Irrigation Research & Extension Committee

FARMERS' NEWSLETTER

NO. 196 — SUMMER 2016

In this edition

Irrigation Research & Extension Committee

Administration & Advertising

The IREC Farmers' Newsletter is published by the Irrigation Research & Extension Committee. The magazine is delivered in an electronic format exclusively to members of IREC. If you wish to become a member either contact the IREC office or join via the IREC website.

Businesses and organisations interested in advertising in the IREC Farmers' Newsletter should contact the IREC office.

IREC Office Manager: Hayley Wordsworth

IREC, Lot 255, Research Station Road, Griffith NSW 2680

P: 02 6963 0936 • M: 0418 402 197

E: irec@irec.org.au

Editorial

The IREC Farmers' Newsletter welcomes all suggestions and contributions for articles from irrigators, advisors and researchers in government and commercial sectors. If you have suggestions for articles or wish to contribute an article please contact the Editor. Please submit articles for the next edition, Autumn 2017, to the editor by 1 February, 2017.

The Editor: Lucy Kealey

IREC, Lot 255, Research Station Road, Griffith NSW 2680

M: 0417 043 982

E: lucykealey@bigpond.com

Design & Production

Leysa Flores M: 0448 304 007 E: leysa.flores@gmail.com

Photography

Cover: Soybean crop growing under overhead irrigation at Finley. PHOTO: MATHEW DUNN

ISSN 0467 - 5282

Chairman's foreword

It is outstanding to have a wet winter under our belt, 100% allocation and plenty of sound options to put that water to productive use.

WET winters bring challenges with seedbed preparation and timely planting of summer crops but they certainly bring out the best in us to ensure the job gets done. It is pleasing to drive around the irrigation valleys of the Murray and Murrumbidgee and see plenty of rice and cotton up and out of the ground. This is a credit not only to our farming community but also to the agronomic research and extension of our rice and cotton industries.

Wet weather workshop

IREC staged a very successful "wet weather workshop" in early October. Brian Dunn from NSW DPI rice research, Jorian Millyard from Cotton Seed Distributors and Kieran O'Keeffe from CottonInfo all gave excellent presentations on adaptive management strategies and the shortcuts that could save time in the lead-up to planting. The workshop was well received by the fifty attendees who gave very positive feedback on the day.

Men's health was another topic broached on the day with counsellor Neville Brady highlighting some hard-hitting truths in an entertaining manner about how men cope with stress. Men talking about how they feel is a great start and it is usually the first step to recovery. A short but very powerful message was packed into a DVD put together by the Leeton Calo's Riders Club. A copy of the DVD can be collected at the IREC office (located in the Murrumbidgee Irrigation Griffith building). It is essential viewing for all of us to get a deeper appreciation of depression and the journey people go through on the road to recovery.

I would like to thank the sponsors of the day: Yenda Producers Cooperative, Murrumbidgee Irrigation, Coleambally Irrigation, Commonwealth Bank, Ricegrowers Association, Riverina LLS and Southern Cotton.

Check out IREC for 2017

I would encourage our members to go onto the IREC website and have a look at the calendar of events for 2017. Among other things there will be an irrigation bus tour to the northern regions of NSW in February and a technology field day during winter.

We will be re-visiting our breakfast meetings in February 2017 to give some progress reports on projects that were established due to the last round. We will also be calling for emerging issues that face our irrigation businesses going forward. Please make yourselves available for one of the breakfast meetings in your area. They will be short and sharp, you get fed and watered, and we will be selecting sites that will be of interest to all.

New partnerships

I am excited to announce a more formal partnership with both Murrumbidgee Irrigation and Coleambally Irrigation. These are our irrigation companies who are working hard to deliver water to the farm gate more efficiently and consistently than ever before. By working with IREC they are showing a clear desire to see our businesses improve and prosper. I encourage you all to take advantage of the discounted membership to IREC that your irrigation company has negotiated on your behalf. It is your involvement in IREC activities that improves the outcome and benefits of IREC activities for everyone.

I trust you will enjoy reading the summer edition of the *Farmers' Newsletter*.

Regards,

Robert Houghton

Cotton picking at the Benerembah nitrogen rate and timing trial, April 2016.

KNOW YOUR PADDOCK POTENTIAL FOR PROFITABLE COTTON

QUICK TAKE

- Set realistic nitrogen budgets and yield targets for your cotton crop — aim for a nitrogen fertiliser use efficiency of 13 kg lint/kg N applied.
- Monitor nitrogen status throughout the crop's development with petiole testing so nitrogen fertiliser application can be increased or decreased as required.
- By assessing the nitrogen use efficiency of your cropping system, it is possible to determine if factors other than nitrogen supply are limiting efficient cotton production.
- Mineralisation of organic nitrogen is an important in-crop source of nitrogen for cotton, therefore maximise the native soil nitrogen contribution to yield by minimising soil constraints.

Nitrogen rate and timing trials in all cotton growing valleys of Australia have provided information about what influences the cotton plant turning applied nitrogen into lint.

Kieran O'Keeffe
Regional Extension Officer (Southern NSW), CottonInfo

CONDUCTED by CottonInfo Regional Extension Officers for the last three seasons, the purpose of the trials has been to explore the factors that influence nitrogen fertiliser use efficiency, i.e. the efficiency of the cotton plant turning applied nitrogen fertiliser into lint yield.

This article presents the results for the 2015–16 trial in southern New South Wales, at Benerembah, 20 kilometres south west of Griffith.

The southern NSW trial was carried out on a bankless 'beds in bays' layout. The cropping history of the paddock was cotton in 2013–14 and fallow in 2014–15. The crop was watered up 5 October 2015, with an even plant stand of 14 plants/metre established.

The trial design was randomised and replicated three times in strips of 8 rows (4 beds) wide by 800 metres long over two 400 m bays.

Nitrogen (N) was applied as urea in single or split applications. The treatments were at the following rates:

- 247 kg N/ha + 0
- 147 kg N/ha + 0
- 147 kg N/ha + 100 kg N/ha
- 0 + 247 kg N/ha
- Zero (control).

Split application treatments were side-dressed with urea 10 December (first square). Nitrogen levels were monitored in crop with four petiole tests.

A comprehensive soil test was done pre-season with no soil nutrient problems found at the site. Pre-season soil nitrogen tests were taken in August to a depth of 60 cm. Nutrilogic (available on the Cottassist website) was then used to determine fertiliser rates. The Nutrilogic program provides a nitrogen rate recommendation for optimal crop nutrition based on soil test results, soil type and any soil constraints such as compaction.

Soil samples were taken from treatments throughout the season to help provide a calibration for a potential soil mineralisation test for the cotton industry.

The irrigation water applied for the first two irrigations was monitored for nitrogen levels using nitrate test strips.

The crop was picked 26 April 2016 and yielded two modules in each replicate. Modules were weighed using the CSD bale trailer. Gin turnout percentages from the Auscott gin at Hay were applied to individual modules.

Samples from modules were tested for quality factors at Australian Classing Services at Narrabri. Seed samples were also tested for nitrogen levels.

Statistical analysis was carried out by Oliver Knox, University of New England and technical input was provided by Chris Dowling, Back Paddock.

Yield results

The zero strips were visible throughout the season with shorter bushes and less leaf material (see picture), so it was surprising to see that the zero strips yielded up to 88 % of the highest yield (Figure 1).

Previous nitrogen work has reported that 60–70% of nitrogen used by the crop is contributed by the soil. This highlights that soil mineralisation is key for a successful season so maintaining a large soil organic nitrogen pool is critical to maintaining production. Access to this nitrogen pool can be compromised by soil constraints such as compaction and sodicity, therefore overcoming these problems results in more efficient production.

The yield results showed that the 247 + 0 and 0 + 247 treatments were significantly different to the other treatments (Figure 1). These treatments yielded half a bale better than the split application. Split application however is the most common application method in the industry and is used by over 90% of growers. It is a risk management strategy that avoids having large amounts of fertiliser nitrogen vulnerable to losses from waterlogging events, such as large rainfall events occurring after an irrigation.

Over the three years of trials there has been a change in the cooperators' attitude to nitrogen management, with the cooperators now comfortable to reduce total nitrogen application rates from around 350 kg N/ha back to around 250 kg N/ha in fallow fields. Their confidence is reinforced by a nitrogen rate trial at Warren in 2015–16 where there was no significant yield increase from nitrogen applications of 180 kg N/ha up to 400 kg N/ha (Figure 2).

An aerial view of the trial site at Benerembah clearly shows the zero nitrogen treatments in the randomised and replicated layout.

Zero treatment on the right (5 rows) and the 247 + 0 treatment on the left (5 rows) showing a difference in growth between treatments.

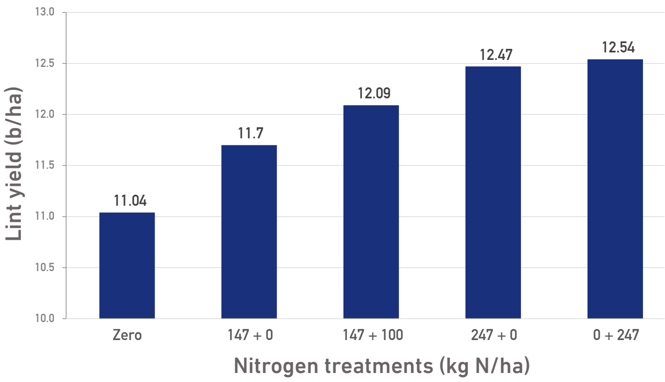


Figure 1. Lint yield of nitrogen treatments at Benerembah, 2015–16

LSD = 0.3

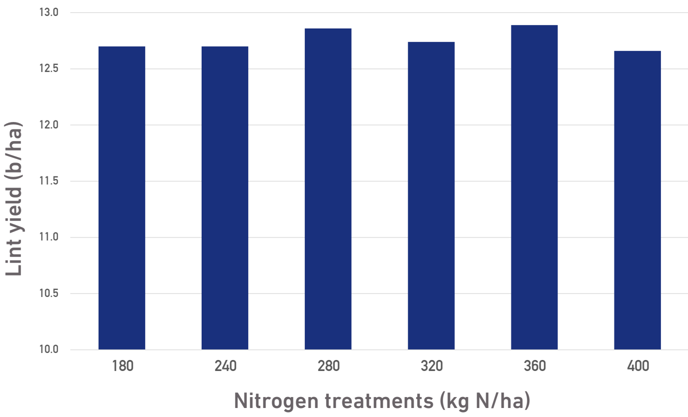


Figure 2. Yield of nitrogen treatments at Warren, 2015–16

Petiole nitrogen results

Petioles were tested in each of the treatments throughout the season. Adequate nitrogen levels should range from 20,000 to 40,000 mg/kg at 500 day degrees, 10,000 to 22,500 mg/kg at 1000 day degrees and decline to 2,500 to 10,000 mg/kg at 1500 day degrees. All of the treatments were in the adequate range through the season except the zero strips, which were always at a deficient level (Figure 3).

Nitrogen fertiliser use efficiency

Growers can monitor the nitrogen fertiliser use efficiency (NFUE) of their applied fertiliser with a simple calculation:

NFUE = lint yield (kg/ha)/applied nitrogen fertiliser (kg N/ha)

To achieve the economic optimum nitrogen fertiliser rate, the yield/N fertiliser index should be between 13 and 18. If the index is greater than 18, insufficient nitrogen has been applied; if the index is well below 13, too much nitrogen has been applied.

In the 2015–16 Benerembah trial, a NFUE of 11.5 was achieved, which is close to the target of 13. Nitrogen application rates could have been reduced by 30 kg N/ha to get to 13 kg lint/kg N.

It is when NFUE drops into single figures that the index indicates something else in the system is reducing nitrogen efficiency. Applying more nitrogen than is required to satisfy the crop's demand will not increase yield. Rather, growers need to assess their cropping system's nitrogen use efficiency and determine if other factors such as irrigation management, layout and drainage times are inducing waterlogged conditions and are limiting efficient cotton production.

Dowling (2016) outlines that NFUE should be benchmarked over a number of seasons as an indicator of crop performance, and to refine target yield and nitrogen application rates. Table 1 shows recommended nitrogen application rates to achieve industry target NFUE. Paddocks with a minor soil constraint would require 10% more applied nitrogen to achieve 11.7–13.0 kg lint/kg N; and paddocks with a moderate soil constraint would require 20% more applied nitrogen to achieve 10.4–11.7 kg lint/kg N.

Constraints typically include soil characteristics and management practices that negatively impact nitrogen availability and efficiency, such as salinity, dispersion, sodicity, compaction and waterlogging. If these constraints are likely to lead to more than 20% yield penalty (a NFUE less than 10 kg lint/kg N), a longer-term program to overcome the constraint needs to be implemented rather than continuing to push yield against constraints with applied nitrogen. High nitrogen rates have the potential for higher nitrogen losses and can contribute to increasing the severity of some soil borne diseases, increased canopy management and defoliation costs.

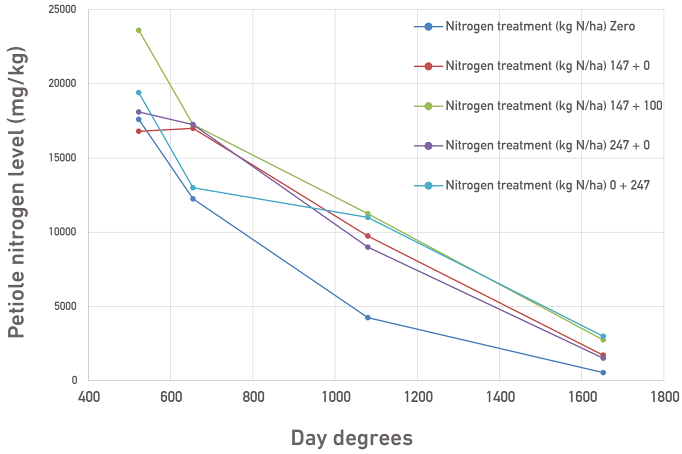


Figure 3. Nitrogen levels of petioles of cotton plants at Benerembah, 2015–16

Plans for 2016–17 season

The CottonInfo Regional Extension Officers will conduct more trials this coming season, with a focus on overcoming soil constraints and reducing variability in fields. Work will continue on quantifying soil mineralisation rates through the growing season. A trial looking at pix management is also being planned.

Further information

Kieran O'Keeffe
M: 0427 207 406
E: kieran.okeeffe@cottoninfo.net.au

Further reading

www.cottassist.com.au/NutriLOGIC/About.aspx

Dowling. C, *The Australian Cotton Grower*, 'How much N is enough for 15+ bales'?, June–July 2016, pp 32–34.

Dowling. C, Impact of changes in variety and management on cotton N dynamics in SoilMate CotNPlan model, SoilMate Technical Bulletin #SMM-01, July 2016.

Macdonald. B, Chang Y, Nadelko T, *The Australian Cotton Grower*, 'Where does the nitrogen fertiliser end up'?, June–July 2016, pp 36–38.

