no 192, autumn 2015

IRRIGATION RESEARCH & EXTENSION COMMITTEE

farmers' newsletter

large area edition

IN THIS EDITION

Winter crop planning

Wheat variety performance in irrigated NVT trials 6

High yielding wheat trials to determine best management 10

High yielding canola trials to determine best management 14

Making the most of water

Canola irrigation — how often in spring? 16

Make the most of summer rains 20

Drainage of rice 22

High yielding winter crops — the best use of water? 24

Water savings through system upgrades 26

Information and technology

Opinion — Who's driving RD&E in the Murrumbidgee? 27

Drones in cropping surveillance 28

Rice extension website 30

Farming systems sustainability

Greenhouse gas submissions from rice 32

Keeping crop viruses at bay 37

Regular pages

Chairman's report 3

Executive Officer's report 4

IREC Executive Committee 40

Advertisers index 40

Administration & advertising

The IREC Farmers' Newsletter is published by the Irrigation Research & Extension Committee. It is distributed to irrigators and their advisors in the Lachlan, Murrumbidgee, Murray and Goulburn valleys. If you wish to subscribe to the Farmers' Newsletter, contact the IREC office.

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

IREC Office Manager: Hayley Wordsworth

IREC, C/ – CSIRO Land & Water, Private Mail Bag, Griffith 2680 NSW

P: 02 6960 1550 • 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, Spring 2015, to the editor by 17 July 2015.

The Editor: Lucy Kealey

IREC, C/ – CSIRO Land & Water, Private Mail Bag, Griffith 2680 NSW

P: 02 6238 3920 • M: 0417 043 982 • E: lucykealey@bigpond.com

Design & production

Richard Howell, TMLC Design. www.tmlc.com.au

Print

Blue Star Print – a Forest Stewardship Council, Chair of Custody certified company. All processes are controlled by an Environmental Management System, certified to ISO14001.

Photography

Cover photo: Benerembah farmer, Peter Salvestro, pulls the boards on a double stop in a newly laser -landformed paddock. Photo: Iva Quarisa

Unless indicated otherwise, all photographs are attributable to the author of the article in which the photograph appears.

Disclaimer:

Articles contributed to the IREC Farmers' Newsletter are prepared by experts or professionals in their field or by persons with extensive experience in the subject areas. Accordingly, these articles are accepted in good faith as being the most relevant and accurate information available at the time of publication. Information contained within this newsletter has not been independently verified or peer reviewed, and advice is given at the reader's risk.

Products or services may be identified by proprietary or trade names to help readers to identify particular types of products but this is not or intended to be an endorsement or recommendation of any product, manufacturer or service provider.

ISSN 0467 – 5282

CHAIRMAN'S REPORT

Welcome to the autumn edition of the IREC *Farmers' Newsletter.*

It seems nothing stays the same forever … and this is so true for an irrigation farmer. From one year to the next, from one season to the next, there are so many variables that make our job challenging. Big ticket items such as the variability of our weather, water availability, commodity prices and our health play a major role in our decision-making process, both long and short term.

Irrigate with technology

In the last one hundred years of irrigation in the MIA, we have seen incredible improvement in the way our crops are supplied with and drained of irrigation water. Today we have the technology to give the plant what it needs when it wants in order to get the most out of that plant — whatever the season throws at us.

We now have a vastly improved weather forecasting service that we can access on our phones, real-time moisture monitoring that we can view on our PCs, and automated irrigation systems that enable us to 'turn off' the tap when the field is ready, regardless of the time of day or night. With advances in the design of layouts, we can finish a crop to its optimum yield giving the 'best return per megalitre'.

The IREC field station is about to be developed into a 'key learning site' that, on completion, will demonstrate irrigation best practice and have the capacity to make valid comparisons between a 'roll over bank' side-delivery bankless channel layout, siphon layouts and subsurface drip systems. All aspects of the irrigation methodology on all systems will be measured and fully analysed. This work is critical to understand and manage flow rates in order to get the maximum benefit from our water, while minimising losses.

The subsurface drip and siphon layouts have been operational for some time with work commencing on the bankless layout this summer in readiness for the 2015–16 summer cropping season.

This season, we have cotton growing on the 'drip' portion of the station with some interesting trial work being carried out. I would like to thank Sandra McDougall and the DPI team for the work they have carried out on thrips in cotton; Kieran O'Keeffe of Cotton Info and Jorian Millyard of CSD for their ongoing support; and to James Hill and the Stott family for their commitment to seeing this site deliver on the outcomes mentioned.

Grow with information

This autumn edition of the *Farmers' Newsletter* is primarily winter crop focused. The GRDC National Variety Trials (NVT) included two irrigated sites in 2014 (reported on pages 6–9), which have come up with some staggering results. Achieving high yields is essential to gain a good return per megalitre and these trials will help us focus on what varieties we need to be growing and how to get the best out of them in terms of management. I hope the 'irrigated' NVT will continue in the MIA for many years to come. The three-year trial, *Southern Irrigated Cereal and Canola Varieties Achieving Target Yields,* will also deliver information specifically for irrigators — with wheat and canola trials being run to determine the best recommendations for managing irrigated crops, including sowing time, nitrogen management and plant density.

A big thank you to all who have contributed to this edition of the *Farmers' Newsletter* — it makes for a good read.

I would like to welcome *Southern Cotton* as IREC's Gold Sponsor for the coming twelve months. Their willingness to progress irrigated agriculture and rural communities generally is a credit to such a new local business. I would also like to thank *Rubicon* for coming on board as IREC's Bronze Sponsor. We are looking forward to working with you over the next twelve months to help ensure our irrigators are exposed to cutting edge, affordable irrigation technology.

I hope the summer crops deliver what they have promised this year.

Happy irrigating,

Rob Houghton

Chairman IREC

EO'S REPORT

It has been a busy summer for IREC with many activities across the region for irrigation farmers to attend.

The fact that these events have been very well supported indicates that irrigators' thirst for knowledge and skills has not diminished.

The irrigation layouts bus trips around Murrami/Whitton and Benerembah in September 2014 and Coleambally in February 2015 had many irrigators travelling long distances to attend. There is now a wide range of surface irrigation layouts in use, and to develop these (laser levelling) is an expensive exercise. If done incorrectly, you can not only blow a lot of money but there can also be negative impacts. When investing in new layouts, farmers want to make sure they get it right and are keen to see and learn more about the various options in order to make the best decision for their farming system.

The rice on beds farm walk at Benerembah in February 2015 was of particular interest. Growing rice successfully on this layout gives irrigators even greater flexibility within their farming businesses. Having an all-purpose irrigation layout allows irrigators to take advantage of fluctuating commodity prices, and be confident that they can grow any crop efficiently and achieve good yields.

IREC is very aware of the time demands these activities have on irrigators. Increasingly people are time poor and any time off the farm is valuable time away from the farming business.

It is our role to ensure your time spent at IREC functions is of utmost value to your farming business.

With this in mind, our aim has been to run highly relevant, timely activities. As such we have been focusing on short duration morning activities, so irrigators can get back to what makes them money — farming!

We also collaborate closely with all industry groups to avoid duplication and to ensure we don't over burden irrigators with activities and functions.

IREC is building strong relationships with different commodity groups including Cotton Australia, the Rice Extension team, Wine Grapes Marketing Board, the nut industry, and the maize industry; as well as financial institutions, Riverina Local Land Services and NSW DPI. IREC will continue to cooperate with these groups to run various field days at trial sites, farm walks and workshops.

Looking ahead, there are a number of irrigator-directed activities that IREC plans to hold as annual events. Such events include end of season crop walks (one each for both permanent plantings and broadacre annual crops), a Pre-season Summer Cropping Symposium, and research priority breakfasts.

