



Australian Government

Cotton Research and
Development Corporation

CottonInfo Extension Activity REPORT

Part 1 - Summary Details

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

CRDC Project Number: CSD 1803

Project Title: “CottonInfo: Measuring nitrogen loss during early season irrigation”

Project Commencement Date: 1/09/2017 Project Completion Date: 30/06/2018

Part 2 – Contact Details

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Part 3 – Final Report

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

Background

1. Outline the background to the project.

Deep drainage and runoff, combined with poor nitrogen fertiliser practice, is resulting in significant nitrogen losses in early season irrigation. Currently 33% of growers are applying over 300kg N/ha, with research showing as little as 20% of this being taken up by the plants (Grace 2016). In an effort to keep the dialogue between researchers and growers active in the face of increasing nitrogen fertiliser costs and the industry need of responsible nitrogen management, CottonInfo established trials during the 2017/18 season quantify the runoff component of the nitrogen loss pathway and highlight the relationship between irrigation and nitrogen management.

Boosting the nitrogen use efficiency of cotton farms within Australia is a key objective of the Australian cotton industry. The movement of nitrogen with irrigation water has been anecdotally found by many growers with differences in crop growth and yields along the length

of the field, from head ditch to tail drain. Nitrogen is also lost from the field through deep drainage and runoff totalling more than 10% of the applied N (MacDonald 2017). Both factors are influenced by irrigation management. Additionally, it has been highlighted through experiments in the Upper Namoi region by Baird (2016) that losses of 20 to 30 kg of pre-applied N can occur in the first irrigation alone. In the same study it was also found that irrigation intensity also affected Water Use Efficiency (WUE) and NUE.

Objectives

2. List the project objectives (from the application) and the extent to which these have been achieved.

- 1) To quantify the runoff component of the nitrogen loss pathway and highlight the relationship between irrigation and nitrogen management.
- 2) To field test the use of drones to measure irrigation furrow advance rate, with the objective of stimulating the commercial service of irrigation assessment in the cotton industry.

Methods

3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related projects.

This trial was run in each cotton valley by the CottonInfo REO.

- Two treatments – Single Siphons and Double siphons
- Four reps of each treatment.
- Soil cores taken to measure soil N at the start of the season and after the second irrigation at the end of the season. They were taken in the head ditch and the tail drain ends of the field and split into three depths, 0-30, 30-60 and 60-90.
- The first two irrigations were monitored (Water up/pre-irrigation and the 1st in crop irrigation). The measurements taken included:
 - Water samples taken from the head ditch and from a single furrow in each treatment at the taildrain end of the field. They were analysed for total N and the N concentration
 - To determine the amount of N applied and lost as runoff, a volume of water is required. This was measured using Irrimate.
 - Irrimate is a suite of tools used to evaluate surface irrigation performance. A range of data was collected in the field including application rate (using a siphon flow meter), advance (advance sensors), cross sectional furrow profile and irrigation time.
 - This data was run through infiltr or Iparm – programs that measure the infiltration characteristic of the soil.
 - The Darling Downs site trialled the used of Drones to measure water advance.
 - SISCO is a computer model that simulates the irrigation event based on the data collected in the field. The output includes:
 - Amount of irrigation water (volume) applied
 - Amount of irrigation water (volume) that ran off as tailwater
 - Amount of water that infiltrated into the soil profile
 - Amount of water that was lost as deep drainage (ie moved out of the root zone)
- This information allowed us to calculate the kg N that is lost in tailwaters.
- SISCO was also used to evaluate the performance of the irrigation event. This enabled a comparison of single siphons and double siphons in term of:

- Application efficiency: which relates the amount of water applied in an irrigation to the amount of water available to the crop to use.
- Requirement Efficiency which describes how well the soil deficit has been met.
- Distribution Uniformity: a measure of how evenly the water has been applied. The aim is to have distribution uniformity as high as possible.

Outcomes

4. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

This project has raised the awareness of the important linkage between irrigation management and nitrogen use efficiency. The trials were run in each valley which engaged seven trial co-operators. The trials provided new insight to irrigation performance, understanding the soils infiltration characteristic, a significant variable affecting performance. Soil testing showed how soil nitrogen can vary along the length of the field, a result of irrigation management and the need to take this into account when soil testing and developing a fertiliser plan. The case study provided in Appendix 1 in the attached final report clearly demonstrated the impact of trial activities on the planned project outcomes. The impact is summarised below:

The irrigation evaluation has given the grower and consultant an insight into how water moves through their soil. While they were not expecting these results at all, it all makes sense now to what they are seeing in the field.