Table 1. Applied nitrogen rate range based on industry target of minimum NFUE of 13 kg lint/kg applied nitrogen (par) and two levels of yield constraint for irrigated cotton production (Dowling 2016)

Yield target		Applied nitrogen rate (kg N/ha)		
bales/ha	kg/ha (lint)	Par (13 kg lint/kg N)	Minor soil constraint (11.7–13 kg lint/kg N)	Moderate soil constraint (10.4–11.7 kg lint/kg N)
9	2043	157	173	189
10	2270	175	192	210
11	2497	192	211	230
12	2724	210	230	251
13	2951	227	250	272
14	3178	244	269	293
15	3405	262	288	314
16	3632	279	307	335
17	3859	297	327	356
18	4086	314	346	377

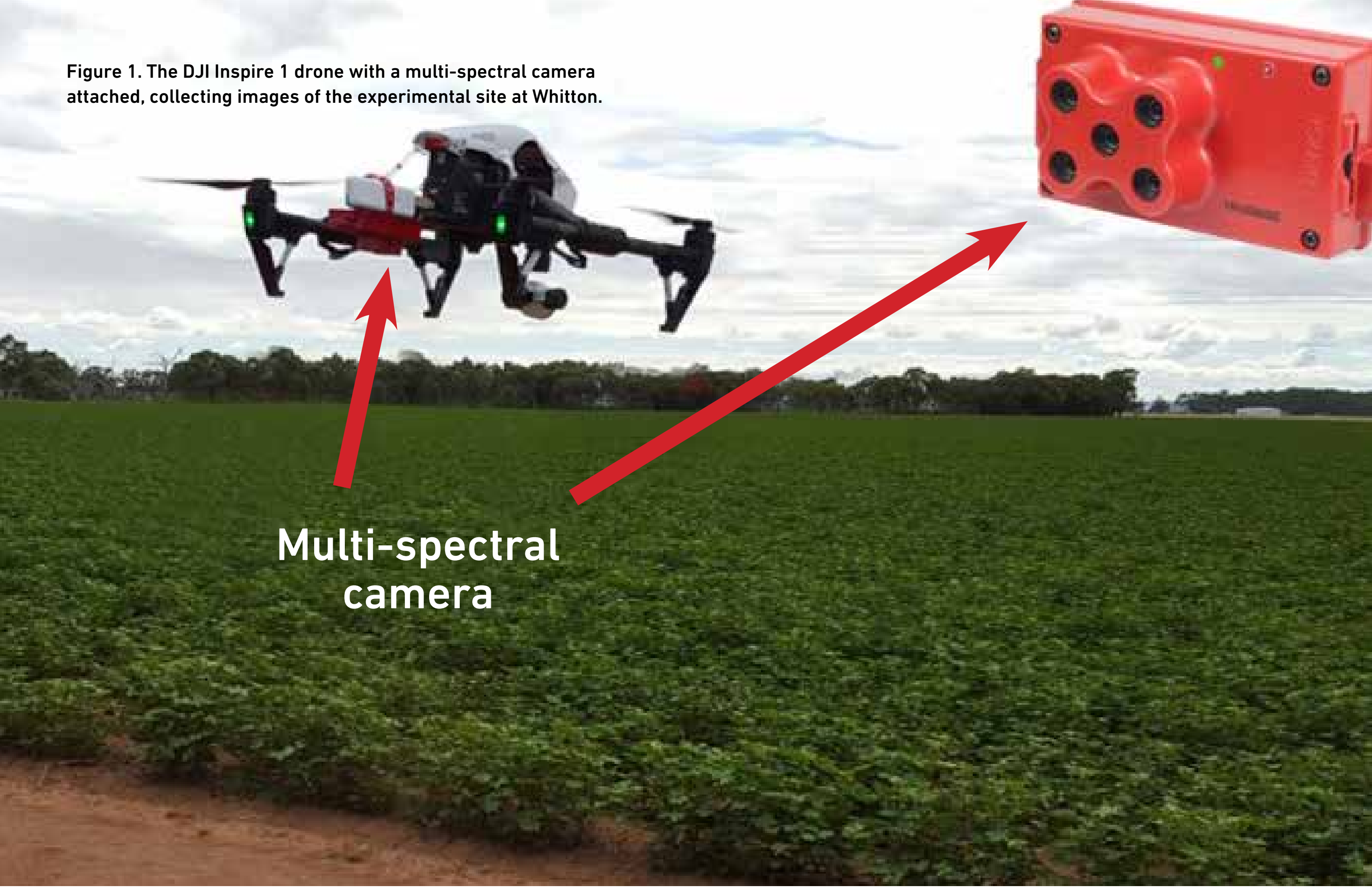


Figure 1. The DJI Inspire 1 drone with a multi-spectral camera attached, collecting images of the experimental site at Whitton.

REMOTE SENSING OF NITROGEN STATUS IN COTTON

QUICK TAKE

- Remote sensing of the nitrogen status of cotton using a low-cost drone equipped with light sensors may provide valuable information for growers in order to develop fertiliser strategies to maximise yield across their farms.
- The CCCI index seems to be a good estimator of nitrogen uptake in cotton at first flower stage.
- Leaf chlorophyll sensitive indexes such as the NDRE and CCCI have potential for predicting yield earlier in the season (first flower) than the most common index employed in agriculture, NDVI.
- The first year results of a study in southern NSW showed that drone-mounted multi-spectral cameras that included the red-edge band were effective tools to monitor the effects of nitrogen management on cotton growth.

In-season assessment of nitrogen status for cotton crops is a recommended practice to optimise nitrogen fertiliser management and maximise yield.

Carlos Ballester-Lurbe[1], Wendy Quayle[1], James Brinkhoff[1], John Smith[2] and John Hornbuckle[1]
[1]Centre for Regional and Rural Futures, Deakin University, Griffith
[2]NSW Department of Primary Industries, Yanco Agricultural Institute

RESEARCH has shown that light reflectance at specific wavelengths from leaves of stressed plants (e.g. nitrogen deficient plants) differs from that of healthy plants and therefore, its measurement can provide useful information for monitoring crop performance throughout the season. Spectral reflectance measurements can be taken at leaf or canopy level, using ground sensors, or at farm level, using sensors on satellites or drones, to generate images.

During the last two years interest in the use of drones for agricultural businesses has increased rapidly. Current advances in drone technology have driven costs down, making this technology more accessible and easier to use for everyone. For instance, drones used in combination with lightweight multi-spectral cameras provide the possibility of acquiring images at a very high resolution (<10 cm) for assessing variability within and between crops.

The flexibility that drones provide in terms of frequent monitoring and operation under diverse weather conditions, compared with satellites, makes drone technology an interesting tool for farmers and consultants. Already aware of this fact, farmers and consultants around Australia have shown great interest in workshops and field days featuring this new technology.

Finding the best index

Deakin University's Centre for Regional and Rural Futures (CeRRF) has investigated the potential of several vegetation indexes for tracking the nitrogen status of cotton, as well as for predicting yield.

The first year of the remote sensing of nitrogen study was conducted on a commercial cotton farm at Whitton, where another study supported by the Cotton Research and Development Corporation (CRDC) was being carried out.

The remote sensing study consisted of eight treatments with nitrogen application rates of 0, 130, 177, 194, 210, 307, 324 and 340 kg N/ha, as shown in Table 1. Basal fertiliser was applied 23 September 2015 and top-dressed urea was applied 10 December 2015.

Table 1. Nitrogen treatments based on eight different rates of nitrogen application using four different fertiliser products. Basal fertiliser was applied 23 September 2015 and top-dressed urea 10 December 2015.

Total nitrogen (kg N/ha)	Fertiliser nitrogen (kg N/ha)				Replicates
	DAP	NH_3N	Urea	Manure	
0	0	0	0	0	3
130	0	0	130	0	3
177	27	150	0	0	4
194	27	150	0	16.6	4
210	27	150	0	33.2	4
307	27	150	130	0	4
324	27	150	130	16.6	4
340	27	150	130	33.2	4

The treatments were replicated three or four times, with each replicate consisting of 3–9 beds of either 100 or 250 metres length.

Spectral reflectance of the crop was measured in all the plots at 62, 83, 97, 118, 154, 160 and 169 days after sowing (DAS) using a Micasense Rededge camera (www.micasense.com) installed on a DJI Inspire 1 drone (Figure 1).

The camera captured images corresponding to the spectral reflectance in the blue, green, red, red-edge and near infrared bands. All the images for each measurement day were uploaded to the Micasense Atlas Imagery & Analytics for Precision Agriculture service, where they were stitched together to produce a whole map of the site.

Above-ground biomass was measured at first flower and plant nitrogen concentration (N%) was determined. Crop nitrogen uptake (N uptake) was then calculated. At maturity, two metres of plants in three adjacent rows per replicate were hand-picked. Seed-cotton was weighed and ginned to determine lint and seed yield.

Three vegetation indexes were calculated from the multi-spectral images and their relationship with the in-field measurements was explored. These were:

1. normalised difference vegetation index [NDVI = (NIR – R) / (NIR + R)], sensitive to variations in biomass and nitrogen status in some crops, e.g. wheat
2. normalised different red-edge index [NDRE = (NIR – RE) / (NIR + RE)], calculated using data from the red-edge region of the light spectrum, which has been reported in many studies as sensitive to the leaf chlorophyll content (see for instance Figure 2)
3. canopy chlorophyll content index (CCCI = NDRE/NDVI), which is the NDRE index normalised by biomass.

Correlation with plant nitrogen

The spectral measurements showed small differences between treatments early in the season when plants from the lowest nitrogen rates were likely able to draw on nitrogen reserves in the soil. Differences between treatments, however, became more evident later in the season when the nutrient requirements of plants increased during boll formation. Figure 3, for example, shows the evolution of the NDRE index at the site from 97 to 160 days after sowing.

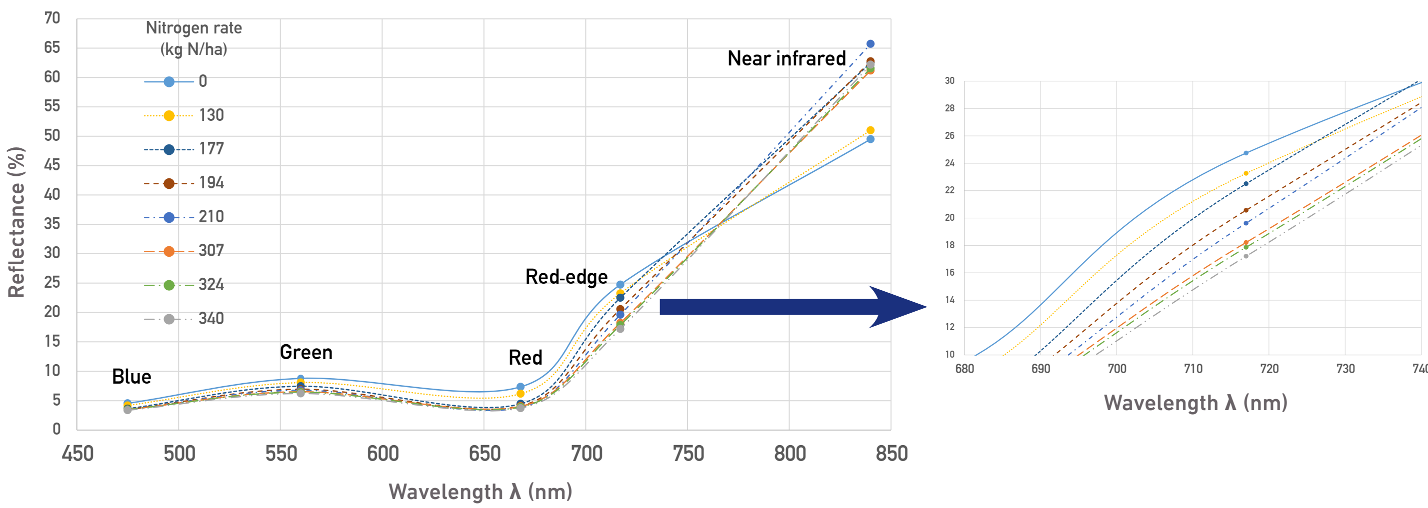


Figure 2. Average canopy reflectance spectra for the eight nitrogen rate treatments applied in the study. Centre wavelengths of the five bands are indicated with a filled circle. Note the higher differences between treatments in the red-edge region of the spectrum, with higher nitrogen rates showing lower reflectance.

NDVI measurements taken at 83 days after sowing were not correlated with either plant nitrogen concentration (N%) or crop nitrogen uptake.

NDRE data was not correlated with plant nitrogen concentration (N%) but it showed a significant correlation (r^2 = 0.56, p<0.05) with crop nitrogen uptake when the relationship was explored at treatment level.

CCCI was the index that showed the best relationships with both plant nitrogen concentration (N%) *(r^2 = 0.80; p<0.0001)* and crop nitrogen uptake *(r^2 = 0.47; p<0.0001)* at the first flower stage.

Correlation with yield

The relationship between yield and the NDVI, NDRE and CCCI indexes was studied throughout the season in order to identify the index that could predict yield earlier and more accurately.

The results obtained show that the chlorophyll-sensitive indices NDRE and CCCI produced the best correlations with lint yield at 83 days after sowing (r^2 = 0.80 and 0.74; *p<0.01*, respectively).

From that point onwards (after 83 days after sowing) however, the NDVI was the index with the best correlations.

A comparison between the yield map of the whole site obtained at harvest and the NDRE maps obtained from the multi-spectral images at 83 and 118 days after sowing is shown in Figure 4. At 83 days after sowing some treatments started showing some signs of nitrogen deficiency, which became further pronounced as the season progressed, leading to a significant decrease in yield.

The CCCI index showed the best correlation with seed yield at 83 days after sowing (r^2 = 0.77; p<0.01) followed by the NDRE (r^2 = 0.63; p<0.05).

The NDVI index was not well correlated until 97 days after sowing, but showed the best correlations from that date onwards.

In general, the relationships between the vegetation indexes and seed yield were better than those obtained for lint yield.

Conclusions

The results obtained during this first year of the study show that the use of drones along with multi-spectral cameras that include the red-edge band were effective tools to monitor the effects of nitrogen management on cotton growth. The technology is now affordable and the automation and simplification of the data collection process will allow a greater uptake by growers.

Vegetation indices such as the NDRE and CCCI are sensitive to the leaf chlorophyll content. They showed greater potential for tracking crop nitrogen status and predicting lint and seed yield in this crop earlier in the season than the most commonly used index, NDVI.

Further research will help to provide more insights into the use of these and other indexes for estimating crop nitrogen status.

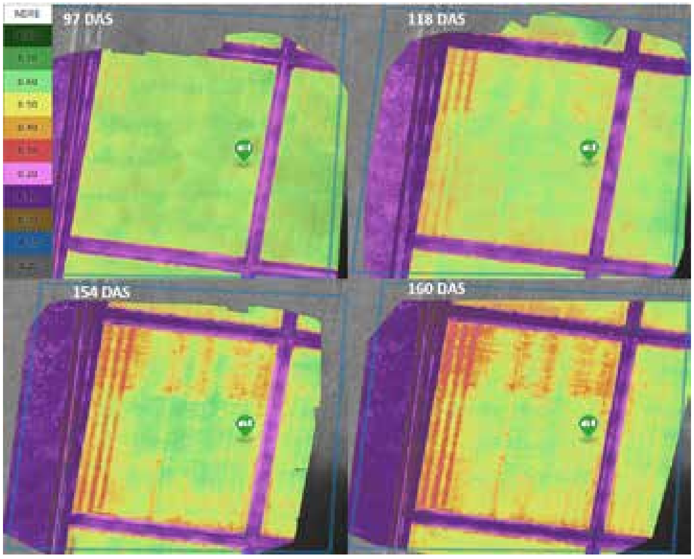


Figure 3. NDRE maps of the cotton farm 97, 118, 154 and 160 days after sowing (DAS). Note the increase in variability within the site throughout the season due to the treatments applied. The three replicates of the 0 and 130 kg N/ha rate treatments are clearly distinguishable at the left side of the site.

Acknowledgements

The project gratefully acknowledges funding provided through the Cotton Research and Development Corporation. The project team also acknowledges the great assistance provided by Stott Farms.