We welcome input and ideas from our members and the wider irrigation industry, about future events and activities that IREC could organise.

Upcoming events

June 2015	Strategic Financial Planning Workshop
July 2015	Summer Cropping Symposium – 2nd week
	2015 GRDC Irrigation Update – 29 July
August 2015	IREC AGM – 10 August
	Lifetime Achievement Award Dinner
	Spring edition of the *Farmers' Newsletter*

Additional events may be added to the IREC Calendar after printing, so check IREC's website or follow IREC on Twitter and Facebook

Over 75 people attended the MIA layouts bus trip. All were keen to see system automation — this water control structure was designed to be controlled by an iPad.

In each edition of the *Farmers Newsletter* there will be a calendar listing the main events for the coming six months. Keep an eye on the calendar and IREC's website, and follow IREC on Twitter and Facebook to keep up with the latest.

Iva Quarisa

Executive Officer IREC

IREC Website: irec.org.au Facebook: irecnsw Twitter: IRECNSW

Gin with us in 2015

At Southern Cotton, we provide quality ginning for quality growers. The Cotton Club is a **new name** to describe your ginning contract. Just like your ginning contract, the Cotton Club offers a tiered ginning price structure – with additional benefits!

Cotton Club Membership benefits

Designed to strengthen partnerships with our growers, deliver competitive ginning rates, and provide education and mentoring pathways, Southern Cotton is pleased to offer four membership levels for growers in the Cotton Club program – **Platinum, Gold, Silver** and **Bronze**.

Why sign up?

By investing in the Cotton Club 12-month ginning program, growers can expect big benefits. For growers who sign up with Southern Cotton for three years, an additional loyalty discount applies across all membership levels. Become a Cotton Club member and enjoy exclusive benefits:

BENEFIT	BRONZE 0-3000 *Bales delivered*	SILVER 3000-7000 *Bales delivered*	GOLD 7-10K *Bales delivered*	PLATINUM 10K+ *Bales delivered*
Reduced ginning fee per bale / volume discount	$70	$69.50	$69	$68.50
3 year loyalty discount	$68.50	$68	$67.50	$67
REDUCED FREIGHT	**0-50km**	**50-100km**	**100-150km**	**150km+**
Radius discount $0-2	nil	$1	$1.50	$2

Southern Cotton
QUALITY SERVICE FOR QUALITY GROWERS

For more information on the Cotton Club, contact Kate O'Callaghan
Phone: 6955 2755 Email: kate.ocallaghan@southerncotton.com.au
southerncotton.com.au

** All Cotton Club membership levels are subject to terms and conditions in the ginning contract.*

IRRIGATED WHEAT VARIETY PERFORMANCE IN 2014

Peter Matthews

Technical Specialist Grain Services, NSW Department of Primary Industries, Orange

QUICK TAKE

- In 2014, the two irrigated sites of the National Variety Trials (NVT) were irrigated to maximise yield potential, rather than irrigated to supplement spring rainfall.
- Wheat yields at the Yenda and Mayrung sites averaged 8.0 and 7.5 t/ha, respectively.
- When selecting varieties to grow, the 2014 data for irrigated wheat varieties should be considered along with results from other irrigated wheat trials.
- The main factors to consider when selecting an irrigated wheat variety are yield potential, classification, maturity and standability (or lodging resistance of a variety).

With the cooperation and expertise of the site co-operators and use of soil moisture monitoring equipment, two irrigated sites of the National Variety Trials (NVT) averaged 8.0 and 7.5 t/ha in 2014.

In 2014, a shift was made in the irrigation management of the two NVT sites in southern NSW, at Yenda, east of Griffith, and at Mayrung, between Deniliquin and Finley. Previously the sites were managed on the basis of supplementary irrigation, with a target yield of five tonnes plus per hectare. Yield at these sites had varied over the previous four seasons, and was very dependent on spring rainfall, with site yields ranging from 4.0 to 6.0 t/ha.

With new high yielding germplasm coming through the wheat breeding programs and an increased focus on irrigated wheat agronomy in the southern irrigation areas, the yield bar was lifted to target site yields of seven tonnes or more per hectare. The 2014 season was tough with limited spring rainfall, meaning crop growth and yields were very dependent on timely irrigation. The Yenda and Mayrung sites averaged 8.0 and 7.5 tonnes/ha respectively.

For growers and agronomists, it is important to keep the 2014 results in perspective, as relying on a single year's data or one trial can provide an unbalanced picture of how a variety may perform over time. The information from 2014 needs to be added to past experience and trial results. Currently there is no separate grouping of irrigated trials in southern NSW for the NVT. Irrigated sites are combined with all the trials in south western NSW to provide an overall picture of varietal performance.

Earlier projects of CSIRO and NSW DPI investigated irrigated wheat variety performance of a large set of commercial varieties and unreleased breeding lines. Currently there is a project managed by NSW DPI, with funding support from GRDC, aiming to improve irrigated wheat crop management and performance in southern NSW (see article on pages 10–13). Growers should use the information from these projects and the NVT trials to make an assessment on the suitability of a wheat variety to their farming system.

NVT site management

Trial management for the 2014 trials used current best management practices targeting an eight tonne per hectare crop. Crop management data is shown in Table 1.

The layout of the two sites was slightly different with the Mayrung trial placed on a 'V' bay system and the Yenda trial on a bankless channel system. Irrigation scheduling in both systems was aimed at avoiding crop moisture stress but at the same time avoiding any periods of waterlogging.

The results for the irrigated NVT trials in 2014 are shown in tables 2, 3 and 4 for the durum, early season and main season trial sets. A large number of lines yielded above the mean site yield, with a number of newer wheat varieties showing promise under irrigation. Seven of the top 10 yielding lines in the Yenda main season trial, were also in the top 10 for Mayrung, highlighting the importance of viewing data from more than one site and if possible more than one year's data, when choosing a new variety.

Important factors

When choosing a variety for irrigated systems, growers need to consider a number of important factors:

1. yield potential, both per hectare and per megalitre
2. variety classification
3. variety maturity
4. standability or lodging resistance of a variety.

Yield and variety classification are linked and any increase in yield of some varieties may be offset by the drop in value from a change in varietal wheat classification (wheat quality). The change in wheat classification needs to be separated from delivery specifications such as protein levels. Protein levels can be manipulated by irrigation scheduling and nitrogen management, but an ASW or APW variety can never be delivered into an AH or APH pool.

Variety maturity is very important, as in most years grain filling will be in the hotter months of the year and any extreme temperatures will affect grain fill. Growers need to be mindful that even though water may not be limiting, heat stress at critical periods can be very damaging to grain formation and subsequent yields. Growers need to match variety maturity with the local environment and must also consider what water resources they have at the start of the season as to whether a crop can be fully irrigated or if only supplementary irrigation is possible.

Crop lodging is often a major constraint to getting the most out of irrigated crops. Lodging can reduce yield and quality, and increase costs through loss of header efficiency. Scores for standability at both Yenda and Mayrung highlighted the role of crop management and irrigation effects. Trials were scored at a similar time but there was a greater tendency for lodging at the Mayrung site. Highlighting variety differences and site differences for lodging were the varieties Sunvale and Yenda. At Mayrung, Sunvale and Yenda scored 3.2 and 8.2 respectively. Whilst at Yenda they scored 5.3 and 8.8 respectively. The Yenda site had less lodging. The value of having good resistance to lodging is reflected by the variety Yenda, as it had good standability even in a high risk situation for lodging. The Mayrung site had a bigger canopy early in the season, and began to lodge earlier than the Yenda site. The other contributing factor may have been the late irrigation of the Mayrung trials. The photos show the level of crop lodging at Mayrung, with some varieties flat on the ground, and others showing little effect.