As a result of the NxI trial the grower and consultant are keen to:

- *Improve the way they manage their N applications*
- *Implement variable rate N application*
- *Possibly change to water-run N for more timely application*
- *Look to optimise their irrigation application*

As per the project application outcomes:

- **The Economic Benefits will be:** Poor irrigation management, that produces excessive drainage, can result in removal of N from the system with potential to impact on lint yield through the reduction of available N. Highlighting this potential loss of N and yield limitation across the cotton industry will increase the awareness of these issues amongst growers with improvements providing the opportunity for increased profitability
 - The surface irrigation performance evaluations provided options for the growers to optimise irrigation performance which leads to reduced deep drainage, runoff and potential water savings. As a result of improved irrigation performance nitrogen losses are reduced.
- **The Environmental Benefits will be:** Reduction of N losses from the systems from runoff and deep drainage. Where N is removed from fields and transported to other areas there is a risk of off-site impacts. There are increased gaseous losses from volatilisation in water storages where the water contains higher N concentrations.
 - Manipulation of irrigation strategies has the potential to improve in Water Use Efficiency (WUE). Improving irrigation performance can result in water savings.

Soil tests have shown the change in soil N along the length of the field which has highlighted the need to take this into consideration when soil testing. It also creates interest and consideration of practices to better manage nitrogen, eg application of urea, variable rate, placement when banded and ability to water run nitrogen when demand is greatest.

- **The Social Benefits will be:** Practices that highlight the impacts of management on WUE and NUE enable better decision making that minimise the environmental footprint of cotton production into the future.
 - This project has increased grower understanding of how irrigation management can affect nitrogen fertiliser losses. Reducing the losses from applied fertiliser is key to improving NUE,

5. Please report on any:-

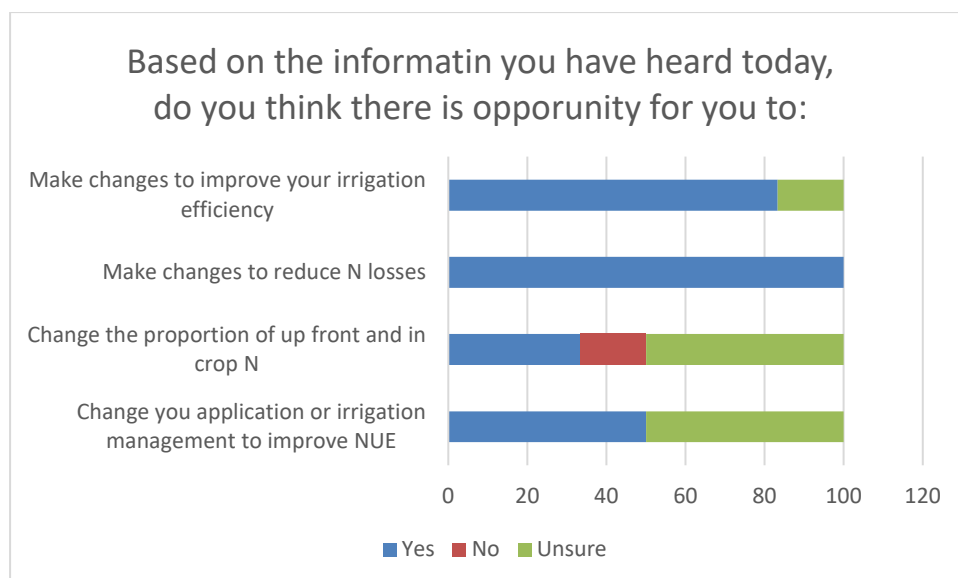
- Feedback forms used and what the results were
- The highlights for participants or key learnings achieved
- The number of people participating and any comments on level of participation

2018 Optimising Irrigation and Nitrogen Research Tour

- REO presentations
- Field day Booklet, <https://www.cottoninfo.com.au/publications/nutrition-irrigation-optimising-irrigation-and-nitrogen-researchers-tour-booklet>
- Evaluation report – Ali Chaffey, submitted to CRDC April 2018
- 519 attendees across 7 regions. 42% Growers, 29% Consultant, 9% farm staff, 20% industry