Further information

Carlos Ballester-Lurbe
Research Fellow
M: 0455 896 012
E: carlos.ballesterlurbe@deakin.edu.au

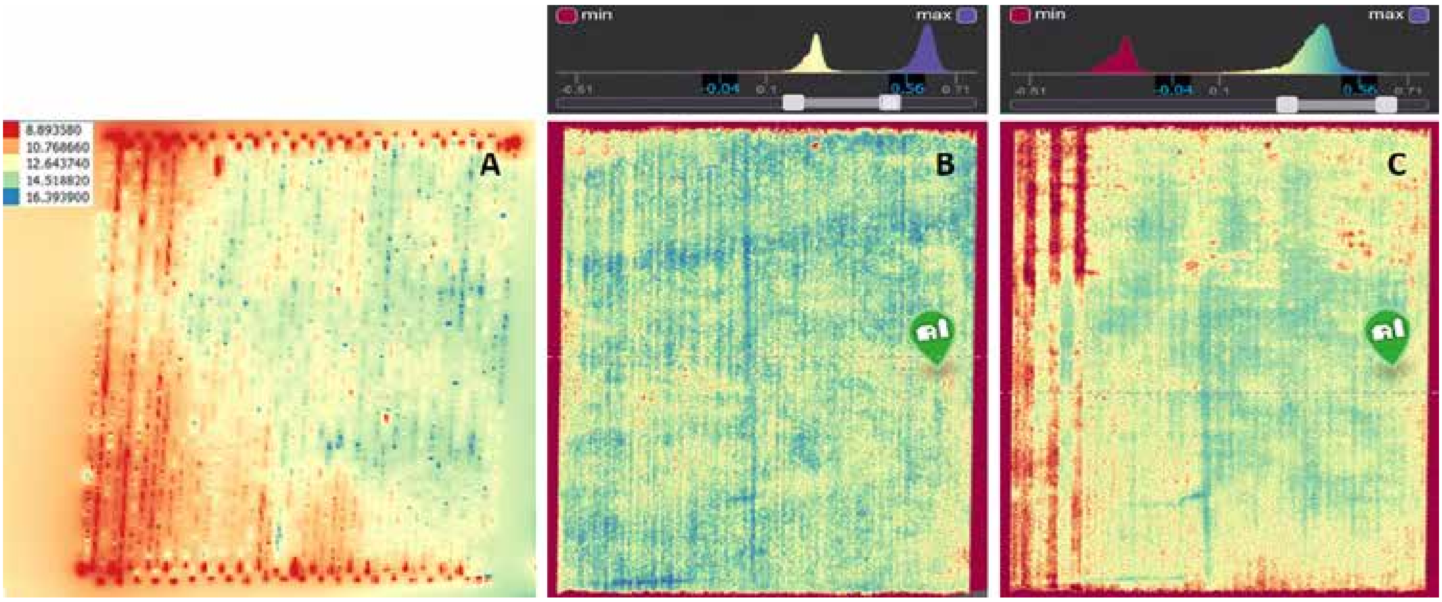


Figure 4. Yield map (bales/ha) of the site at harvest (A) and NDRE maps of the site at 83 (B) and 118 (C) days after sowing

Commercial-scale trials are testing the industry-wide threshold for controlling thrips in southern cotton production systems.

VALIDATING THRIPS THRESHOLDS FOR SOUTHERN COTTON

QUICK TAKE

- Thrips, an early season pest of cotton crops, were predicted to have a greater effect in southern growing regions than in the north because early crop establishment is strongly linked to yield.
- Four trials conducted on commercial-scale cotton crops tested the current industry spray threshold of 10 thrips/plant against a lower threshold of 1 thrips/plant.
- Trials were conducted at Whitton and Darlington Point over two seasons in 2014–15 and 2015–16.
- No yield difference was observed between sprayed and unsprayed plots in the two seasons.
- The dominant thrips species in the trial crops was onion thrips, making up 80% of the population.

Cotton crops in southern Australia have a shorter growing season than northern crops, giving them less opportunity to recover from early season crop damage and stress.

Sandra McDougall, Sarah Beaumont, Jianhua Mo, Alicia Ryan, Scott Munro and Mark Stevens
NSW Department of Primary Industries, Yanco Agricultural Institute

THE length of the growing season for cotton crops is important because links have been made between early crop establishment and high yields. Thrips are sucking pests of cotton seedlings and where their pressure is high, they can cause cupping of leaves up to the 6-leaf stage of cotton development. This results in reduced leaf surface area during the establishment phase.

Insecticides are commonly used to control thrips in the southern cotton production region, averaging two sprays per season. The industry-wide spray threshold is 10 thrips per plant and more than 80% leaf area loss for seedlings up to the 6-leaf stage. Due to the shorter growing season in the south, we wished to test if this threshold was sufficient to minimise yield losses from thrips damage.

We conducted commercial-scale trials to test the adequacy of the industry threshold for southern NSW in controlling thrips numbers and damage and compared it with a lower threshold of 1 thrips/plant and an unsprayed control.

Thrips control options

Western flower thrips are an established pest in many horticultural crops in southern NSW and have developed resistance to a number of pesticide groups. In 2014–15 season we didn't know if western flower thrips were going to be a significant thrips pest of establishing cotton, so we needed to use an insecticide with western flower thrips activity.

Dimethoate and omethoate are two registered/permitted thrips insecticides in cotton but they are relatively ineffective against western flower thrips. As broad spectrum insecticides they have a high negative impact on a broad range of beneficial insects potentially resulting in the flaring of mite and whitefly populations.

Sulfoxaflor (Transform™) is newly registered in cotton for aphid control and was known to have good activity against western flower thrips, hence it was used in the 2014–15 season. Fipronil, used in the 2015–16 trials, is another foliar insecticide registered and widely used for thrips in cotton. It is effective against western flower thrips, however it is highly toxic to bees, has moderate toxicity to a broad range of beneficials and can also flare mite or whitefly populations.

Trial details

Trials were conducted on commercial furrow-irrigated cotton crops at the IREC Field Station at Whitton and Darlington Point during the 2014–15 and 2015–16 seasons. The trials were planted in two rows on 1-metre beds in the first two weeks of October in the first season and mid-October in the second. We used Sircot variety 74BRFD. All seeds were treated with a fungicide seed treatment Dynasty® (azoxystrobin+ metalaxyl-M+ fludioxonil). Some treatments also used seeds that were coated with the insecticide Cruiser® (thiamethoxam).

Pesticide treatments

2014–15 season

1. Industry thrips threshold: sulfoxaflor (Transform) at 10 thrips/plant
2. Low threshold: sulfoxaflor at 1 thrips/plant + thiomethoxam (Cruiser) seed treatment
3. Control: no pesticide/untreated

2015–16 season

Wet weather prevented paddock access resulting in changed treatments

Whitton site

1. Industry thrips threshold: fipronil (Regent®) at 10 thrips/plant (1 spray only)
2. Low threshold: fipronil (Regent) and thiomethoxam (Cruiser) (1 spray only)
3. Control: no pesticide/untreated

Darlington Point site

1. Industry thrips threshold: fipronil (Regent) at 10 thrips/plant (1 spray)
2. Industry threshold: fipronil (Regent) at 10 thrips/plant (2 sprays)
3. Control: thiomethoxam (Cruiser) seed treatment with no foliar sprays

Thrips populations at trial locations

Onion thrips (*Thrips tabaci*) was the dominant species making up 80% of all adult thrips monitored from seedling to 17-leaf stage in both seasons (Figure 1). Other thrips species observed were tomato thrips (*Frankliniella schultzei*), western flower thrips (*F. occidentalis*), plague thrips (*Thrips imaginis*) and some predatory thrips species.

A healthy cotton seedling (top) compared with a seedling displaying 'cupping' of the leaves (below) — a symptom of thrips damage.

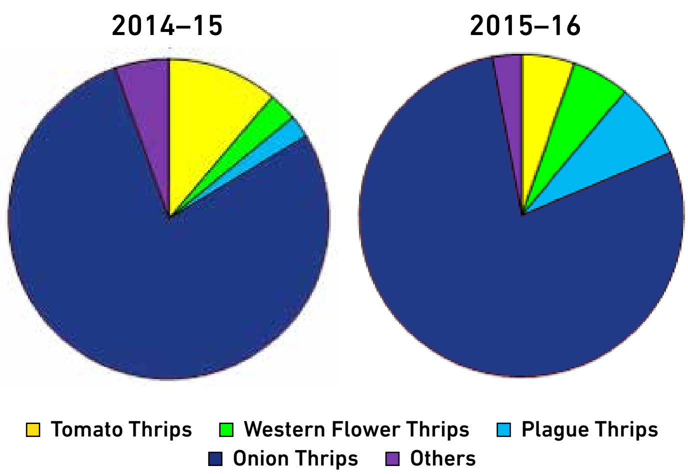


Figure 1. Relative proportions of adult thrips species from trial locations in the early stages of the 2014–15 and 2015–16 seasons.

Thrips on the underside of the cotyledon of a cotton plant.

There was no effect on yield results in two seasons of the experiment, suggesting growing conditions have been adequate to allow plants to recover from early season thrips damage.

Did pesticide treatments reduce thrips numbers?

In the 2014–15 season, two sprays of sulfoxaflor were applied before the high-threshold sprays were triggered. Neither showed any effects in thrips control at the Whitton site (Figure 2). In fact, larval thrips numbers continued to increase despite two sprays.

In an effort to bring down thrips numbers at Whitton, fipronil was applied in lieu of sulfoxaflor at the time when the first high-threshold sprays were triggered. Whereas at the Darlington Point site, the sulfoxaflor was used as the thrips numbers were not so high. Following this round of sprays, larval thrips numbers in treated plots were significantly reduced compared with unsprayed plots at both sites.

At Whitton, thrips numbers again hit the 10 thrips/plant threshold so both plots were sprayed and thrips numbers, although remaining above the threshold, were less than a quarter of the numbers of the unsprayed plots. At Darlington Point the overall numbers were lower and only the 1 thrips/plant plots were re-sprayed and only that plot remained significantly lower than the other treatments at the end of the establishment phase.

In 2015–16 rainfall prevented either site being sprayed at the 1 thrips/plant threshold.

The Whitton site, planted 9 October 2015, was sprayed with a single fipronil spray when thrips numbers were around 10 thrips/plant and the plants were at 5–6 leaf stage (Figure 3). The thiomethoxam seed treatment significantly reduced larval thrips numbers in the first monitoring period but not subsequently.

The Darlington Point site was planted a week later and initially became waterlogged, so on 15 November when the first foliar fipronil spray could be applied, the plants had only two leaves and significant cupping, and thrips numbers were greater than 10 thrips/plant for almost two weeks prior.

The thiomethoxam seed treatment had no noticeable effect on thrips numbers. The thrips numbers dropped post-fipronil spray in all plots even the unsprayed seed treatment plots, although there were significantly less thrips in both sprayed fipronil treatments (approximately 2 versus 5 thrips/plant). The second fipronil spray on the 2-spray plot again reduced thrips numbers and again both fipronil treatments had lower numbers of thrips compared with the unsprayed thiomethoxam seed treatment plots. There were high levels of variability in both the cotton plants and thrips numbers at the Darlington Point site.

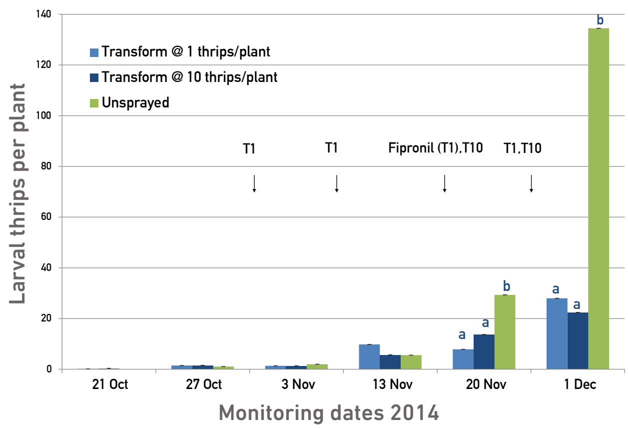


Figure 2. Average numbers of larval thrips in different threshold treatments at Whitton 2014–15. T1 = sulfoxaflor (Transform) applied at 1 thrips/plant, T10 = sulfoxaflor applied at 10 thrips/plant. Error bars show the standard errors. Arrows indicate spray timings.

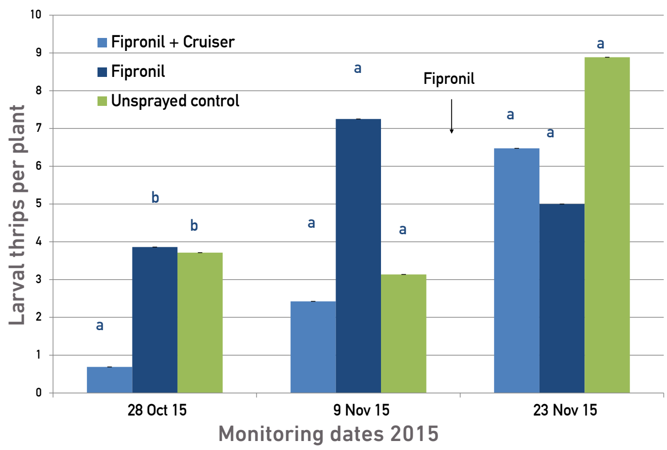


Figure 3. Average numbers of larval thrips in different threshold treatments at Whitton 2015–16. Error bars show the standard errors. Arrows indicate spray timing. Note that the significance difference in treatments on 28 Oct 2015 was with log transformed data.

Did pesticide treatments affect yield?

We found no difference in yield or turnout between the threshold treatments and the unsprayed treatment in either trial, despite a drop in thrips numbers following the sprays.

In both seasons there were no significant differences in yields from either hand or machine harvest assessments (Figure 4). This suggests that in the last two seasons, growing conditions have been adequate to allow plants to recover from early season thrips damage.

Where to next?

The threshold trial will be replicated for a third season in 2016–17 at three sites. The third season will provide a better understanding of how a cotton crop recovers from early season thrips damage and what this means for growers' pest management options.

Acknowledgements

This project has been partially funded by the *CRDC Establishing Southern Cotton – IPM* project (DAN1501, 2014–17).

We greatly appreciate the cooperation of the IREC demonstration farm committee, the Stott family and farm staff, James Hill and Matt Watson. Thanks to Dupont, Dow and Caltex for supplying insecticides for the experiment. Thanks to Jorian Millyard (Cotton Seed Distributors) for supplying seed in the first trial and trailer scales for weighing modules. Thanks to Lewis Wilson (CSIRO) for advice. Thanks to Warrick Stillard (CSIRO) and team for hand ginning our cotton samples in the first season.

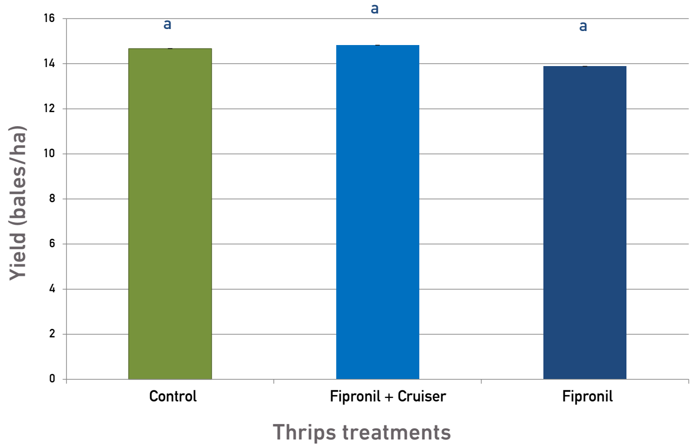


Figure 4. Yield of mechanically-harvested cotton from the Whitton site 2015–16 season trial. Note that bales were weighed after being in the paddock over winter and yields were approximately 1 bale/ha greater than what was calculated from the hand harvest data.

Further information

Dr Sandra McDougall
Leader Southern Irrigated Cropping Systems
T: 02 6951 2728
M: 0427 401 466
E: Sandra.McDougall@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au

LIFTING MAIZE YIELD WITH NEW MANAGEMENT PRACTICES

QUICK TAKE

- In the 2015–16 season, crop nitrogen uptake and grain yield in a maize trial in northern Victoria increased by applying 75% of the predicted crop nitrogen requirement up-front and 25% in-crop, compared with 40% up-front and 60% in-crop.
- Monitoring of soil moisture is critical to maximise crop production and productivity of key resources such water and nitrogen.
- First-year results suggest that nitrogen uptake and yield benefited from a shorter irrigation deficit than is standard practice in the region.
- Despite the challenges faced at the experimental site, the results suggest that nitrogen and irrigation management strategies can be refined to increase crop nitrogen uptake and grain yield.

The management of irrigation and nitrogen fertiliser in high input systems such as irrigated maize can have significant impact on crop nitrogen uptake and grain yield.

John Smith[1], Sam North[2], Wendy Quayle[3], Damian Jones[4], Rob Fisher[4] Don Griffin[2], Carlos Ballester-Lurbe[3], James Brinkhoff[3] and John Hornbuckle[3]

[1] NSW Department of Primary Industries, Yanco
[2] NSW Department of Primary Industries, Deniliquin
[3] Deakin University Centre for Rural and Regional Futures, Griffith
[4] Irrigated Cropping Council, Kerang

This article has been adapted from a paper presented at GRDC Grains Research Update, Moama 28 July 2016.