For more information on the performance of wheat varieties on irrigation in this or past seasons go to the NVT website **www.nvtonline.com.au** or talk to your local agronomist.

Acknowledgement

I would like to thank Paul Moon at Yenda and Harry Kooloos at Mayrung for managing the sites and the irrigation scheduling as the great results achieved would not have been possible without their cooperation.

Further information

T: 02 6391 3198
M: 0427 007 395
E: peter.matthews@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au/agriculture/field

Crop lodging at the Mayrung NVT wheat site in 2014. The left picture is a breeding line with good standability (score 8–9), compared with a line, pictured on the right, of poor standability (score of 1–2). Varieties were rated on a scale of 1 to 9, 1 being flat on the ground and 9 standing upright.

Table 1. Fertiliser and irrigation management for NVT irrigated wheat sites, Yenda and Mayrung 2014

	Yenda		Mayrung	
Fertiliser	Date	kg/ha	Date	kg/ha
MAP pre-sowing	13 May	95	1 May	95
MAP sowing	13/14 May	80	1 May	80
Urea pre-sowing	13 May	70	1 May	70
Urea in-crop 1	7 Jul	150	3 Jul	150
Urea in-crop 2	12 Aug	150	11 Aug	200
Irrigation	Date	ML/ha	Date	ML/ha
	12-Aug	1.0	15-Aug	0.6
	17-Sep	1.0	24-Sep	0.6
	17-Oct	1.0	16-Oct	0.6
	—	—	3-Nov	0.6

Table 2: Results for durum, NVT irrigated wheat site, Yenda 2014

Variety	Yenda				
	Grain yield t/ha	Yield % site mean	Protein %	Screenings (<2.0mm) %	Standing score[a]
Caparoi	8.39	103	12.5	0.1	5.8
DBA-Aurora	8.95	110	11.6	0.2	3.7
EGA Bellaroi	8.16	101	13.1	0.1	8.3
Hyperno	8.5	105	12.1	1.3	1.5
Jandaroi	7.56	93	13.2	0.1	2.3
Tjilkuri	8.13	100	12.1	0.4	8.0
Site mean (t/ha)	8.1	CV (%)	1.92	Probability	<0.001
LSD (t/ha)	0.28	LSD%	3	Sowing	14/05/2014 Harvest 02/12/2014

Table 3: Results for early season, NVT irrigated wheat sites, Yenda and Mayrung 2014

Variety	Yenda					Mayrung				
	Grain yield t/ha	Yield % site mean	Protein %	Screenings (<2.0mm) %	Standing score[a]	Grain yield t/ha	Yield % site mean	Protein %	Screenings (<2.0mm) %	Standing score[a]
Adagio	7.68	96	12.5	3.5	9.0	8.22	111	11.5	0.3	8.5
Bolac	7.71	96	13.1	1.7	8.2	7.2	97	12.1	2.0	6.0
Chara	8.13	102	12.8	2.2	8.0	7.25	98	12.0	0.4	4.5
EGA Bounty	7.95	99	12.8	0.3	5.8	7.50	101	11.7	0.3	2.0
EGA Gregory	7.76	97	12.6	0.9	7.2	7.10	96	11.4	0.4	2.8
EGA Wedgetail	7.68	96	13.2	0.7	8.2	7.55	102	11.8	0.6	7.2
Estoc	8.21	103	13.7	2.3	8.2	7.48	101	12.0	0.4	5.0
Forrest	8.02	100	12.7	0.5	7.8	7.32	99	11.0	0.5	5.2
Gascoigne	8.23	103	12.7	0.5	7.5	7.45	101	12.1	0.3	3.5
Gauntlet	7.32	92	13.1	2.5	7.5	6.80	92	11.6	1.1	4.7
Gazelle	8.08	101	11.4	0.2	8.5	7.56	102	10.8	0.2	4.7
Kiora	8.63	108	12.6	1.2	8.5	7.85	106	11.1	0.9	5.8
Lancer	7.98	100	13.4	0.3	8.2	7.40	100	11.8	0.4	4.7
Mitch	7.91	99	11.2	0.2	6.7	7.59	102	10.9	0.3	3.3
QAL2000	8.82	110	10.8	0.4	7.7	7.58	102	10.3	0.3	3.7
Scenario	6.73	84	12.7	2.8	9.0	7.62	103	11.6	0.3	9.0
Strzelecki	7.00	88	13.0	0.4	6.7	6.42	87	11.7	0.4	3.8
Sunguard	7.41	93	12.4	0.4	6.7	7.09	96	12.0	0.3	2.2
Suntop	8.19	103	12.4	0.8	8.1	7.64	103	11.4	0.7	4.7
Sunvale	7.04	88	13.3	0.3	5.5	6.95	94	13.0	0.3	1.3
Sunzell	7.94	99	13.4	0.3	7.0	6.71	91	11.8	0.3	5.8
Trojan	9.06	113	12.6	0.4	8.7	7.55	102	11.3	0.3	5.3
Viking	8.45	106	12.0	0.9	7.8	7.29	98	11.4	0.3	2.5
Site mean t/ha	7.99					Site mean t/ha	7.41			
Probability	<0.001	CV (%)	3.24			Probability	<0.001	CV (%)	3.58	
LSD (t/ha)	0.44	LSD %	6			LSD (t/ha)	0.44	LSD %	6	
Sowing	13/05/14	Harvest	05/12/14			Sowing	01/05/14	Harvest	13/12/14	

National Variety Trials
A GRDC INITIATIVE

[a] Standing score: 9 – standing, 1 – flat; standing scores are mean values of visual ratings.

Table 4: Results for main season, NVT irrigated wheat sites, Yenda and Mayrung 2014

Variety	Yenda					Mayrung				
	Grain yield t/ha	Yield % site mean	Protein %	Screenings (<2.0mm) %	Standing score[a]	Grain yield t/ha	Yield % site mean	Protein %	Screenings (<2.0mm) %	Standing score[a]
Barham	7.32	91	12.2	0.2	7.8	6.32	84	11.1	0.3	3.7
Chara	8.15	101	12.8	0.7	8.3	7.79	103	11.6	0.3	6.7
Cobra	9.15	113	12.8	0.2	7.7	8.72	116	10.8	0.2	7.7
Condo	8.08	100	12.8	0.2	6.7	7.68	102	11.3	0.4	4.0
Corack	7.91	98	12.3	0.4	8.5	8.37	111	10.6	0.2	7.8
Crusader	7.55	94	13.0	0.9	7.8	7.25	96	12.1	0.2	6.7
Dart	7.75	96	13.4	2.9	8.0	7.13	95	12.1	0.4	5.7
EGA Gregory	7.78	96	12.6	0.2	6.8	7.08	94	11.5	0.3	5.8
Elmore CL Plus	8.04	100	12.6	1.1	7.8	7.01	93	11.6	0.7	5.2
Emu Rock	7.55	94	13.4	2.7	8.8	7.35	97	12.0	2.0	7.2
Gascoigne	8.90	110	12.7	0.2	6.7	7.82	104	11.4	0.3	4.8
Gauntlet	7.81	97	12.9	0.7	7.7	7.48	99	11.4	0.3	4.8
Grenade CL Plus	7.70	95	12.1	0.5	8.8	6.87	91	11.7	0.1	6.8
Harper	7.45	92	13.1	1.0	6.8	7.41	98	11.5	0.8	4.3
Impala	8.43	104	12.3	0.7	6.7	7.33	97	11.7	0.2	4.8
Justica CL Plus	7.93	98	13.7	0.1	8.5	7.57	100	12.2	0.1	7.3
Kord CL Plus	8.03	99	13.2	0.3	8.7	7.48	99	11.6	0.3	7.5
Lincoln	8.35	103	11.9	0.8	7.2	7.82	104	11.5	0.3	4.0
Livingston	7.92	98	13.3	0.9	7.7	6.91	92	12.3	0.2	5.7
Mace	8.57	106	12.4	1.5	8.2	7.74	103	11.3	0.6	6.5
Merlin	7.71	95	14.0	0.2	7.7	7.36	98	12.9	0.4	5.3
QAL2000	8.84	110	11.1	1.0	8.3	7.85	104	10.4	0.6	5.2
QALBIS	7.76	96	11.5	1.7	6.8	6.92	92	10.7	0.6	5.3
Spitfire	8.05	100	13.5	0.2	6.7	7.15	95	12.1	0.3	3.5
Sunguard	7.71	96	12.5	0.2	6.5	7.17	95	11.8	0.3	4.7
Sunmate	8.49	105	12.6	0.3	8.3	8.03	107	11.1	0.4	6.8
Suntop	8.69	108	12.3	0.4	8.0	7.58	100	11.2	0.2	6.2
Sunvale	7.36	91	14.0	0.4	5.3	6.98	93	12.3	0.2	3.2
Trojan	8.63	107	12.9	0.4	8.8	8.15	108	11.1	0.2	7.0
Ventura	8.24	102	13.4	0.9	6.5	7.17	95	12.4	0.2	3.3
Viking	8.16	101	12.2	0.6	8.0	7.81	104	10.8	0.3	4.7
Wallup	8.09	100	13.1	0.7	8.7	7.44	99	12.0	0.4	7.3
Yenda	8.33	103	11.7	1.4	8.8	8.06	107	10.9	0.7	8.2
Yitpi	7.34	91	13.0	1.2	7.3	6.70	89	12.3	0.6	3.2
Site mean t/ha	8.07					7.54				
Probability	<0.001		CV (%)	2.72		<0.001		CV (%)	3.59	
LSD (t/ha)	0.36		LSD %	4		0.46		LSD %	6	
Sowing	14/05/2014		Harvest	05/12/2014		19/05/2014		Harvest	13/12/2014	