2018 Gwydir CGA Field Walk

- 27th March 2018
- 27 attendees (Growers, consultants and industry)
- Field day booklet
- Field day evaluation
- The average understanding of irrigation performance and impact on nitrogen losses improved from 3 to 4. (where 1= very basic, 2 = basic, 3 = fair, 4 = good and 5 = very good).
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- What are some of the key messages you have taken from today:
 - Irrigation time on field is critical
 - Irrigation affects NUW
 - Irrigation run times vs nitrogen losses and placement
 - N loss in irrigations

Webinar: Nitrogen management in cotton: Your three key questions, answered!

- 28th May 2018, 42 participants
- <https://www.youtube.com/watch?v=u9twBYKAlqQ&t=1s>
- 58 Registered
- 42 Attendees (22% Growers, 42% Consultants, 36% Industry)
- Webinar evaluation
 - 70 per cent of participants found the webinar useful, of which 35 percent indicated that the webinar was extremely useful.
 - 80 percent of respondents indicated that the webinar improved their understanding of soil testing to account for soil variation in irrigated cotton fields (15% strongly agree, 42% moderately agree, 23% were neutral. 20% disagreed.
 - 69 percent of respondents indicated that the webinar improved their understanding of Nitrogen losses associated with fertiliser applied pre-season versus in-crop.
 - 62 percent of respondents agreed that the webinar provided them with information to better manage nitrogen in their cotton fields.

Will you be changing any practices as a result of attending this webinar?

- Yes. Spread out nitrogen applications if possible.
- Variable-rate a must
- More attention to a planned petiole/tissue testing program
- Less N upfront
- Definitely will make recommendations to make changes
- Yes, applying more if not all of the N in crop.
- A little. It comes down to risk vs reward. Have been burnt before with wet springs and unable to apply N through water run/irrigation because didn't need to irrigate! So there will be an inherent risk management of N applications favouring a little more than required and a little earlier than required....
- More focus on N being applied in-crop rather than upfront.

Cotton Conference

- O'Keeffe, K. & Montgomery, J. 2018. CottonInfo NxI trials results. Presentation 2018 Australian Cotton Conference 7-9 August, Broadbeach. <http://australiancottonconference.com.au/wp-content/uploads/Kieran-OKeeffe-Janelle-Montgomery.pdf>
- Approx. 100 people in the Conference Room.

Conclusion

6. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?

The trials have demonstrated the link between irrigation management and nitrogen losses. The importance of a surface irrigation performance evaluation to ensure an efficient application of irrigation water to minimise N losses.

The key messages from the trials are:

- Soil N can vary significantly down the length of the field, often higher at the taildrain.
- Variation in soil N between the head ditch and tail drain ends of the field should be taken into account when developing an N budget for the field.
- Correct placement of pre-plant Nitrogen can minimise nitrogen losses in the first two irrigations.
- Nitrogen use efficiency and irrigation management are intrinsically linked within an irrigated cotton system.
- Significant losses of both Soil N and Fertiliser N can occur through water logging (denitrification), surface runoff and deep drainage.
- 75 percent of irrigation events measured had an application efficiency of less than 80 percent, therefore there is significant room for improvement in irrigation management.
- If irrigators increase flow rates, it can result in excess tail waters if siphons are not pulled at the correct time and can significantly reduce the efficiency of an irrigation.
- Measure to manage – know your current irrigation performance before making any changes to flow rates and cut-off times.
- Optimising irrigation performance will decrease nitrogen loss from the field. It will result in reduced N loss through deep drainage and runoff, and enable more N to remain in the soil profile where it can be extracted by the crop.

Extension Opportunities

7. Detail a plan for the activities or other steps that may be taken:
 - (a) To tell other CGAs/growers/regions about your project.
 - (b) To keep in touch with participants.
 - (c) For future projects.

This trial was an extension activity in itself, using the trials to demonstrate the link between irrigation management and nitrogen losses. The results have been extended through industry publications, a webinar, field walks, CottonInfo research tour and the Australian Cotton Conference (see attached Project Report).

The key messages will continue to be extended in CottonInfo regional newsletters and associated CottonInfo Annual Operating Plan (AOP) activities.