THERE needs to be a balance in crop management to ensure crop yields are not limited by insufficient water and nitrogen, while at the same time ensuring there is not over-application of these significant resources, which can contribute to excessive production costs and reduced productivity.

Results of a maize trial in 2015–16 suggest that current nitrogen and irrigation management strategies can be refined to increase crop yield.

The research reported in this article is part of the *Maximising on-farm irrigation profitability project* conducted by NSW DPI and Deakin University in conjunction with the three regional irrigation grower groups — Irrigated Cropping Council, Southern Growers and Irrigated Research and Extension Committee. Each of the grower groups hosts field experimental sites for the project, which are key sites for the extension of project findings. Organisations such as Local Land Services, CottonInfo and Rice Extension are also involved in project extension.

With a reduction in water availability in the southern Murray–Darling Basin of around 30% there is now much greater emphasis on ensuring irrigation farmers can optimise production with less water. The overall objective of this project is to develop sustainable broadacre irrigation systems that increase the profitability and flexibility of farming systems in the region.

The project has two components. The first is a water–plant component that aims to assess the impact of varying surface irrigation management strategies (scheduling and frequency) on nitrogen use efficiency, water use efficiency and overall system profitability. The second is a hydrology component that aims to develop irrigation design criteria to enable precise application of water in basin irrigation layouts, such as bankless channel systems. New criteria for irrigation layouts will enable greater flexibility in irrigation management to match recommendations from the agronomy component of the project.

In 2015–16, a field experiment was conducted in a commercial maize crop at Numurkah, in partnership with the Irrigated Cropping Council to investigate the interaction between nitrogen and irrigation management.

Field experiment and analysis

The experiment had two irrigation management and two nitrogen management strategies, with two replicates per treatment (eight bays in total). The maize variety Pioneer hybrid P0021 was sown 25 October 2015 to achieve a plant density of 90,000 plants/ha. The irrigation and nitrogen treatments were applied to whole bays within a border check surface irrigation system.

Irrigation of the experimental site was the same across all treatments up until the crop was established (7-leaf stage and four irrigation events). The irrigation treatments began after the fourth irrigation and continued until the end of the irrigation season. Irrigation frequency of the two treatments was based on:

1. standard grower irrigation practice (average 45 kPa matric potential)
2. reduced or short irrigation deficit (average 30 kPa matric potential).

Matric potential was monitored in each bay by installing two Watermark sensors at 5, 15, 30 and 45 cm depth. Average measurements at 15 cm were used for scheduling the irrigations.

A nitrogen application rate of 218 kg N /ha was calculated using a nitrogen budget for the site. Nitrogen was applied as urea and the two application strategies were:

1. 'up-front' where 75% of the total nitrogen was applied prior to planting and the remainder was water-run in-crop during the third irrigation event (16 December)
2. 'split' where 40% of the total rate was applied prior to planting and the remainder was water-run in-crop during the third and fourth (25 December) irrigation events.

Whole plants from 2 metres of plant row at six locations across each bay were taken at establishment (i.e. 7-leaf stage) and physiological maturity. The samples were analysed to determine nitrogen uptake.

Each bay was harvested with a commercial header and the harvested grain unloaded into a weigh bin to determine yield, before being loaded into a truck for delivery.

Crop nitrogen uptake and yield

Crop nitrogen uptake at establishment, when irrigation treatments had not yet been imposed, was not influenced by nitrogen management strategies, with an average crop nitrogen uptake of 32 kg N/ha.

At physiological maturity there was a significant effect on crop nitrogen uptake from each of the irrigation and nitrogen treatments, as well as a significant interaction between the two. Crop nitrogen uptake at physiological maturity increased from 149 to 167 kg N/ha (LSD, $P=0.06$) by reducing the irrigation interval from 45 to 30 kPa (average) matric potential.

Similarly, crop nitrogen uptake increased from 140 to 176 kg N/ha (LSD, $P<0.001$) by applying more nitrogen at planting in the 'up-front' strategy. Maximum crop nitrogen uptake was achieved when more

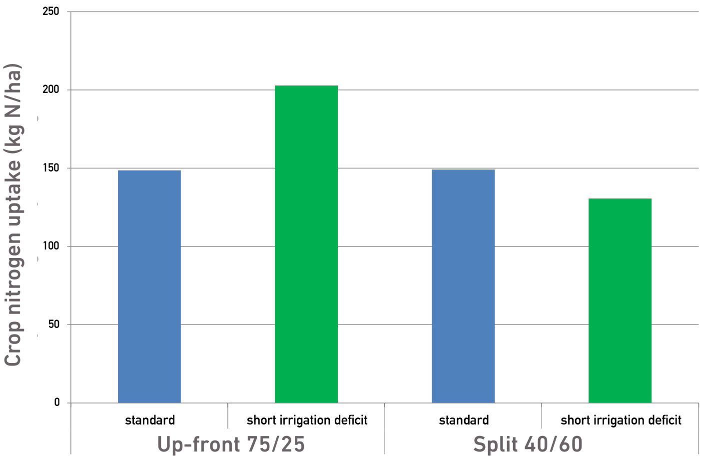


Figure 1. The interaction between irrigation management (standard and short irrigation deficit) and nitrogen management (up-front and split) in maize. Applying more nitrogen upfront with a shorter irrigation frequency significantly increased crop nitrogen uptake in the 2015–16 season.

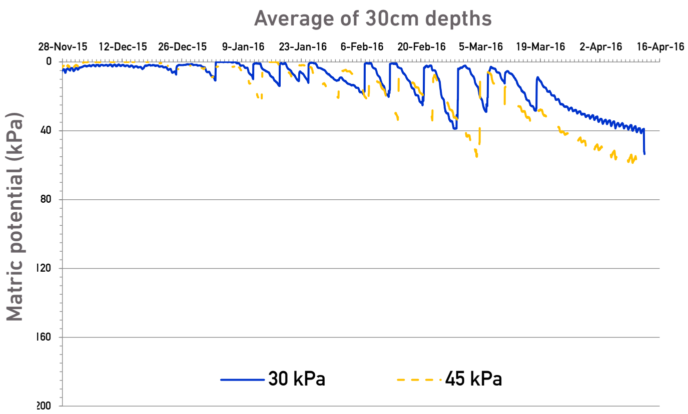


Figure 2. Average matric potential at 30 cm depth for the two irrigation treatments. The short deficit (30 kPa) irrigation treatment is the solid blue line and the standard irrigation deficit (45 kPa) is the dashed yellow line.

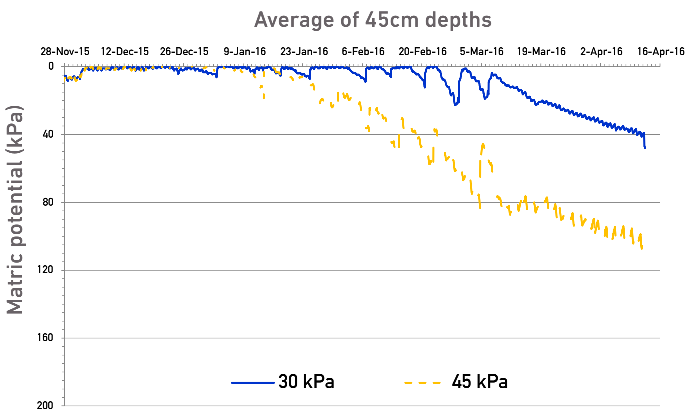


Figure 3. Average matric potential at 45cm depth for the two irrigation treatments. The short deficit (30 kPa) irrigation treatment is the solid blue line and the standard irrigation deficit (45 kPa) is the dashed yellow line.

nitrogen was applied up-front and the shorter irrigation deficit was used (Figure 1).

Maize grain yield was strongly influenced by poor establishment in three bays, which was caused by very wet conditions as a result of rain shortly after planting following pre-irrigation of the field. This meant that three of the eight bays were not harvested as part of the trial, eliminating the second replicate in all but one treatment and precluding any statistical analysis of grain yield.

For the bays that were harvested, grain yield was higher with more frequent irrigation or shorter deficit, i.e. 10.1 t/ha with 30 kPa deficit, compared with standard practice deficit, i.e. 8.7 t/ha with 45 kPa deficit.

A grain yield of 11.1 t/ha was achieved using the 'up-front' nitrogen management strategy compared with 8.8 t/ha with the 'split' strategy.

Soil moisture monitoring during the experiment highlighted some issues regarding the suitability of the standard irrigation practice for the soil type at the site. Although it is only one year's data, it appears that the short irrigation deficit treatment may better suit the red clay loam soil at the site.

Matric potential measurements at the 30 and 45 cm soil depths showed that from the end of January until harvest, the irrigation applications in the standard treatment were not refilling the soil water profile (Figure 2 and Figure 3). Given this result, it is considered more likely that yield was limited in the standard treatment by water stress during the season rather than the short irrigation deficit treatment providing a higher grain yield.

Management to lift yield

It is important to note that this is only the first year of a three-year trial and that the results from the 2015–16 season were strongly affected by wet soils at establishment. Despite these problems, there was as improvement in crop nitrogen uptake and grain yield when 75% of the predicted crop fertiliser nitrogen requirement was applied up-front, compared with only 40% applied up-front. This result provided the project with some confidence to continue investigation into the impact of these nitrogen management strategies in irrigated maize production.

The result from the irrigation treatment highlighted the importance of soil moisture monitoring. Upon first inspection it appears that crop nitrogen uptake and grain yield benefit from a shorter irrigation deficit. However, monitoring of the soil moisture status showed that the irrigation application in the standard treatment of the experiment was not applying enough water and this resulted in a reduction in crop nitrogen uptake and grain yield due to water stress.

During the 2016–17 season, new tools such as multi-spectral and thermal imagery will also be used to more precisely assess the temporal and spatial variability within bays caused by the irrigation and nitrogen treatments applied.

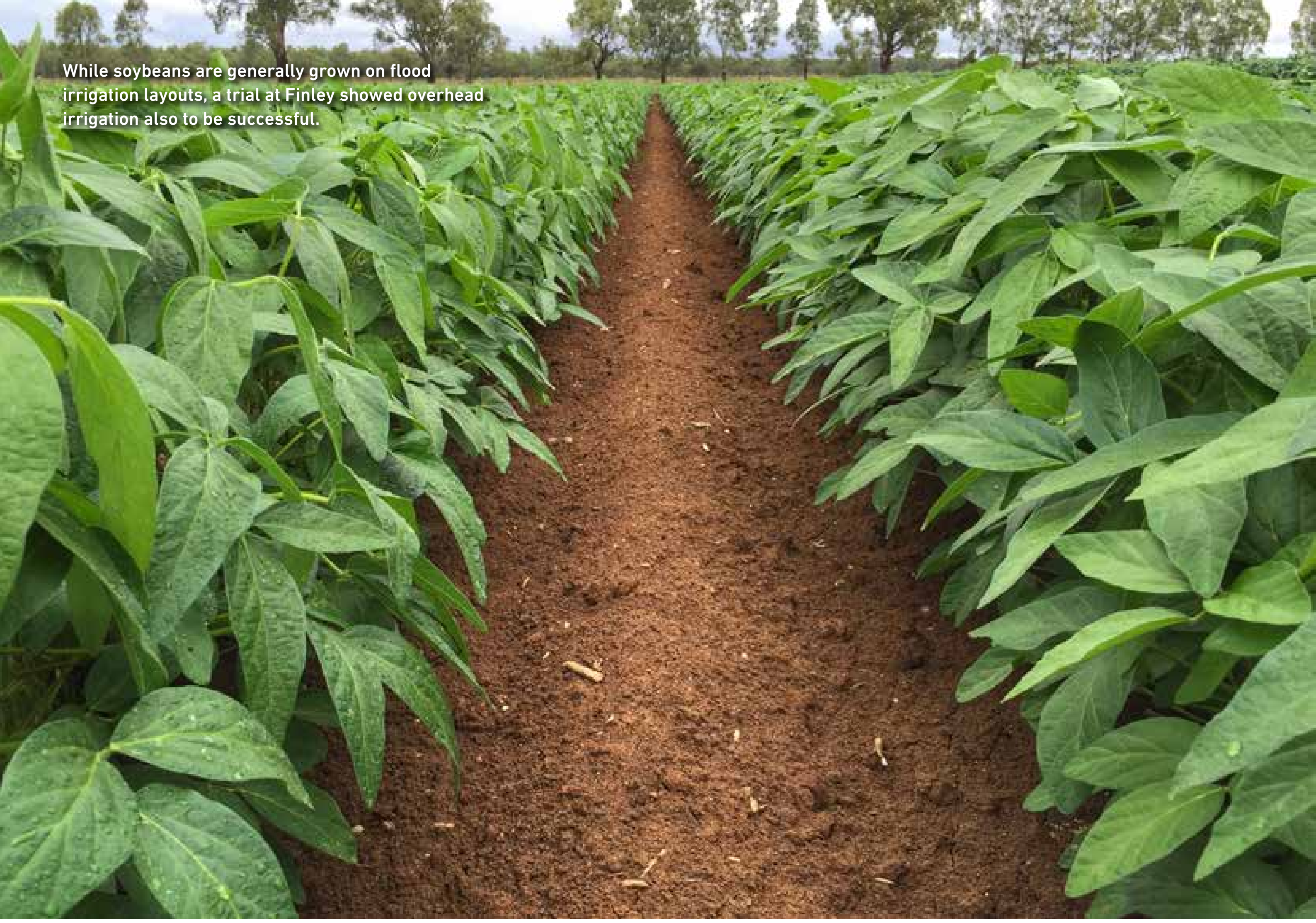
Acknowledgements

The project is supported by funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit Programme, the Cotton Research and Development Corporation and the Rural Industries Research and Development Corporation.

The contribution of Mr Ray Thornton for the time and effort in conducting the trial and Rubicon for water monitoring is gratefully acknowledged.

Contact details

John Smith
Research Officer, Irrigation
M: 0472 060 597
E: john.smith@dpi.nsw.gov.au



While soybeans are generally grown on flood irrigation layouts, a trial at Finley showed overhead irrigation also to be successful.

OVERHEAD IRRIGATION OF SOYBEANS IN SOUTHERN NSW

QUICK TAKE

- High soybean grain yields can be achieved on a relatively flat layout with overhead irrigation, as demonstrated by a trial in southern NSW where yields of over 4.5 t/ha were achieved.
- Djakal and the breeding line N005A-80 were the highest yielding varieties across all plant densities and row spacings.
- The treatments with a targeted plant density of 40 plants/m^2 yielded the highest across all varieties and row spacings.
- At a targeted plant density of 40 plants/m^2, the highest yields were achieved with a 30 cm row spacing.

Soybeans in southern NSW generally are grown on raised bed layouts with furrow irrigation. However, trial work suggests overhead irrigation on flat to undulating ground also may be successful.

Mark Richards[1], Luke Gaynor[1], Mathew Dunn[2] and Alan Boulton[2]
[1] NSW Department of Primary Industries, Wagga Wagga
[2] NSW Department of Primary Industries, Yanco

A FIELD experiment was conducted in the 2014–15 summer cropping season growing soybeans with overhead irrigation on a relatively flat site in the Finley area.

The experiment tested one new breeding line and two commercial varieties at three row spacings and two targeted plant densities. The aim was to examine the effect of treatments on dry matter production, harvest index, grain yield and protein.

Details of the trial site are presented in Table 1, and the treatments are described in Table 2.

Table 1. Site details of overhead irrigation trial.

Site details	
Location	Finley, NSW
Trial period	Summer growing season 2014–15
Soil type	Red brown, fine sandy clay loam over light clay
Previous crop/s	Wheat (stubble baled)
Establishment irrigation	Rainfall and post-sowing irrigation
Irrigation method	Overhead irrigation
Sowing date	20 November 2014
Inoculation	Water injected peat slurry Group H
Fertiliser	125 kg/ha legume starter
Herbicides pre-emergent	Roundup® 450 @ 1.5 L/ha + trifluralin @1.6 L/ha
Insecticides	Indoxacarb 150 g/L @ 400 mL/ha by air
In-crop rainfall	179 mm
Irrigations	7.83 ML/ha
Harvest date	15–16 April 2015

Table 2. Treatment details of overhead irrigation trial.