National Variety Trials
A GRDC INITIATIVE

[a] Standing score: 9 – standing, 1 – flat; standing scores are mean values of visual ratings.

ACHIEVING 10 TONNES OF IRRIGATED WHEAT IN THE MURRUMBIDGEE

Tony Napier, Deb Slinger, Luke Gaynor, Neroli Graham & Cynthia Podmore

NSW Department of Primary Industries

QUICK TAKE

- Preliminary trial results showed variety selection and agronomic management were major drivers of high yielding irrigated wheat production.
- For the 2014 season, Suntop, Chara and Kiora were superior yielding varieties at the Leeton and Coleambally trial sites.
- Results from 2014 also showed that plant density and nitrogen management had a significant effect on grain yield.
- Further trials will be conducted in 2015 and 2016 to validate results and provide recommendations for management of high yielding wheat crops.

The best performing wheat varieties in dryland systems may not be equally successful in irrigated systems, therefore identifying the best varieties for irrigated systems is essential to achieving high yields.

The importance of correct variety selection for dryland crops is well documented but the same depth of information does not exist for irrigated crops. Irrigated agriculture has the added pressure of uncertain water allocation and water cost, which creates the need for irrigated crops to produce 'more crop per drop'.

The first season's wheat trials as part of the *Southern Irrigated Cereal and Canola Varieties Achieving Target Yields* project were conducted in 2014. Preliminary results show the significant effect that agronomic management had on grain yield of irrigated wheat, however it will be important to also consider the results from the same trials in 2015 and 2016.

The trial

The trials evaluated the effect of variety, plant density, nitrogen management and interactions of all three factors on wheat grain yield. In the Murrumbidgee Valley, wheat trials were conducted at two locations: Leeton Field Station and Coleambally. Other trials in this project were located in the Lachlan Valley, the Murray Valley, north west Victoria, south east South Australia and Tasmania.

The trial at Leeton Field Station was conducted on a self-mulching medium clay soil with barley as the previous crop. The trial was sown on 17 May 2014 with six rows per plot and a row spacing of 260 mm. The trial received three spring irrigations and was harvested on 9 December 2014.

The trial at Coleambally was conducted on a medium grey clay soil with barley as the previous crop. The trial was sown on 14 May 2014 with six rows per plot and a row spacing of 280 mm. The trial received two spring irrigations and was harvested on 9 December 2014.

The timing of irrigations at Leeton was determined by a combination of evapotranspiration and crop growth factor. The timing of the irrigation at Coleambally was scheduled so two irrigations would be applied during the season. Figure 1 illustrates the higher soil tension and reduced soil moisture available in the Coleambally trial, compared with the Leeton site, which contributed to overall lower yields at Coleambally.

The Coleambally site of a new irrigated crops project that is evaluating the effect of variety selection and agronomic management on wheat grain yield.

Yield results

The wheat varieties evaluated at both locations (Leeton Field Station and Coleambally) were:

- Bolac Ⓑ
- Suntop Ⓑ
- Corack Ⓑ
- Mace Ⓑ
- Kiora Ⓑ (VX2485)
- Wallup Ⓑ
- Merinda Ⓑ
- Chara Ⓑ
- EGA Gregory Ⓑ
- Lancer Ⓑ
- Dart Ⓑ
- Impala Ⓑ

Varieties displaying the symbol Ⓑ are protected under the *Plant Breeder's Rights Act 1994.*

Suntop (10.32 t/ha) and Chara (10.32 t/ha) were the highest yielding varieties at Leeton Field Station (Figure 2). Grain yield of these varieties was statistically similar to that of Kiora, Merinda and Corack. Lancer (10.01 t/ha) was the sixth highest yielding variety and was statistically similar to Merinda, Corack and Wallup. EGA Gregory (8.84 t/ha) recorded the lowest yield and was statistically lower than all other varieties except Mace (9.05 t/ha).

Suntop (7.33 t/ha) was the highest yielding variety at Coleambally and was statistically similar to Lancer, Chara and Mace (Figure 3). Kiora (7.09 t/ha) was the fifth highest yielding variety and was statistically similar to Chara and Mace. Dart (5.86 t/ha) recorded the lowest yield and was statistically lower in yield than all other varieties. Bolac (6.00 t/ha) recorded the second lowest yield and was statistically similar in yield to EGA Gregory, Impala and Merinda.

The Coleambally wheat trial had one less spring irrigation than the Leeton trial, which may explain the lower yields when compared with the Leeton trial.

Both wheat trials demonstrated that varietal selection is a major driver of achieving high yields. Suntop and Chara were in the highest yielding bracket at both the Leeton and Coleambally trial sites. Lancer and Kiora also performed well, with both achieving high grain yield at both sites. Dart and EGA Gregory performed poorly and achieved lower than average grain yields at both sites.

Effect of nitrogen management

The results from the 2014 season showed that timing of nitrogen application had a significant influence on wheat grain yield at Leeton. The treatments are shown in Table 1.

