moderate to high pressure of the key insect pests can be expected this season. However, the industry has the tools to manage these pests following some simple IPM guidelines:

- Favourable conditions for a build-up of insect pests are also favourable for beneficial populations – give them a chance to establish
- Bollgard II® technology is very useful in years of high *Heliothis* pressure and will also control tip worm
- The cotton industry has excellent sampling and threshold guidelines for key insect pests that are continually being updated. Refer to the 2010-11 Cotton Pest Management Guide (CPMG) for threshold and sampling guidelines.
- There is now more selective chemistry available for use in both conventional and Bollgard II® cotton for controlling *Heliothis* and sucking pests. Table 19 in the 2010-11 CPMG shows the impact of commonly used insecticides and miticides on beneficial insects in cotton.

#### **Key Messages**

- *Practice good farm hygiene. This reduces the overwintering habitat of many key insect pests.*
- *Monitor pests, beneficials and crop development according to industry guidelines*
- *Use recommended pest thresholds to minimise insecticide use.*
- *Be as selective as you can when choosing insecticides to preserve beneficials.*