Treatments	
Varieties	Djakal, Bidgee, N005A-80 (unreleased breeding line)
Row spacing	2 rows/plot (90 cm), 3 rows/plot (60 cm), 6 rows/plot (30 cm)
Targeted plant density	25 plants/m², 40 plants/m²

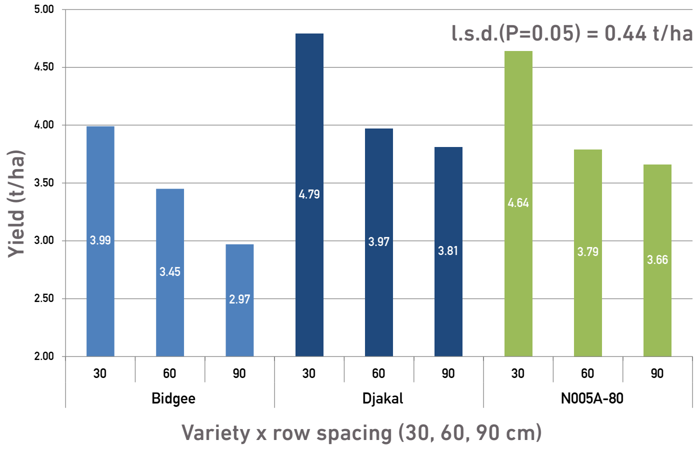


Figure 1. Soybean grain yield for variety x row spacing interaction at the 40 plants/m² targeted plant density

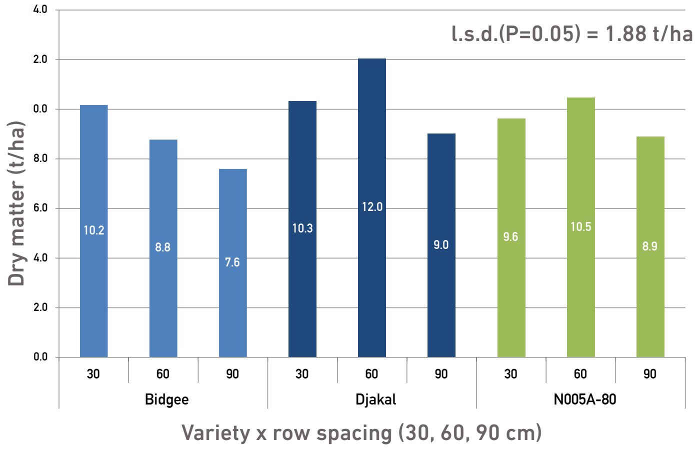


Figure 2. Soybean dry matter for variety x row spacing interaction at the 40 plants/m² targeted plant density

Variety results

When averaged across all row spacings and targeted plant densities, the grain yields of both Djakal and N005A-80 were significantly higher than Bidgee. The highest yielding variety treatments were Djakal and N005A-80, both at 40 plant/m² targeted plant density on 30 cm row spacing, with yields of 4.79 and 4.64 t/ha respectively (Figure 1).

There was a significant interaction between variety and row spacing for peak dry matter production (Figure 2). Both Djakal and N005A-80 achieved their highest dry matter yield at the 60 cm row spacing; however there was no statistical difference between 30 and 60 cm in dry matter production for these varieties. Bidgee dry matter declined linearly with widening row spacing, with 90 cm row spacing significantly lower than 30 and 60 cm row spacing (Figure 2).

Few changes in seed protein were found in response to row spacing and target plant density, but seed protein differed largely between varieties. When averaged across all row spacings and targeted plant densities, Djakal had a significantly lower protein concentration than both Bidgee and N005A-80, at 42.2, 45.2 and 46.1% respectively.

Row spacing results

When averaged across all varieties and targeted plant densities, the grain yield of treatments with the 30 cm row spacing was significantly higher than both the 60 and 90 cm row spacings, at 4.1, 3.6 and 3.3 t/ha respectively.

The experiment tested one new breeding line and two commercial varieties, planted at three row spacings and two targeted plant densities and irrigated by overhead sprinkler.

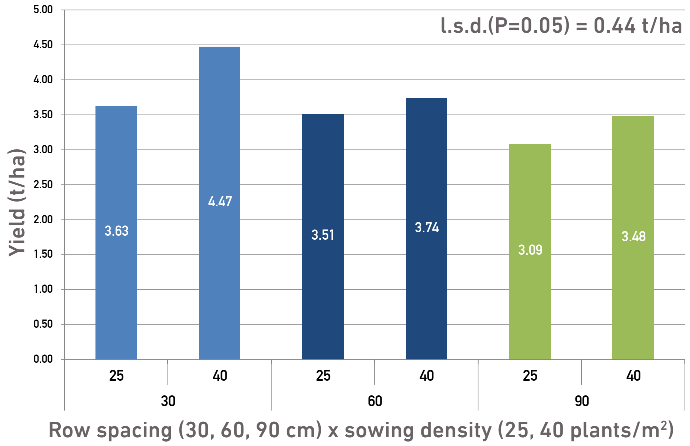


Figure 3. Soybean grain yield for row spacing x targeted plant density interaction averaged across varieties

Variety selection, row spacing and targeted plant density were key agronomic factors for achieving high yields when using overhead irrigation.

Soybean grain yields above 4.5 t/ha were achieved under overhead irrigation on a relatively flat layout in the Finley experiment.

Total dry matter averaged across all varieties and targeted plant densities was significantly higher on the 30 and 60 cm row spacings than the 90 cm row spacing, at 10.0, 10.4 and 8.5 t/ha respectively. This in part explains how the narrower row spacing was higher yielding than the 90 cm row spacing. In general terms, grain yield was correlated with total dry matter production.

Targeted plant density results

The actual plant densities achieved for the 25 and 40 plants/m² density targets were an average of 21 and 31 plants/m², respectively. Across all varieties and row spacings, the 40 plants/m² targeted plant density was significantly higher yielding than the 25 plants/m², at 3.9 and 3.4 t/ha respectively.

There was a significant interaction between targeted plant density and row spacing (Figure 3). At the higher targeted plant density (40 plants/m²), the narrower row spacing (30 cm) yielded higher than the wider row spacings (60 and 90 cm) for all three varieties. However, at the lower targeted plant density (25 plants/m²) there was no statistical effect of row spacing on grain yield for Bidgee and Djakal varieties, with the only exception being N005A-80 at 90 cm row spacing. From this data, it is apparent that plant density has a greater influence over grain yield than row spacing.

Summary

This experiment demonstrated that under overhead irrigation on a relatively flat layout, soybean grain yields above 4.5 t/ha were achievable.

Variety selection, row spacing and targeted plant density were all key agronomic factors for achieving high yields under this irrigation method and paddock layout. In summary, based on this experiment, for soybeans grown under overhead irrigation:

- Djakal and N005A-80 varieties yielded higher than Bidgee
- 30 cm row spacing was found to be the optimum row spacing especially at higher targeted plant densities
- optimum plant density, especially at narrow row spacing was 30 plants/m² — maintaining a population at or above this level was critical to maximising yield potential.

Acknowledgements

This experiment was part of the Southern NSW Soybean Agronomy Project (DAN00192, 2014–18), which is jointly funded by GRDC and NSW DPI.

Technical assistance was provided by John Dando and Paul Morris.

Further information

Mathew Dunn
Soybean Agronomist
T: 02 6951 2747
E: mathew.dunn@dpi.nsw.gov.au

New rice varieties, including YRK5 pictured here, offer improved cold tolerance and shorter growing seasons than existing varieties.

NEW VARIETIES GIVE RICE GROWERS MORE FLEXIBILITY

QUICK TAKE

- Two new rice varieties offer greater flexibility in rice farming sytems and rotations, and will fit well into double cropping programs.
- The new varieties have greater cold tolerance and the potential to be planted later than the current commercial varieties.
- Later recommended planting dates and drill sowing of the new varieties will reduce lodging and water use, respectively, without affecting grain quality or yield.
- The new varieties will be monitored under a range of growing conditions for the 2016–17 season, with the aim of providing more comprehensive growing guides for each variety before next season.

New shorter season, cold tolerant rice varieties are changing the options for rice farming and making growing systems more flexible and water efficient.

Gae Plunkett, Leah Garnett and Troy Mauger
Rice Extension

YRM70 and YRK5 will be assessed for both agronomic performance and market acceptance this season; and all going well, the new varieties will be named and released for the 2017–18 season.

YRM70 is a semi-dwarf medium grain variety that has similar grain quality characteristics to Reiziq$^{\phi}$ but with improved cold tolerance that is similar to Sherpa$^{\phi}$ with a shorter growth duration.

YRK5 is a semi-dwarf 'Japanese quality' short grain variety that is similar in grain quality characteristics to Opus but with improved cold tolerance and a shorter growth duration.

The new varieties have the potential to change cropping systems and rotations and will fit well into double cropping programs. They also offer water saving benefits, making rice more sustainable and able

Table 1. Crop details for four commercial blocks of YRM70 grown in 2015–16

Location	Yenda	Jerilderie	Whitton	Widgelli
Previous crop	2015 Wheat	Fallow	2014 Wheat	Fallow
Sowing method	Drill sown	Drill sown	Dry broadcast	Drill sown
Sowing date	27 Nov	10 Nov	29 Oct	8 Nov
PI date	22 Jan	16 Jan	29 Dec	8 Jan
Harvest date	28 Apr–5 May	22–28 Apr	6 Apr	9–14 Apr
Yield (t/ha)	11.1	12.2	12.3	12.4

New shorter season rice varieties will fit well into double cropping programs. As canola is being harvested, this paddock is worked up in preparation for planting YRK5. PHOTO: SCOTT JEWELL

Comparison of sowing methods for a Reiziq

In a drill sown crop in 2015–16, Reiziq⊕ used 1.2 ML/ha less water than an adjoining dry broadcast crop with the same yields and soil type.

Sowing method	Drill	Dry broadcast (flush & fill)
Area (ha)	23	33
Water use (ML/ha)	10.7	11.9
Yield (t/ha)	12.8	12.8

to compete against selling water on the temporary water market. The decision to sow these varieties can be made after late allocation announcements when there is more certainty of water availability.

Sowing recommendations

The recommended planting window extends after winter crop harvest, providing an opportunity for later planting while maintaining yield.

December-sown trials at Yanco have demonstrated good yield potential since 2010. With improved cold tolerance, the risk of weather extremes affecting the whole rice crop, across a farm or the industry, can be mitigated by using these varieties to stagger sowing dates.

Drill sowing of these varieties is recommended to encourage a shorter plant, which will reduce lodging at harvest time. Drill sowing also increases water use efficiency. Drill sowing is becoming more popular with 36% of all crops in the southern growing regions being drill sown last season, compared with 26% aerial sown and 38% dry broadcast.

Growers have changed to drill sowing for many reasons: ducks, slime, snails and wind, to name a few. This year particularly, drill sowing allowed growers to sow quickly without time-consuming preparation.

YRM70 and YRK5 crops will be tested under a range of sowing methods this season in commercial trials. Demand for both varieties was strong and all seed was allocated with late planting being a feature of the current season. Over 90 growers with YRM70 across the Murray and Murrumbidgee valleys and over 50 growers with YRK5 in the Murray Valley started planting at the start of November.

Agronomy recommendations

Close attention to water management and weed control is required due to warmer temperatures in the establishment period in November compared with the cooler October period. YRM70 and YRK5 can yield well and not lodge where nitrogen is managed well. Lodging will occur when high rates of nitrogen are applied prior to permanent water.

The amount of nitrogen applied up-front or before permanent water should be 75% that applied to Reiziq or Sherpa for YRM70 and 70% for YRK5. Similar total nitrogen rates are required to achieve maximum yield potential. Both varieties will need NIR Tissue Testing at PI to determine nitrogen topdressing rates.

This season the Rice Extension team, NSW DPI rice agronomy team and SunRice will be monitoring YRM70 and YRK5 crops under a range of growing conditions. The aim is to produce comprehensive growing guides available prior to next season, with information on nutrition, sowing method and dates, harvest dates and yields — to enable informed decisions and flexible and water efficient farming practices.

Further information

Gae Plunkett
Rice Industry Extension Coordinator, Leeton
M: 0419 790 019
E: gplunkett@rga.org.au

Canola stubble is disced into the soil immediately after harvest in preparation for sowing of the new short season rice varieties.

Drill sowing is recommended to encourage a shorter plant to reduce lodging, as well as increase water use efficiency.

With well-planned operations, it is possible to be watering up newly sown rice within three days of canola harvest.

YRM70 drill sown in November 2016. The recommended planting window of the new varieties extends after winter crop harvest.


Considerable research is being conducted on options for measuring PI nitrogen uptake with a reduced level of crop sampling.

BETTER INFORMATION FROM IMPROVED NIR TISSUE TEST

QUICK TAKE

- **Good rice nitrogen management leads to increased grain yield, water use efficiency and profitability.**
- **The NIR Tissue Test allows the accurate determination of the rice crop's nitrogen requirements at panicle initiation (PI) based on economic return.**
- **Recent updates to the NIR Tissue Test program have improved its accuracy for current rice varieties.**
- **The PI predictor is a useful tool for helping to determine approximately when PI should occur in a crop.**

The NIR Tissue Test is a free service for rice growers and agronomists, allowing them to make better nitrogen topdressing decisions for their rice crops.

Brian Dunn
Research Agronomist (Irrigation)
NSW Department of Primary Industries
Yanco Agricultural Institute

A BIG advantage of using the NIR Tissue Test to determine nitrogen topdressing requirements at panicle initiation (PI) is that the recommendations are based on the economic return of applying the nitrogen fertiliser and will provide the most profitable option.

The application of excessive nitrogen at PI not only wastes money but can also increase the risk of lodging and potentially increases the crop's susceptibility to cold temperatures at microspore while insufficient nitrogen may reduce grain yield. The risk of lodging is even more important with the short season varieties, YRM70 and YRK5, and the tall variety Koshihikari, which all have an increased potential to lodge at high levels of crop nitrogen.

Recent changes to the NIR Tissue Test

Some modifications have been made to the NIR Tissue Test in the last two seasons that will greatly increase its accuracy at predicting nitrogen uptake. The tissue test program converts the fresh weight measured by the grower into a dry weight, to allow the calculation of nitrogen uptake. It has been discovered that this conversion factor is not as accurate as we would like for current rice varieties, especially when drill sown, which has resulted in some of the reported PI nitrogen topdressing recommendations being lower than the actual crop requirement.

This inaccuracy was partially modified last season and has been further refined for the coming season providing growers with more accurate topdressing recommendations.

PI Predictor

It can be very difficult to determine when a crop has reached PI. The only accurate method is to slice open some tillers and look for the furry tip (Figure 1). Rice Extension and NSW DPI have been busy fine-tuning the internet-based PI Predictor to help provide a guide to growers and agronomists on when their crop should reach PI.

The PI Predictor requires the grower to enter the variety, sowing date, sowing method and location of their crop. The predictor then downloads up-to-date weather data from BoM (Bureau of Meteorology) to provide a reasonably accurate prediction of when PI will occur. It is important that the crop is still physically checked for PI as the PI Predictor is only a guide and some variability in the predicted PI date can occur.

The PI Predictor is located at pipredictor.sunrice.com.au

Satellite or aerial imagery

Imagery is a very useful tool for showing the variability in crop growth across a field and enables targeted sampling to help account for the variability that is present. NDVI is the traditional imagery used by growers but research has shown it to have limited value at higher levels of crop growth. When nitrogen uptake at PI is above 80 to 90 kg N/ha, NDVI cannot determine any differences with the same NDVI value given regardless of the crop's nitrogen uptake level (Figure 2).

Research has shown that remote sensing imagery that includes the red-edge wavelengths (700 to 740 nm), i.e. NDRENDVI, does not have the same problem (Figure 3). At this time there are limited red-edge imagery options available but they should become increasing available in coming seasons.

If growers have the opportunity to acquire a red-edge image instead of NDVI it is recommend they do so.