At the Leeton site, applying the majority of nitrogen (82%) as a topdressing at or after the first node stage (post-emergent

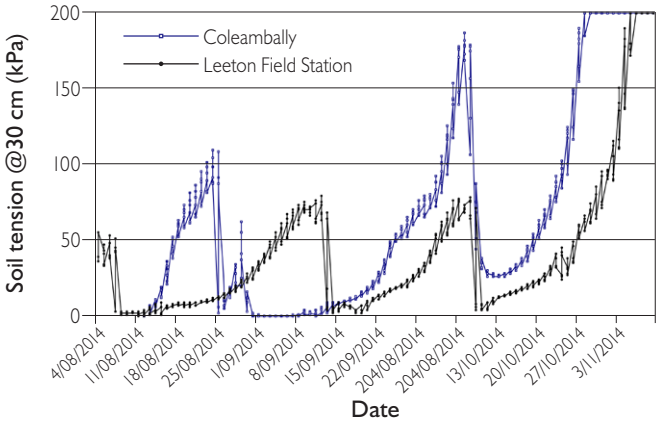

***Figure 1**. Soil moisture tension (kPa) at 30 cm for the wheat trial sites at Leeton and Coleambally.*

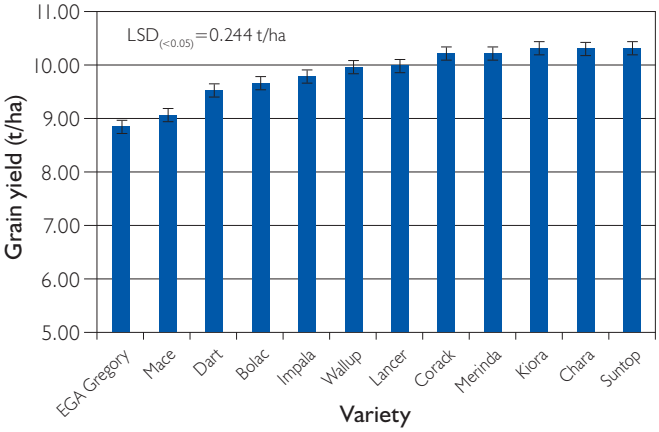

***Figure 2**. Wheat grain yield (t/ha) of each variety, averaged across all nitrogen and plant density treatments at Leeton Field Station 2014.*

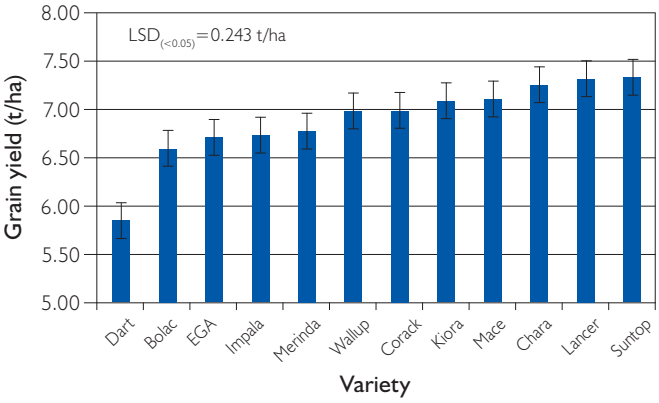

***Figure 3**. Wheat grain yield (t/ha) of each variety, averaged across all nitrogen and plant density treatments at Coleambally 2014.*

Table 1. Nitrogen applications at the Leeton and Coleambally trial sites in 2014

Trial site	Treatment type	Nitrogen applied (kg N/ha) Pre-sowing	1st node	Late post-emergent
Leeton Field Station	Pre-emergent	90	50	30
	Post-emergent	30	50	90
Coleambally	First node	90	60	20
	Early booting	90	20	60

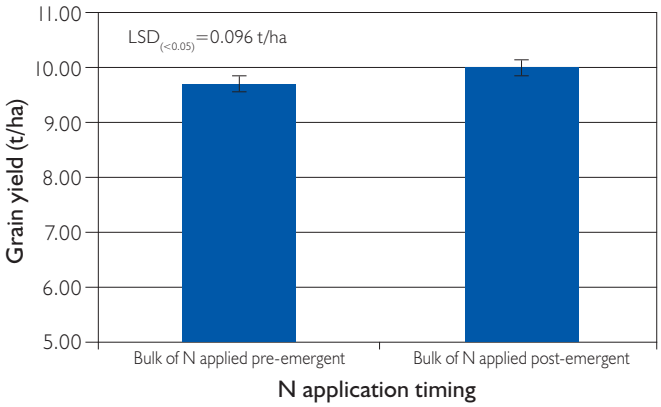

Figure 4. Wheat grain yield (t/ha) of nitrogen treatments, averaged across all varieties and plant density treatments at Leeton Field Station 2014.

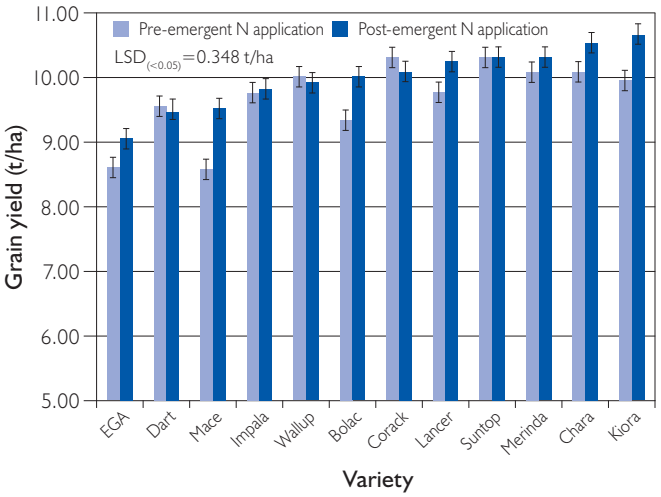

Figure 5. The effect of wheat variety and nitrogen application on grain yield (t/ha) at Leeton Field Station 2014.

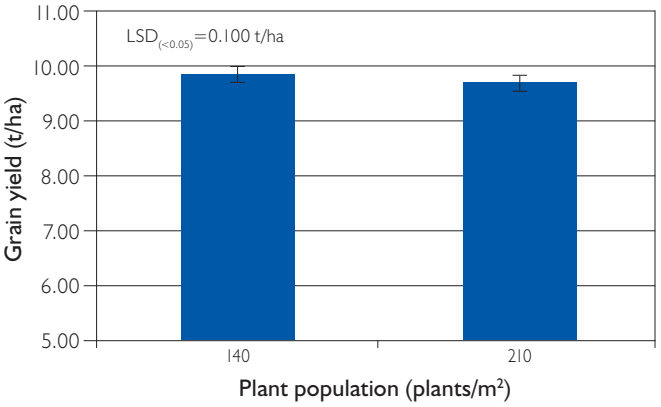

Figure 6. The effect of plant density (plants/m^2) on wheat grain yield (t/ha), averaged across all varieties and nitrogen treatments at Leeton Field Station 2014.

treatment), significantly increased grain yield compared with applying over half of the nitrogen (53%) at sowing (pre-emergent treatment). The post-emergent treatment yielded an average of 10.00 t/ha, which was statistically higher than the pre-emergent treatment, which yielded an average of 9.70 t/ha (Figure 4).

Nitrogen management at the Coleambally trial was different to that at the Leeton trial with all treatments having the largest application of nitrogen applied at sowing. Nitrogen management varied with different topdressing rates at first node and early booting. Changing the timing of nitrogen topdressing treatments at the Coleambally trial did not significantly affect grain yield. The early booting application treatments yielded an average of 6.93 t/ha, which was statistically similar to the first node treatments, which yielded an average of 6.86 t/ha.

The interaction of variety and nitrogen timing appears to be related to wheat maturity. The earlier maturing varieties performed better with earlier applications of nitrogen and the later maturing varieties performed better with the later applications of nitrogen.

At the Leeton site, Kiora (10.67 t/ha) was the highest yielding variety for the post-emergent nitrogen application treatments (Figure 5). Kiora was statistically similar in grain yield to Chara, Merinda and Suntop. EGA Gregory (9.08 t/ha) was the lowest yielding variety in the post-emergent nitrogen treatments and had significantly lower yield than all other varieties.

Corack (10.31 t/ha) was the highest yielding variety in the pre-emergent nitrogen application treatments at the Leeton wheat trial. This was statistically similar in yield to Suntop, Chara, Merinda and Wallup. Mace (8.58 t/ha) was the lowest yielding variety in the pre-emergent nitrogen treatments. Mace and EGA Gregory yielded significantly lower than all other varieties.