Future direction

Considerable research funded by RIRDC is being conducted on options for measuring PI nitrogen uptake with a reduced level of physical crop sampling or no sampling at all. All available remote sensing options are being evaluated to determine how accurately PI nitrogen uptake can be predicted. Depending on the level of accuracy achieved and the cost of the different options, modifications to the current sampling method to include remote sensing imagery and reduce the level of physical sampling will be incorporated into the NIR Tissue Test in future seasons.

Further information

Brian Dunn
T: 02 6951 2621
E: brian.dunn@dpi.nsw.gov.au

Figure 1. The crop is at panicle initiation once the furry tip (the developing panicle) is visible above the airspace and node in three out of ten main tillers.

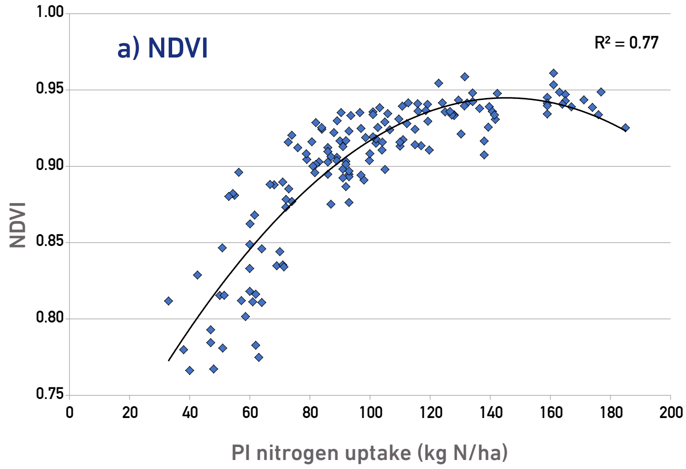


Figure 2. Measured PI nitrogen uptake (kg N/ha) compared with NDVI values collected using the micaSense RedEdge camera mounted on a drone.

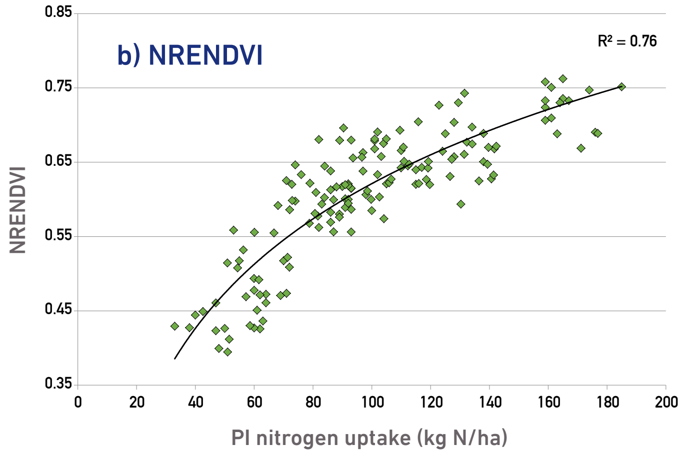


Figure 3. Measured PI nitrogen uptake (kg N/ha) compared with NRENDVI values collected using the micaSense RedEdge camera mounted on a drone.

Canola at the seedling stage at the Coleambally irrigated canola experiment in 2015.

OPTIMISING NITROGEN FOR IRRIGATED CANOLA

QUICK TAKE

- During 2015, the 'target yields' project investigated matching nitrogen (N) fertiliser application to water allocation to obtain an optimum canola grain yield.
- With a water budget sufficient for only one spring irrigation and a yield target of 3.0 t/ha, a split application of applied nitrogen totalling 200 kg N/ha gave the highest yield — with 75% of applied nitrogen at sowing and 25% at visible bud.
- Increasing the nitrogen application above 200 kg N/ha, without increasing the water budget, resulted in a lower grain yield, lower oil content and increased lodging damage.
- Grain yield averaged 2.88 t/ha across all treatments. The three highest yielding varieties were Hyola 575CL, Diamond and Hyola 577.

The results of a canola trial at Coleambally during 2015 showed that increased nitrogen rates must be matched with increased water application to achieve yield gains.

Tony Napier, Daniel Johnston, Glenn Morris, Cynthia Podmore and Neroli Graham
NSW Department of Primary Industries

THE second year of irrigated canola trials as part of the *Southern irrigated cereal and canola varieties achieving target yields* project was conducted in 2015. The Autumn 2016 edition of this newsletter (No. 194) reported on the results from the variety, plant density and time of sowing experiment for canola. An irrigated canola experiment was also conducted in 2015 to evaluate the effect of nitrogen rate and nitrogen timing on yield and quality.

The experiment

The irrigated canola experiment was conducted on Ken and Wendy Brain's property at Coleambally to evaluate the effect of variety and nitrogen interactions on canola grain yield, grain quality (oil content) and crop lodging.

The experiment was conducted on a red medium-clay soil where wheat as the previous crop. The plots were sown into dry soil 28 April 2015 and irrigated up two days later. The crop established very well with all varieties averaging a plant density of over 40 plants/m². The experiment was harvested by a small plot header 17 November 2015.

With one autumn irrigation, one spring irrigation and in-crop rainfall, it was calculated that the crop received approximately 3.7 ML/ha of water during the growing season. Soil moisture monitoring indicated that the crop experienced some moisture stress over spring. It is estimated that to reduce moisture stress and maximise yield, a further 1.0 to 1.5 ML/ha of applied irrigation was required.

Soil testing showed a starting nitrogen level of 82 kg N/ha at the site and it was estimated that there would be approximately 50 kg N/ha of in-crop mineralisation during the growing season. The pre-sowing fertiliser for all treatments included 150 kg/ha of MAP, 150 kg/ha of Gran-AM and 120 kg/ha of urea (providing a total of 100 kg N/ha). The MAP, Gran-AM and urea were all applied about 40 mm deep, one day before sowing.

The experimental nitrogen treatments included various rates of urea applied at sowing and a single topdressing three months later at visible buds. These nitrogen applications were surface applied by hand.

The total nitrogen available varied between treatments. Including soil mineralisation of nitrogen, 282 kg N/ha was available at the lowest nitrogen rate and 382 kg N/ha was available at the highest rate.

Crop performance

Grain yield

Grain yield averaged 2.88 t/ha across all variety and nitrogen timing treatments. Hyola 575CL was the highest yielding variety at 3.57 t/ha, which was significantly higher than all other varieties. Diamond had the second highest yield with 3.30 t/ha, which was statistically similar to Hyola 577. Hyola 450TT was the lowest yielding variety at 2.38 t/ha and was statistically similar in yield with Pioneer 44Y84, Victory 3002 and Hyola 750TT. Results for grain yield are shown in Figure 1.

Table 1. Nitrogen treatments evaluated in the 2015 Coleambally irrigated canola experiment.

Treatment	Total applied (kg N/ha)	Pre-sowing fertiliser (kg N/ha)	Urea at sowing (kg N/ha)	Urea at visible bud (kg N/ha)
Low (150 upfront)	150	100	50	0
Medium (200 upfront)	200	100	100	0
Medium (200 split)	200	100	50	50
High (250 upfront)	250	100	150	0

Table 2. Canola varieties evaluated in the 2015 Coleambally irrigated canola experiment.

Canola varieties evaluated under irrigation in 2015		
Pioneer 44Y84 (CL)	AV Garnet	Hyola® 575CL
Pioneer 45Y88 (CL)	ATR Gem	Hyola® 577CL
Pioneer 44Y87 (CL)	Hyola® 50	Hyola®450TT
ATR Bonito	Hyola® 559TT	Victory® V3002
Diamond	Hyola® 750TT	

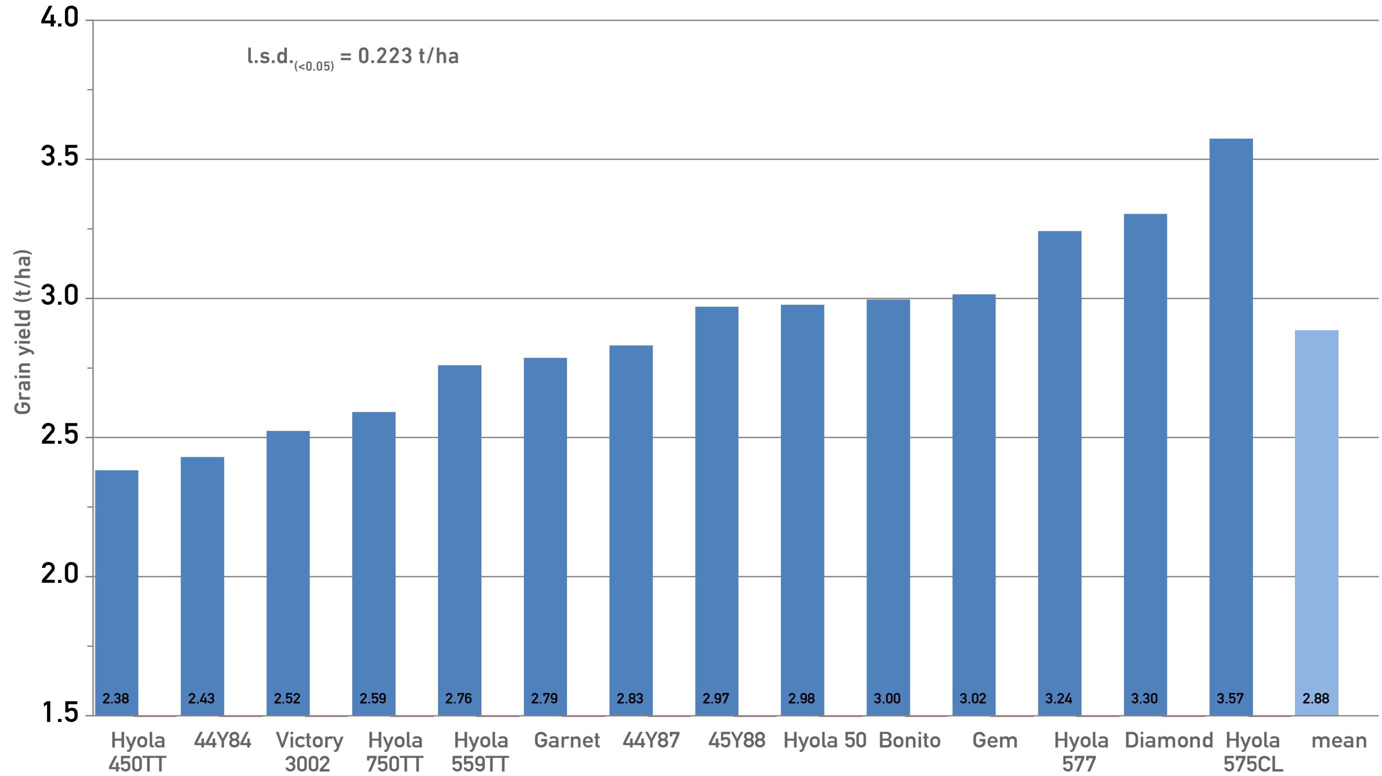


Figure 1. Mean grain yield of varieties averaged across all nitrogen treatments for the 2015 Coleambally irrigated canola experiment.

Table 3. Mean grain yield, oil content and crop lodging score for the 2015 Coleambally irrigated canola experiment.

Variety	Grain yield (t/ha)	Oil content (%)	Lodging score* (28 October)	Lodging score* (10 November)
Hyola 575CL	3.57 e	41.46 e	0.0 a	0.2 a
Diamond	3.30 d	40.19 cd	0.0 a	1.6 bc
Hyola 577	3.24 d	40.70 de	0.3 a	0.3 ab
Gem	3.02 c	40.24 cd	0.0 a	0.6 ab
Bonito	3.00 c	41.69 e	0.0 a	1.1 b
Hyola 50	2.98 bc	40.77 de	0.0 a	0.2 a
45Y88	2.97 bc	35.09 e	0.0 a	0.2 a
44Y87	2.83 bc	38.49 b	0.0 a	2.2 c
Garnet	2.79 bc	39.51 c	0.7 b	2.5 c
Hyola 559TT	2.76 b	40.62 d	0.1 a	0.8 ab
Hyola 750TT	2.59 ab	37.59 b	0.1 a	2.0 c
Victory 3002	2.52 a	40.07 cd	0.3 a	1.6 bc
44Y84	2.43 a	38.96 dc	0.2 a	1.6 bc
Hyola 450TT	2.38 a	40.98 de	2.5 c	2.8 c
Trial mean	2.88	**39.74**	**0.30**	**1.25**
l.s.d. (<0.05)	*0.22*	*1.01*	*0.42*	*0.77*

* 0=no lodging; 9=completely lodged

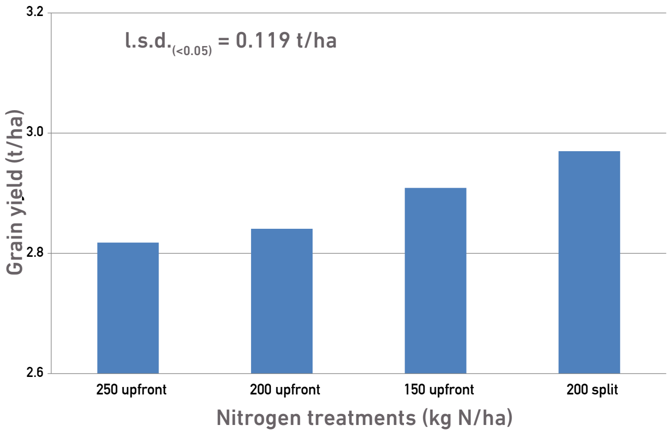


Figure 2. Mean nitrogen treatment grain yields averaged across varieties for the 2015 Coleambally irrigated canola experiment.

Table 4. Mean grain yield, oil content and crop lodging score of nitrogen treatments, 2015 Coleambally irrigated canola experiment.

Treatment	Grain yield (t/ha)	Oil content (%)	Lodging score* (10 November)
Low (150 upfront)	2.91 ab	40.32 c	0.71 a
Medium (200 upfront)	2.85 a	39.70 b	1.31 b
Medium (200 Split)	2.97 b	39.79 bc	1.35 b
High (250 upfront)	2.82 a	39.16 a	1.63 b
Trial mean	2.88	39.74	1.25
l.s.d. (<0.05)	0.119	0.538	0.41

* 0=no lodging; 9=completely lodged

Oil content

Grain oil content averaged 39.74% across all variety and nitrogen treatments. ATR Bonito had the highest oil percentage with 41.69%, which was statistically similar to Hyola 575CL, Hyola 450TT, Hyola 50 and Hyola 559TT. Pioneer 45Y88 had the lowest oil content with 35.09%, which was significantly lower than all other varieties. Results for oil content are shown in Table 3.

Lodging

Crop lodging was assessed twice with the first assessment on 28 October and the second assessment on 10 November.

The first assessment was conducted when the crop would normally have been cut and windrowed and no longer susceptible to lodging. On this date there was minimal overall lodging with Hyola 450TT and Garnet the only two varieties with any lodging damage.

The second assessment was conducted two weeks later to assess lodging damage when the crop was not windrowed and left for direct harvesting. At the second assessment there was increased lodging throughout the experiment with lodging observed in Hyola 450TT, Garnet, Pioneer 44Y87 and Hyola 750TT. Some lodging was observed in Diamond, Pioneer 44Y84 and Victory 3002. Almost no lodging was recorded in Hyola 575CL, Pioneer 45Y88, Hyola 50 and Hyola 577. Results for lodging are shown in Table 3.

Nitrogen response

The '200 split' and '150 upfront' treatments were significantly higher yielding then the '250 upfront' and '200 upfront' treatments. The '200 split' and '150 upfront' treatments yielded 2.97 and 2.91 t/ha respectively, when averaged across all varieties. Results for grain yield response to nitrogen are shown in Figure 2 and Table 3.

The '150 upfront' treatment gave the highest oil content percentage with 40.32% when averaged across all varieties and was statistically similar in oil content to the '200 split' treatment. Both of these treatments were significantly higher than the '250 upfront' treatment with 39.16%. Results for oil percentage response to nitrogen are shown in Table 4.