Plant density

There were two plant density treatments established:

- low – 140 established plants/m^2
- high – 210 established plants/m^2

At Leeton, the low wheat plant density (140 plants/m^2) resulted in a significantly higher average yield (9.90 t/ha) across all wheat varieties compared with the high plant density (210 plants/m^2) (9.80t/ha) (Figure 6). However, grain yield response to plant density differed between varieties and therefore individual variety results should be used as opposed to the average, when considering response to plant density. This is likely due to a variety's ability to compensate with tillers.

At the Leeton trial, for the low plant density treatments (140 plants/m^2), Kiora (10.40 t/ha) was the highest yielding variety (Figure 7). This was statistically similar in yield to Corack, Merinda, Suntop, Chara and Wallup. Mace was the lowest yielding variety with a grain yield of 8.96 t/ha. Mace and EGA Gregory both had significantly lower grain yield than all other varieties for the low density treatments.

In the high plant density treatment (210 plants/m^2), Chara (10.49 t/ha) was the highest yielding variety. This was statistically similar in yield to Suntop and Kiora. EGA Gregory was the lowest yielding variety with a grain yield of 8.53 t/ha. EGA Gregory was

significantly lower in yield than all other varieties for the high plant density treatments.

At the Coleambally trial, plant density did not significantly affect grain yield. The high plant population treatment had an average grain yield of 6.91 t/ha which was statistically similar to the low plant population treatment, which had an average grain yield of 6.89 t/ha.

Similarly at Coleambally, the interaction of variety and plant density did not significantly affect grain yield, which may have been due to the trial's lower yield levels. The effect of tillering on grain yield for each variety and plant density is yet to be analysed.

Conclusion

The wheat variety trials demonstrated that correct variety selection and agronomic management are key drivers in achieving high yields.

Suntop was the highest yielding variety at both trial sites. Chara was the second highest yielding at Leeton and third highest yielding at Coleambally. Other varieties that made up the top five varieties across both sites were Kiora, Merinda, Corack, Lancer and Mace.

Other management factors assessed in this trial, including nitrogen timing and plant density, were found to also impact grain yields.

Applying the majority of nitrogen (83%) at first node and late post-emergent (booting) resulted in higher yields compared with applying higher nitrogen (53%) pre-sowing. However, there was a varietal effect with the early maturing varieties yielding higher from early applied nitrogen and the later maturing varieties yielding higher from the late applied nitrogen.

Lower plant density produced higher yields at Leeton but there was no effect of plant population at Coleambally. There was a significant interaction between variety and plant density.

These research trials will be conducted for another two years (2015 and 2016). The research outcomes of the project will also assist with the development of three tools for growers and advisers (due for completion in 2017):

1. 'Irrigated Wheat: Best Practice Guidelines in Southern Irrigated Cropping Systems' manual
2. 'Irrigated Canola: Best Practice Guidelines in Southern Irrigated Cropping Systems' manual
3. Variety Specific Agronomy Packages (VSAPs) for each research location.

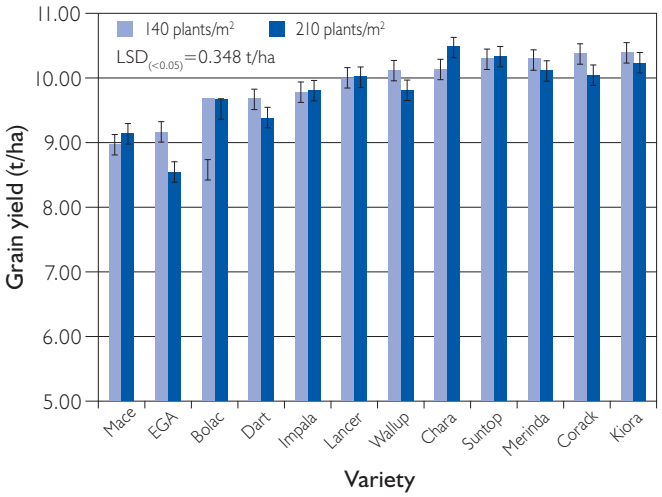

Figure 7. *The effect of wheat variety and plant density (plants/m²) on grain yield (t/ha) at Leeton Field Station 2014.*

Topdressing of wheat trials at Leeton Field Station, a site of the Southern Irrigated Cereal and Canola Varieties Achieving Target Yields *project.*

Three years of data will be gathered to identify best management practices and produce guidelines for high yielding irrigated cereals and canola.

Acknowledgements

This research is part of the Irrigated Cereal and Canola Varieties Achieving Target Yields *(DAN00198) project which is cofounded by GRDC and NSW Department of Primary Industries. The support of Glenn Morris, Paul Morris and Patrick Dando for assistance with trial management, field assessments and data collection is gratefully acknowledged. We would also like to gratefully acknowledge David Bellato for allowing us to establish the Coleambally trial on his property.*

Further information

Tony Napier
M: 0427 201 839
E: tony.napier@dpi.nsw.gov.au

ACHIEVING FOUR TONNES OF IRRIGATED CANOLA IN THE MURRUMBIDGEE

Tony Napier, Deb Slinger, Luke Gaynor, Neroli Graham & Cynthia Podmore

NSW Department of Primary Industries

QUICK TAKE

- Preliminary trial results showed variety selection was a major driver of high yielding irrigated canola production.
- Time of sowing and nitrogen timing did not significantly affect canola grain yield in the first year trials.
- The interaction of variety and time of sowing interaction had a significant effect on canola grain yield.
- Further trials will be conducted in 2015 and 2016 to validate results and provide recommendations.

Canola can be an important crop for broadacre irrigators in the Riverina. However, growers will only make canola part of their rotation if high yields can be achieved consistently and commodity prices are sufficient.

With low water allocations and high irrigation costs, growers need to achieve high yields every season and produce 'more crop per drop'. The *Southern Irrigated Cereal and Canola Varieties Achieving Target Yields* project aims to identify the most suitable canola varieties for irrigated farming systems in the Riverina and the best management practices required to achieve high yields.

The first of three seasons of trials was conducted in 2014. Results of a further two years of trials will validate the initial findings and be used to develop recommendations in the form of best management practice guides and variety specific agronomy packages (VSAPs). In the Murrumbidgee Valley, canola trials were conducted at two locations: Leeton Field Station and Coleambally. Similar trials are being replicated throughout all irrigation areas of south eastern Australia.

The trial

The irrigated canola trial at Leeton Field Station evaluated the effect of variety, plant density, sowing time and the interactions of all three on canola grain yield. The trial was conducted on a self-mulching medium clay soil with barley as the previous crop. The trial was sown on two dates: 9 April and 24 April 2014, with six rows per plot and a row spacing of 300 mm. The trial received three spring irrigations and was harvested between 12 and 17 November 2014.

Variety & plant population

Twelve canola varieties were evaluated at Leeton Field Station. They were:

- Pioneer 43C80(CL)
- Pioneer 44Y84(CL)
- Pioneer 44Y87(CL)
- Pioneer 45Y88(CL)
- ATR-Bonito
- AV Garnet
- ATR-Gem
- Hyola50
- Hyola450TT
- Hyola559TT
- Hyola577CL
- Victory V3002

The far set of trials, with canola in flower, are part of the Southern Irrigated Cereal and Canola Varieties Achieving Target Yields *project, located at Leeton Field Station.*

There were significant varietal differences in grain yield. Highest grain yields were achieved by the varieties Pioneer 45Y88(CL) and Hyola 50, with 4.21 t/ha and 4.16 t/ha, respectively (Figure 1). These grain yields were 20% greater than the lowest yielding variety Pioneer 44Y84(CL) and Pioneer 43C80(CL) which yielded 3.15 t/ha and 3.31 t/ha, respectively (Figure 1).