The '150 upfront' treatment had the lowest lodging damage (assessed 10 November) with a lodging score of 0.71 and significantly less lodging damage than all other nitrogen treatments. A lodging response to nitrogen rate was observed. As the nitrogen rate increased, lodging damage increased. Results for lodging to nitrogen are shown in Table 4.

Conclusion

The experiment was established in the recommended sowing time (late April) and received one autumn and one spring irrigation. Under these conditions, this experiment demonstrated that Hyola 575CL, Diamond and Hyola 577 where the highest yielding varieties. With a total of 3.7 megalitres (ML) applied as irrigation and rainfall, the experiment demonstrated an irrigation efficiency of 0.78 t/ML.

In the other 2015 Murrumbidgee canola experiment at Leeton (reported in *Farmers' Newsletter* No. 194), there was a higher average grain yield of 3.80 t/ha, but with a higher water usage, the irrigation efficiency for that trial was lower at 0.70 t/ML. From these trials, growers can work on a range of 0.7–0.8 t/ML for crop budgeting.

Nitrogen treatments had a significant effect on yield results. With one autumn and one spring irrigation, this experiment had a yield average of 2.88 t/ha. Under these conditions, this trial demonstrated that a nitrogen application rate above 200 kg N/ha can lower yield, lower oil content and increase lodging damage.

Previous research has shown that when targeting higher yields (i.e. geater than 4.0 t/ha), water application needs to be increased as well as increasing nitrogen application. It is estimated that at least an extra 1.0 ML/ha of water and 50 kg/ha of nitrogen needs to be applied when increasing the yield target from 3.0 to 4.0 t/ha.

No yield penalty was observed when the applied nitrogen application rate was lowered to 150 kg N/ha. A yield increase of 4.6% was observed when splitting the 200 kg N/ha nitrogen application rate and delaying 25% of the total rate to be applied at the visible bud stage.

The overall incidence of lodging in this experiment was low. The most susceptible variety only had a lodging score of less than 3.0. The experiment demonstrated that increasing the applied nitrogen rate above 150 kg N/ha at sowing, increased the incidence of crop lodging. With the low level of lodging, it is unlikely lodging would have had any impact on yield.

Acknowledgements

This research is part of the *Irrigated Cereal and Canola Varieties Achieving Target Yields* (DAN00198) project, which is jointly funded by GRDC and NSW Department of Primary Industries. The co-operation of Wendy and Ken Brain for allowing the trial to be conducted on their property is gratefully acknowledged. The support of Gabby Napier and Michael Hately for assistance with trial management, field assessments and data collection is also gratefully acknowledged.

Further information

Tony Napier
Research & Development Agronomist – Southern Cropping Systems
M: 0427 201 839
E: tony.napier@dpi.nsw.gov.au

Daniel Johnston topdressing canola plots with urea in July 2015.

The canola experiment with the first few varieties just beginning to flower in July 2015.

The experiment (and the surrounding co-operator's crop) at full flowering in September 2015.


Aerial view of the crop sequencing for double cropping trial at Leeton Field Station, August 2014.

CROP SEQUENCING FOR IRRIGATED DOUBLE CROPPING

QUICK TAKE

- Cotton, as a single crop, had a much higher gross margin return per hectare and per megalitre than any other single commodity. This was due to a combination of high yield and high price in the season of the experiment.
- The crop sequence of fallow/cotton/faba bean/fallow produced a higher gross margin return per hectare and per megalitre than any other cropping sequence.
- The canola/maize/faba/fallow sequence had the second highest gross margin return per hectare while the wheat/fallow/wheat/fallow sequence had the lowest gross margin return per hectare.

NOTE: Commodity prices have changed considerably since writing this report and so make allowance for this when comparing gross margins.

The evaluation of crop sequences for double cropping will provide information to enable irrigators to capitalise on their investment in irrigation infrastructure and farming systems.

Tony Napier[1], Luke Gaynor[2], Daniel Johnston[1], Glenn Morris[1] and Michael Rollin[3]
[1]NSW Department of Primary Industries, Yanco
[2]NSW Department of Primary Industries, Wagga Wagga
[3]NSW Department of Primary Industries, Orange

This article has been adapted from a paper presented at GRDC Grains Research Updates Griffith 27 July 2016 and Moama 28 July 2016.

THE crop sequencing project aimed to identify and address some of the potential difficulties with double cropping systems, where a winter crop is grown directly after a summer crop (or vice versa). The project has addressed issues of herbicide residues, irrigation layouts and management, and stubble management, and quantified achievable crop yield and profitability.

Table 1. Summary of the seven treatments evaluated in the crop sequencing experiment at Leeton Field Station

Season/year	Treatment						
	T1	T2	T3	T4	T5	T6	T7
Winter 2014	Fallow	Fallow	Fallow	Wheat	Wheat	Barley	Canola
Summer 2014–15	Soybean	Soybean	Cotton	Soybean	Fallow	Soybean	Maize
Winter 2015	Fallow	Fallow	Faba bean	Wheat	Wheat	Barley	Faba bean
Summer 2015–16	Maize	Soybean	Fallow	Soybean	Fallow	Soybean	Fallow

The project had two core sites, one at Boort in northern Victoria and the other at Leeton Field Station in southern New South Wales. The Victorian site focused on the technical aspects of double cropping, including herbicide options and stubble management, and the NSW site focused on different cropping sequences to quantify achievable crop yield and profitability. This article reports on the Leeton experiment.

The experiment

The trial site was established at Leeton Field Station in a field with a history of irrigated lucerne. The paddock was formed into 1.83 metres wide beds suitable for furrow irrigated cropping. The crop sequencing started in early 2014 with a winter cropping or fallow phase. The project ran for two years (four cropping seasons) ending in mid-2016 with the harvest of the second summer cropping phase.

The trial included both single cropping (one crop per year) and double cropping (two or three crops in two years) treatments. The experiment had seven treatments with four replications of each treatment (Table 1). Each plot was three beds wide by 120 m long, giving a total plot area of 660 m^2 and a treatment area of 0.264 ha. There was a fallow buffer area of one bed between each plot.

Table 2 shows the commodity prices (ex GST) used in the gross margin analysis. Most prices were sourced from the Igrain website for the 2014–15 season. Commercial prices were sourced from retailers or contractors for the cost of chemicals, fertilisers and contract harvesting. Some cotton costs were sourced from the NSW DPI 2014–15 cotton gross margin budgets for southern NSW. Commodity prices and variable input costs were kept consistent over both years to ensure the final results were not impacted by using inconsistent sources of input data across seasons.

Treatment description and results

Treatment one (T1)

The 2014 winter phase was left as fallow.

The 2014–15 summer phase was sown with Djakal soybeans 20 November 2014, irrigated with 8 ML of water and harvested 5 May 2015 with a yield of 3.09 t/ha.

The 2015 winter phase was left as fallow.

The 2015–16 summer phase was sown with P1756 maize 7 October 2015, irrigated with 10 ML of water and harvested 22 March 2016 with a yield of 13.4 t/ha.

Treatment two (T2)

The 2014 winter phase was left as fallow.

The 2014–15 summer phase was sown with Djakal soybeans 20 November 2014, irrigated with 8 ML of water and harvested 5 May 2015 with a yield of 3.36 t/ha.

The 2015 winter phase was left as fallow.

The 2015–16 summer phase was sown with Djakal soybeans 26 November 2015, irrigated with 7 ML of water and harvested 6 April 2016 with a yield of 3.09 t/ha.

Table 2. Summary of commodity prices used

Commodity	Price
Wheat – APW	$258 per tonne
Barley	$241 per tonne
Canola – no grade	$449 per tonne
Soybean – no grade	$512 per tonne
Maize – feed	$287 per tonne
Cotton lint	$500 per bale
Cotton seed	$300 per tonne
Faba beans	$450 per tonne

The crop sequencing project at Leeton Field Station, August 2015.

Irrigation of cotton, with wheat fallow (left) and maize (right).

Treatment three (T3)

The 2014 winter phase was left as fallow.

The 2014–15 summer phase was sown with Sitcot 71 cotton 1 October 2014, irrigated with 10 ML of water and harvested 29 April 2015 with a yield of 13.95 bales/ha.

The plots were cultivated and prepared for the 2015 winter phase with faba beans sown 22 May 2015. The faba beans were irrigated with 3.1 ML of water and harvested 9 December 2015 with a yield of 4.52 t/ha.

The 2015–16 summer phase was left as fallow.

Treatment four (T4)

The 2014 winter phase was sown to Dart wheat 23 May 2014 but due to poor establishment, the crop was re-sown 20 June 2014. The wheat was irrigated with 3.5 ML of water, harvested 11 December and achieved a yield of 5.25 t/ha.

The wheat stubble was burnt and the 2014–15 summer phase of Djakal soybeans was direct seeded 16 December 2014. The soybeans were irrigated with 7 ML of water and harvested 21 April 2015 with a yield of 2.79 t/ha.

The plots were cultivated and prepared for the 2015 winter phase with Corack wheat sown 16 May 2015. The wheat was irrigated with 3.1 ML of water and harvested 23 November 2015 with a yield of 6.64 t/ha.

The 2015–16 summer crop was sown with Djakal soybeans 26 November 2015, irrigated with 7 ML of water and harvested 5 April 2016 with a yield of 2.69 t/ha.

Treatment five (T5)

The 2014 winter phase was sown to Dart wheat 23 May 2014 but due to poor establishment, the wheat was re-sown 20 June 2014. The wheat was irrigated with 3.5 ML of water and harvested 12 December with a yield of 5.17 t/ha.

The 2014–15 summer phase was left as fallow.

The 2015 winter phase was sown to Suntop wheat on 16 May 2015, irrigated with 3.1 ML of water and harvested 1 December 2015 with a yield of 7.01 t/ha.

The 2015–16 summer phase was left as fallow.

Treatment six (T6)

The 2014 winter phase was sown to Scope barley 23 May 2014, irrigated with 3.5 ML of water and harvested 29 November 2014 with a yield of 4.19 t/ha.

The barley stubble was burnt and the 2014–15 summer phase of Djakal soybeans was sown 2 December 2014. The soybeans were irrigated with 7.5 ML of water and harvested 21 April 2015 with a yield of 2.79 t/ha.

The plots were cultivated and prepared for the 2015 winter phase with Spartacus barley sown 18 May 2015. The barley was irrigated with 3.1 ML of water and harvested 18 November 2015 with a yield of 6.11 t/ha.

The 2015–16 summer phase was sown with Djakal soybeans 26 November 2015, irrigated with 7 ML of water and harvested 5 April 2016 with a yield of 2.86 t/ha.

Treatment seven (T7)

The 2014 winter phase was sown to Hyola 50 canola 16 May 2014, irrigated with 3.0 ML of water and harvested 13 November 2014 with a yield of 3.44 t/ha.

The 2014–15 summer crop of Pioneer P0012 maize was direct seeded on 21 November 2014. The maize was irrigated with 9 ML of water and harvested 21 April 2015 with a yield of 9.75 t/ha.

The plots were cultivated and prepared for the 2015 winter phase with faba beans sown 22 May 2015. The faba beans were irrigated with 3.1 ML of water and harvested 9 December 2015 with a yield of 4.57 t/ha.

The 2015–16 summer phase was left as fallow.

Table 3. Gross margin return per hectare ($/ha) for each crop in the crop sequencing experiment at Leeton Field Station

Season/year	Treatment						
	T1	T2	T3	T4	T5	T6	T7
Winter 2014	Fallow —	Fallow —	Fallow —	Wheat $540	Wheat $521	Barley $299	Canola $566
Summer 2014–15	Soybean $903	Soybean $1000	Cotton $4766	Soybean $863	Fallow —	Soybean $962	Maize $1275
Winter 2015	Fallow —	Fallow —	Faba bean $1467	Wheat $790	Wheat $907	Barley $785	Faba bean $1515
Summer 2015–16	Maize $2111	Soybean $971	Fallow —	Soybean $844	Fallow —	Soybean $931	Fallow —

Table 4. Gross margin return per megalitre ($/ML) for each crop in the crop sequencing experiment at Leeton Field Station

Season/year	Treatment						
	T1	T2	T3	T4	T5	T6	T7
Winter 2014	Fallow —	Fallow —	Fallow —	Wheat $154	Wheat $149	Barley $85	Canola $189
Summer 2014–15	Soybean $113	Soybean $125	Cotton $477	Soybean $123	Fallow —	Soybean $128	Maize $142
Winter 2015	Fallow —	Fallow —	Faba bean $473	Wheat $255	Wheat $293	Barley $253	Faba bean $489
Summer 2015–16	Maize $211	Soybean $139	Fallow —	Soybean $121	Fallow —	Soybean $133	Fallow —

Inter-row cultivation of maize at the experimental site.

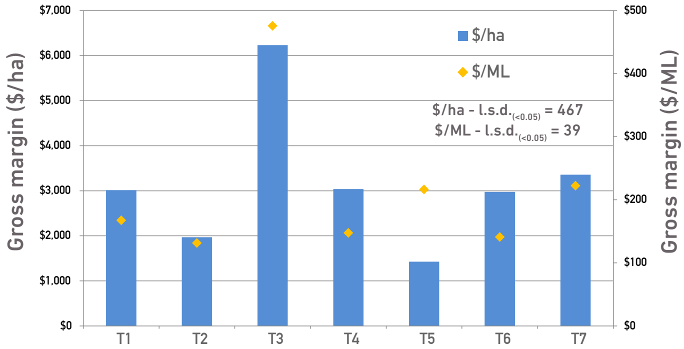


Figure 1. Gross margin return over two years from the crop sequencing experiment at Leeton Field Station

Cropping phase results

In the first cropping phase (Winter 2014), all treatments had a relatively low gross margin return for both $/ha and $/ML. The low returns were due to low yields for the cereal crops and a low commodity price for canola.

In the second cropping phase (Summer 2014–15), the cotton treatment had the highest gross margin return for both $/ha and $/ML. The very high returns resulted from a high yield and a high commodity price. The gross margin return for the cotton treatment was over 300% higher than the gross margin return for the maize treatment, which had the second highest returns for both $/ha and $/ML. The soybean treatments suffered some early flowering moisture stress, which likely reduced yield potential.

In the third cropping phase (Winter 2015), the faba bean treatments had the highest gross margin returns for both $/ha and $/ML. The gross margin return for the faba bean treatments were over 60% higher than the gross margin return for all the other cropping treatments in that cropping phase.

In the fourth cropping phase (Summer 2015–16), the maize treatment had the highest gross margin return for both $/ha and $/ML. The maize gross margin for $/ha was over 100% higher than all other treatments, while the maize gross margin for $/ML was over 50% higher than all other treatments.

Cropping sequence results

The fallow/cotton/faba bean/fallow sequence (T3) had the highest gross margin return for both $/ha and $/ML. The high gross margin return for T3 resulted mainly from a high cotton yield (13.95 bales/ha) in summer 2014–15 and the high commodity price. The T3 gross margin per hectare results were at least 85% higher than all other rotations and at least 110% higher per ML. The T3 sequence also included a faba bean crop in winter 2015 that had a high gross margin result, which was second only to another faba bean crop (T7) in that particular season. The T3 rotation also used less water than most other treatments except the wheat/fallow (T5) sequence, which is reflected in the very large gross margin per ML result.

The canola/maize/faba bean/fallow sequence (T7) had the second highest gross margin return for both $/ha and $/ML. The T7 rotation included three crops back-to-back, concluding in a summer fallow. The highlight of this rotation was the faba bean crop in winter 2015 which had the highest gross margin of the crops in this sequence as well as the highest gross margin of all the winter 2015 treatments. This was in part due to a very good yield from the faba bean crop (4.57 t/ha). The previous T7 maize crop in summer 2014–15 also had a comparatively high gross margin for both $/ha and $/ML despite the relatively low yield. The T7 rotation resulted in increased income compared with some treatments, partly due to the fact that it produced three crops, while some other rotations only had two crops. It is also noted that the water use in T7 was comparatively low at 15.10 ML/ha in total.

Other rotation results that compared favourably on a gross margin per hectare basis, and were not much lower than that of T7, were the sequences that produced four crops in the rotation period. These were the barley/soybean/barley/soybean (T6) and wheat/soybean/wheat/soybean (T4) sequences. The T4 and T6 rotations resulted in comparatively good cumulative gross margin results, ranging from $3,037/ha to $2,977/ha. There was variation noted between the gross margin results for T4 and T6 in individual years.

The wheat/fallow/wheat/fallow (T5) sequence had the lowest gross margin return on a per hectare basis with a return of only $1,428/ha over the two years. Even though this sequence had the lowest gross margin for $/ha, it had a much better gross margin return on a per megalitre basis with $216/ML.

Conclusion

This data is useful to compare gross margin per hectare for land use and water use across years. Outside the cotton effect, there is useful information and trends within this data. The T5 effect is of interest, as whilst it had the lowest gross margin per hectare for land use, it was one of the best for gross margin per megalitre for water use. This implies that if water is limited, growers need to seriously consider increasing the proportion of winter crops within their rotation and using summer fallows as a break. In contrast, if water is plentiful and of low cost, a more summer crop dominant rotation could be more profitable.

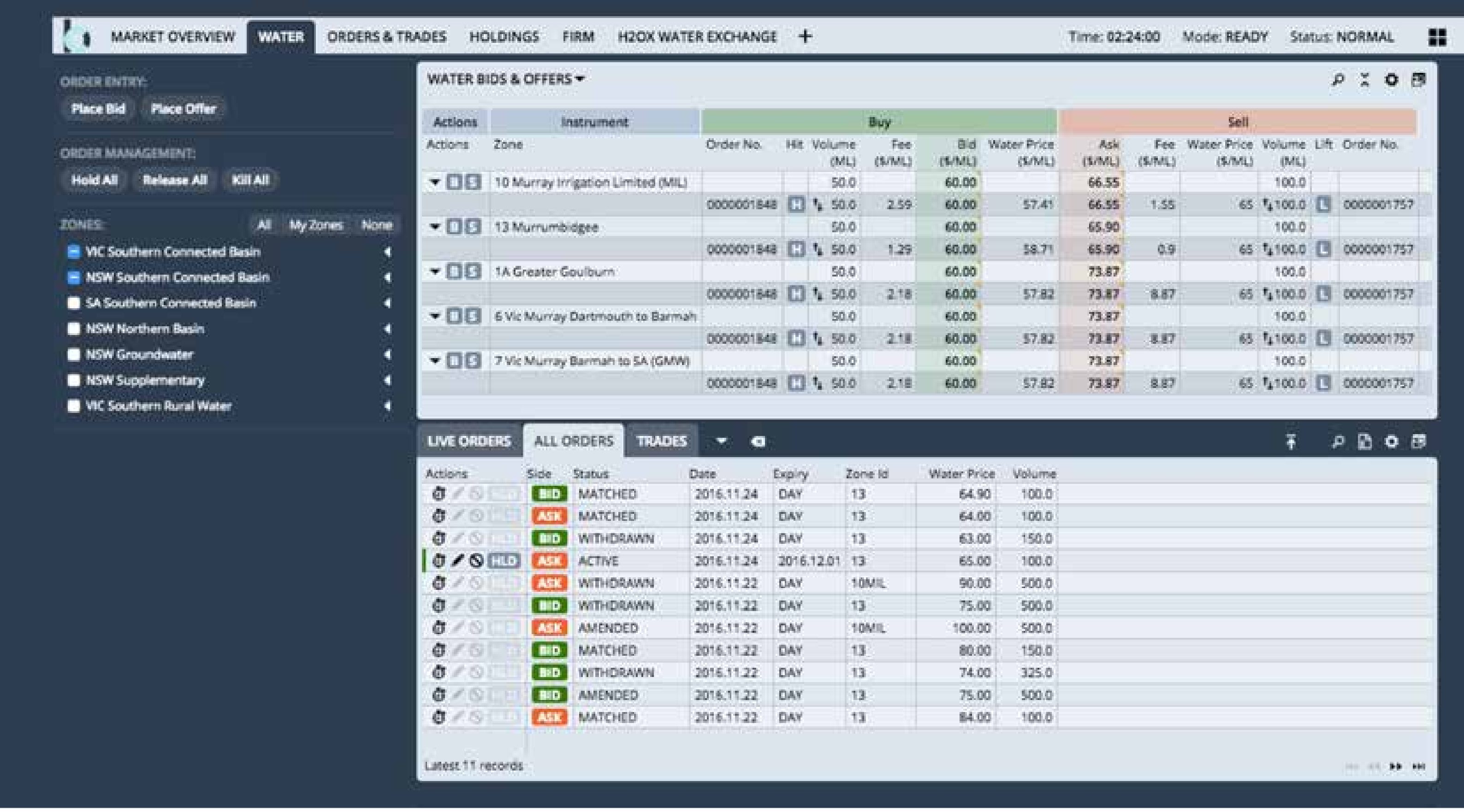
Growers need to fully understand the influence of commodity price, water cost and inputs costs on their overall farm profitability. This study aimed to help develop a realistic foundation for a decision support tool to be developed to account for variances in the fore-mentioned price variables.

Acknowledgements

The research is part of the *Correct Crop Sequencing for Irrigated Double Cropping project* (GRDC project VIC00010 2014–2016) jointly funded by NSW DPI, ICC and GRDC. The support of Alan Boulton and Paul Morris for field work and data collection is gratefully acknowledged. The support of Fiona Scott and Rajinder Pal Singh for economic analysis is also gratefully acknowledged.

Further information

Tony Napier
T: 02 6951 2796
E: tony.napier@dpi.nsw.gov.au



STRATEGIES AND PRODUCTS TO MANAGE MARKET WATER

QUICK TAKE

- Water markets have changed fundamentally in recent years, with a reduction of water available for irrigation in the Murray–Darling Basin and the separation of land and water titles.
- Recent seasonal changes have shown the benefit of a consistent carryover strategy that enables irrigators to average out the benefits of access to water and take advantage of good prices for later years of low water availability.
- 'Parking' carryover provides irrigators with an opportunity to obtain more water, at low prices, than is possible against their own entitlements.
- Irrigators can manage risk of water availability by diversifying the types of entitlement held, and using different types of water products.
- Irrigators with a good water availability strategy are likely to secure more water than those with an inflexible approach.

Irrigators need to be prepared to effectively manage the risks associated with availability of water. This season showed how quickly availability and temporary markets change.

Jack Bennetto[1] and Andrew Bomm[2]
[1]H2OX, Bendigo; [2]Progressive Agriculture, Wagga Wagga

SOME useful observations about water markets can be made, not only as we come out of a dry season and into a wet one in the southern Murray-Darling Basin but also in view of institutional and organisational changes to irrigation water. Two main supply and demand factors have changed permanently in the last decade.

Changed market fundamentals

Everyone is aware of the Basin Plan and the volume of water that has been shifted from production to environmental use. Some small volumes of this water may be traded back to production on occasion but in practice this water is no longer available to irrigators, so supply has been reduced by about a quarter.

Equally significant has been the separation of land and water titles. Water is now much more mobile and this has had a significant effect on demand. Water is moving more easily to crops with high commodity prices, and new irrigated cropping areas are spreading water demand to even more hectares of country. Nut plantings in particular are expanding rapidly in response to high commodity prices, and this continues to increase demand and price in water markets.

Have a carryover strategy

Carryover strategies aren't straightforward but irrigators should have a consistent one. Current water allocations throw up some stark lessons about carryover strategies from one year to the next.

Many irrigators carried over substantial volumes of water into the 2016–17 season. In the Murrumbidgee Valley, average carryover against general security entitlement was 19%. In the NSW Murray, it was 27%. With Murrumbidgee temporary water prices around $200/ML, and water in the NSW Murray around $260/ML, these high carryover statistics surprised many people.

When assessing a carryover strategy, averages are a good place to start. If the allocation is well below average and prices well above, the odds are that the situation will move in the other direction next year. It may not, but the odds are more in favour of a swing back. Likewise, if allocation is high and prices are low, it's a better bet that it's not going to stay as good next year. Water agencies will always be conservative in the inflow forecasts they provide to the market, and these shouldn't be relied on too heavily when developing risk management strategies.

Although we couldn't predict the incredible turnaround we've seen this year, even managing a carryover strategy assuming average conditions would have seen irrigators best positioned. Many irrigators carried over water while buyers were in the market paying over $200/ML. For some, carryover assisted winter crop production, even though few would purchase water at that price for that use. Last year (2015–16) was one of the worst years for inflows on record.

There are no restrictions to carrying over cash instead of water. Irrigators are always free to get back into the water market the next year to secure production, or stay out if gross margin returns don't justify it. Had average inflows occurred over this winter and spring, the price would still have been less expensive this year than it was in autumn. Selling water in that situation and securing needs for the following year would have provided more megalitres for irrigators and minimised their risk of account spill. As it happened, the weather turned strongly and those who off-loaded carryover and bought back in, enjoyed a windfall.

Parking carryover is sought this year

A lot of irrigators will be in the market this season trying to lock in as much carryover water as possible. Many will be looking to buy temporary water and carryover more than the limits against their entitlement by parking some of their water on other irrigators' licences. These arrangements are currently offered on a $/ML basis, negotiated by water brokers on behalf of irrigators with carryover space on their licence. This year, the price for carryover parking space is currently around $30/ML, though it is usually less in drier years.

These arrangements are regularly made between irrigators known to each other, on an informal basis. It's one of the things that makes it so hard for people analysing water markets to get reliable price data!

There is also an opportunity for irrigators to manage their own parking arrangements by owning licences with generous carryover provisions. An option many irrigators are looking at is Victorian low reliability licences, which allows 100% allocation against entitlement. These licences don't get allocation against them on a regular basis — only when needs for the following year's high reliability Victorian licences have been met. They may receive an allocation next year under average inflow conditions. The price for Victorian low reliability licences is currently around $250/ML, reflecting the market's view about the value of occasional allocations and use for parking space in wet years.

A new floor under prices

One of the other key lessons we can draw from this season is that even with maximum storage supply, it appears unlikely that water will again sit at very low prices for sustained periods across the season. Although prices in the NSW Murray and Murrumbidgee did fall to $50/ML and below, it was brief and only under remarkable circumstances.

In a very wet early October, the market was very uncertain about how much cotton and rice was going to be planted. Large downgrades in summer crop plantings would have reduced demand in the market from producers. However, the rain stopped and production will be high this year, as it normally is in times of full allocation. The market now knows there are good crop plantings and the price has rebounded in the Murrumbidgee and Murray valleys. In a full allocation year with the wettest September on record, current prices have caused the market to re-think what it considers to be a floor price.

Diversification strategies

Seasonal croppers can maximise their opportunities for securing water by diversifying allocation risk, rather than relying only on annual allocations against their licence. For example, instead of holding 2000 ML of Murrumbidgee general security entitlement, an irrigator in the MIA might hold 1000 ML on this licence, plus a spread of NSW general security and Victorian high reliability water. Some cotton and rice farmers even hold parcels of local or interstate high security water. This strategy spreads the risk for irrigtors if one valley has availability well below other valleys.

Trade restrictions present risks

Irrigators face risk when diversifying their water portfolio. The main challenge is the ability to shift this water into the valley where it's needed for production. Trade restrictions between trading zones can come into force when natural system constraints prevent the further transfer of water from one part of the system to another.

This season, several trade restrictions were in place and water was difficult to move. The ability for Murrumbidgee irrigators to sell into the NSW Murray was restricted, causing higher prices in other parts of the system. Trade from upstream to downstream of the Barmah Choke has also been restricted, though Menindee now contributing to the overall resource will help. The restriction has created a price premium for water downstream of the Barmah Choke.

If water can't be moved due to trade restrictions, then a sale and re-purchase in a different valley may add to the cost of water.

Different water supply products

Instead of holding entitlement, there are currently two main options for securing supply ahead of seasons, and there are some new innovations on the way.

Forward water allows irrigators to lock in a guaranteed volume (ML) of supply for the next season, a product generally offered to the market by high security water holders. It can also be taken up for longer terms. Forward water is basically a one-off parcel of high security water for a set period. There's often a premium paid on this relative to temporary market purchasing, though it can represent good insurance for those with forward cropping contracts.

The other option is *leasing entitlement* for a set period. The lessee bears the risk of low allocations, but it can be a well-priced product for those without the equity to secure entitlement. In the current investment climate of low returns, investors are potentially responsive to 5% returns. This would place an entitlement lease in the NSW Murray at about $65/ML and about $70/ML in the Murrumbidgee.

Further information

Jack Bennetto
T: 1800 988 118
E: jack.bennetto@h2ox.com

MORE INFORMATION AT YOUR FINGERTIPS

IREC has a long and proud history of taking on the challenges of the time for irrigators. The ability to do this also means the organisation has to move with the times.

Iva Quarisa
Executive Officer, IREC

THE past 12 months have been hectic with a number of changes for IREC. In addition to strengthening our partnerships, IREC has also made some administrative improvements, one of which is making the *IREC Farmers' Newsletter* available in digital format.

This summer edition of the *IREC Farmers' Newsletter* is the second in a digital format and we are still finding the best fit. All feedback would be greatly welcomed as we want to ensure the best reading experience for you, our members and readers.

Along with the move of the *IREC Farmers' Newsletter* into the digital age, you may have noticed IREC has reinvigorated its logo and website.

We believe the IREC website is now easier to navigate while still housing a wide range of valuable information.

Our calendar of events is a new addition to the website. This calendar not only lists all relevant industry activities throughout the year but also provides details of upcoming IREC events.

Another important feature on the website is the resource tab. This not only links to the latest and past editions of the *IREC Farmers' Newsletter* but it also links to various crop and industry publications, videos and organisations, as well as Upstream News.

Upstream News is the IREC bi-monthly electronic newsletter which is sent to all IREC members. The aim of Upstream News is to keep you in the loop on IREC-related activities, research, events and partnerships — in a succinct, easy-to-read format.

We hope these improvements to the way IREC communicates with members makes accessing information easier for you, as well as adding value to your membership of IREC. Your feedback and thoughts on how we can continue to improve are always very welcome.

Further information

Iva Quarisa
T: 02 6963 0936
E: iva@irec.org.au

IREC Executive Committee

IREC Chairman	Rob Houghton	0428 559 249	roberthoughton50@hotmail.com
IREC Deputy Chairman	Kieran O'Keeffe	0427 207 406	kieran.okeeffe@cottoninfo.net.au
Executive Officer	Iva Quarisa	0402 069 643	iva@irec.org.au
Secretary	Hayley Wordsworth	02 6963 0936	irec@irec.org.au
Cropping and Water Management Subcommittee	vacant		
Horticultural Crops/Permanent Plantings Subcommittee	vacant		
Vegetable Industry	vacant		
Griffith & District Citrus Growers	Carmel La Rocca	0412 811 343	
Leeton District Citrus Growers	Sam Ciccia	02 6955 6441	
Wine Grapes Industry	Eric Berton	0427 630 175	efvberton@bigpond.com
Rice R&D Committee	Drew Braithwaite	02 6963 4204	dbraith@me.com
Ricegrowers' Association of Australia	Rachel Kelly	02 6953 0433	rkelly@rga.org.au
Ricegrowers' Ltd. (SunRice)	Alan Walsh	03 5882 4330	walsh6@ozsky.net
Maize Industry	Bernie Walsh	0427 478 227	walshfarms@bigpond.com
Cotton Industry	Kieran O'Keeffe	0427 207 406	kieran.okeeffe@cottoninfo.net.au
Murrumbidgee Irrigation	Lindsay Golsby-Smith	02 6962 0200	lindsay.golsby-smith@mirrigation.com.au
Coleambally Irrigation	Bernard Star	02 6950 2839	bstar@colyirr.com.au
Charles Sturt University	vacant		
Deakin University	John Hornbuckle	0429 862 920	j.hornbuckle@deakin.edu.au
NSW Department of Primary Industries	Deb Slinger	0427 026 207	deb.slinger@dpi.nsw.gov.au
Murrumbidgee Private Irrigators Inc.	Iva Quarisa	0402 069 643	ivaquarisa@gmail.com
Riverina Local Land Services	Anna Wilson	0428 964 785	anna.wilson@lls.nsw.gov.au

Advertisers Index