Two established plant populations were evaluated at Leeton, including 30 established plants/m2 (low rate) and 50 established plants/m2 (high rate). Plant population did not have any significant effect on yield in this trial. The low plant population treatment averaged 3.69 t/ha, which was statistically similar to the high plant population treatment, which averaged 3.66 t/ha.

Plant population did not have a significant effect on grain yield across all varieties. Some varieties including Pioneer 43C80(CL) and Hyola 557TT had slightly increased grain yield at the higher plant population of 50 plants/m2 while other varieties such as Pioneer45Y88(CL) and Garnet had a reduction in yield with increasing plant population.

Time of sowing

Two time of sowing treatments were evaluated: 9 April 2014 (early sown) and 24 April 2014 (late sown). The later sowing time had the higher grain yield with an average of 3.73 t/ha but was statistically similar to the earlier sowing time with an average grain yield of 3.62 t/ha.

Delaying the sowing time of canola at Leeton from 9 April 2014 to 24 April 2014 had no effect on grain yield. The first sowing date had significantly more frost damage than the second sowing date but final grain yields were similar for both time of sowing treatments. The sowing time effect requires further investigation outside the event of frost, as it is likely that there would be yield differences across sowing times.

The interaction between variety and time of sowing was significant in terms of grain yield, with Hyola 577TT increasing from 3.1 t/ha to 3.8 t/ha when sown at the later sowing date of 24 April 2014. Varieties such as Pioneer 44Y84(CL), Pioneer 43C80(CL) and Bonito had higher grain yields when sown on 24 April 2014, however Pioneer44Y87(CL) and Hyola 50 showed a decrease in grain yield when sown late (Figure 2).

Conclusion

This trial demonstrated that a grain yield of 4 t/ha is achievable for irrigated canola and that correct variety selection is a key driver of achieving high yields. Hyola 50 and Pioneer 45Y88(CL) both yielded over 4 t/ha, when yield results were averaged across treatments. AV Garnet and Pioneer 44Y87(CL) also performed with average yields of 3.88 t/ha and 3.84 t/ha respectively.

Plant density was shown to impact final yield but the results were not statistically significant this season. More trial work is needed to determine the effect of sowing date and time of nitrogen application (not discussed in this article) on yield and grain quality.

The research trials will be conducted for another two years (2015 and 2016). The research outcomes of the project will also assist with the development of three tools for growers and advisers (due for completion in 2017):

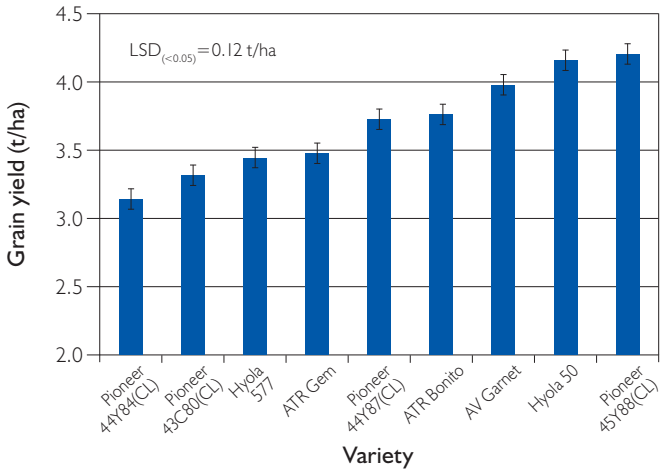

***Figure 1**. Grain yield of canola varieties evaluated at Leeton Field Station 2014.*

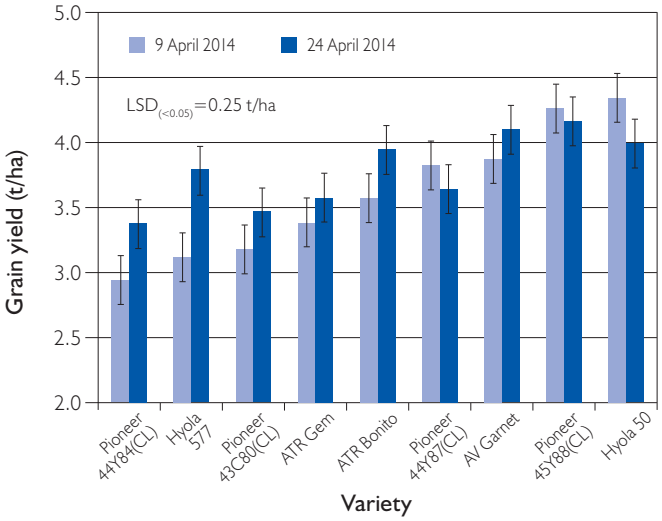

***Figure 2**. Grain yield (t/ha) of each variety at the two sowing dates at Leeton Field Station in 2014.*

1. 'Irrigated Wheat: Best Practice Guidelines in Southern Irrigated Cropping Systems' manual
2. 'Irrigated Canola: Best Practice Guidelines in Southern Irrigated Cropping Systems' manual
3. Variety Specific Agronomy Packages (VSAPs) for each research location.

Acknowledgements

This research is part of the Irrigated Cereal and Canola Varieties Achieving Target Yields *(DAN00198) project which is cofounded by GRDC and NSW Department of Primary Industries. The support of Glenn Morris, Paul Morris and Patrick Dando for assistance with trial management, field assessments and data collection is gratefully acknowledged. We would also like to gratefully acknowledge Ken Brain for allowing us to establish a second trial on his property at Coleambally.*

Further information

Tony Napier
M: 0427 201 839
E: tony.napier@dpi.nsw.gov.au

CANOLA – HOW MANY SPRING IRRIGATIONS ON HEAVY CLAY?

Brian Dunn

Research Agronomist, NSW Department of Primary Industries, Yanco

This research is part of the Irrigated Cereal and Canola Varieties Achieving Target Yields (DAN00198) *project, cofounded by GRDC and NSW Department of Primary Industries.*

QUICK TAKE

- One spring irrigation was sufficient for canola to achieve maximum grain yield on a self-mulching clay soil. Although little rainfall was received in spring, the soil moisture profile was full during winter.
- Hyola 559TT yielded higher than Hyola 577CL in all irrigation treatments due to a higher harvest index.
- There was no impact of nitrogen rate and nitrogen timing on canola growth and grain yield, regardless of irrigation treatment.

Canola is a valuable crop in the rice farming system but growers often face the dilemma of how many spring irrigations are required to achieve good yields and profit. With water availability at a premium it is important to know if water required for an additional spring irrigation could be better utilised elsewhere.

In 2014, an experiment was established at Leeton Field Station on a heavy self-mulching clay soil to investigate the spring irrigation requirements of canola grown following wheat. The impact of four irrigation intensities on grain yield and quality, water use and productivity was investigated.

Prior to sowing, the wheat stubble was burnt, the plots cultivated and graded, and single superphosphate and urea drilled into the soil.

Two canola varieties, Hyola® 559TT and Hyola® 577CL, were sown. Seed was spread on the soil surface at 5.0 kg/ha and all bays were given a flush irrigation to start germination. A full list of cultural practices, their timing and other details is provided in Table 1.

Irrigation & nitrogen treatments

Four spring irrigation treatments were established: zero, 1, 2 and 4 irrigations, with 4 replications of each treatment. Each irrigation treatment was in a separate bay so water use could be accurately measured. The timing of the irrigations was determined using a combination of evapotranspiration data, crop factors and rainfall. The spring was excellent for an irrigation experiment with no rainfall events greater than 11 mm after 1 June and a total seasonal rainfall of 152 mm.

The irrigation and variety treatments were split for nitrogen (N) application rates and timing. Four nitrogen treatments were applied:

1. 100 kg N/ha upfront
2. 150 kg N/ha upfront
3. 50 kg N/ha upfront + 100 kg N/ha topdressed
4. 100 kg N/ha upfront + 50 kg N/ha topdressed.

The upfront nitrogen was applied as urea drilled into the soil before sowing and the topdressed nitrogen was applied as urea spread onto the dry soil surface before a 10 mm rain event at stem elongation (Table 1).

Establishment

Crop establishment was generally poor across the plots due to poor seed placement (seed not sufficiently covered with soil). Two sites were selected in each plot where establishment was satisfactory; plant counts and all plant samples were collected from these sites. The variety 577CL achieved a significantly higher plant density than 559TT, with 38 and 28 plants/m^2 respectively.

Plant growth, grain yield & oil content

There was no difference in plant growth between variety, irrigation or nitrogen treatments, with an average total dry matter production of 14.7 t/ha.

Harvest index was significantly higher for 559TT than 577CL, with 0.28 and 0.23 respectively. This contributed to 559TT achieving a higher hand-sample grain yield than 577CL, with 4.10 and 3.38 t/ha respectively, when averaged across irrigation and nitrogen treatments (Figure 1).

Harvest index of the 1 and 2 irrigation treatments was similar, with 0.26, but harvest index for both the zero and 4 irrigation treatments was significantly lower, with 0.25 each.

Commercial irrigated canola yields are generally around 2.5 t/ha, with some growers achieving over 4.0 t/ha. The grain yields presented in this article are from hand cut and threshed samples, which are generally higher than header harvest yields due to less grain losses. There was no significant difference in grain yield between irrigation treatments, although the 1 and 2 spring irrigation treatments yielded higher than the zero and 4 irrigation treatments (Figure 1).

Despite the soil having a very low level of soil nitrogen, following two rice crops and one wheat crop, there was no significant difference between the nitrogen rate and timing treatments for dry matter or grain yield (Figure 2).

Grain oil content was high with an experiment average of 50.9% and no significant difference between irrigation, variety or nitrogen treatments (Table 2).

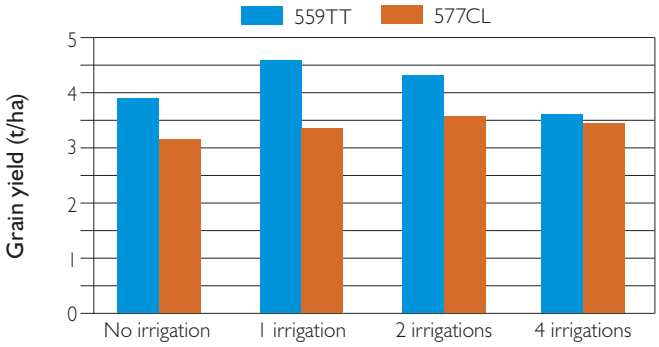

Figure 1. *Hand-harvest grain yield (t/ha) for two varieties under different irrigation management. (lsd (P<0.05) = ns)*

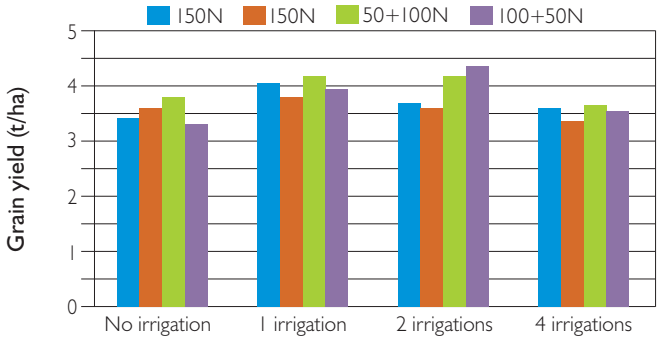

Figure 2. *Hand-harvest grain yield (t/ha) for two varieties under different irrigation management. (lsd (P<0.05) = ns)*

Table 1. Timing and details of cultural practices for the trial site

Practice	Details
Field preparation	Wheat stubble burnt – cultivated and graded
Pre-sowing fertiliser	400 kg/ha single super, sown 8 cm deep. 50, 100 & 150 kg N/ha as urea sown 8 cm deep
Pre-sowing herbicide	1.7 L/ha of 480 g/L trifluralin, harrowed twice
Varieties and rate	Hyola 559TT and Hyola 577C @ 5 kg/ha seed; seed spread on soil surface and flush irrigated
Topdressed nitrogen	50 & 100 kg N/ha as urea, 15 July – prior to 10 mm rain,
Irrigation dates	1 irrigation – 28 Aug. 2 irrigations – 11 Aug, 12 Sep. 4 irrigations – 4 Aug, 8 Sep, 29 Sep, 14 Oct.

Table 2. Canola grain yield (hand sample), water use, water productivity and oil content for irrigation by variety interaction

No. of spring irrigations	Variety	Grain yield (t/ha)	Water use (rain+irrig.) (ML/ha)	Water productivity (t/ML)	Grain oil content %
Zero	559TT 577CL	3.90 3.16	2.51	1.6 1.3	50.6 50.3
1 irrigation	559TT 577CL	4.59 3.36	3.37	1.4 1.0	50.8 51.4
2 irrigations	559TT 577CL	4.31 3.57	4.09	1.1 0.9	51.2 51.4
4 irrigations	559TT 577CL	3.61 3.45	5.51	0.7 0.6	50.8 50.6
lsd (P<0.05)		n.s.	0.16	n.s.	n.s.

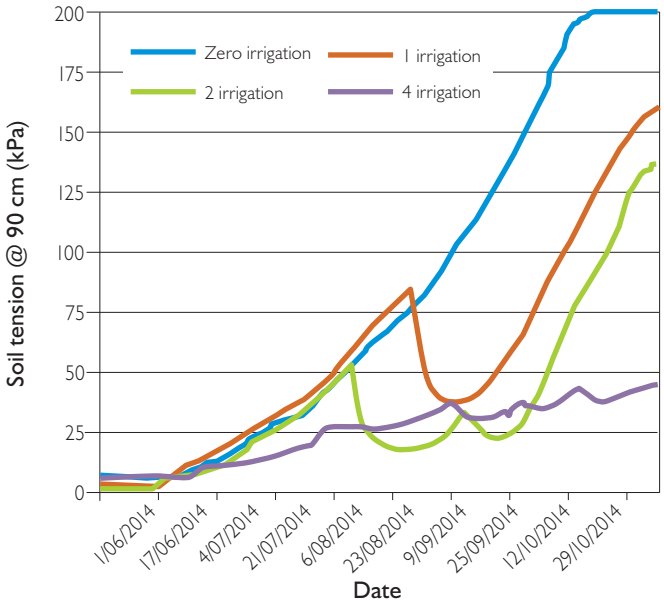

***Figure 3**. Soil moisture tension (kPa) at 90 cm depth for each of the irrigation treatments.*

Water use & water productivity

The autumn irrigation used for germinating the canola and evening up soil moisture between bays used 1.0 ML/ha and was included in the water use and water productivity calculations. This combined with the 1.5 ML/ha received as rainfall during the crop's growing period resulted in the zero irrigation treatment receiving 2.5 ML/ha for the season.

The 1, 2 and 4 spring irrigation treatments used 3.4, 4.1 and 5.5 ML/ha respectively, consisting of rainfall and irrigation water (Table 2). There was a significant difference between irrigation treatments for water productivity, the zero irrigation treatment was the highest with 1.4 t/ML followed by the 1, 2 and 4 irrigations with 1.2, 1.0 and 0.6 t/ML respectively.

The soil profile was full of moisture during early winter due to good autumn rain in March and April, combined with the germination irrigation and rain in May. The zero irrigation treatment maintained grain yield by using soil moisture stored at depth during the spring as shown by the soil tension data at 90 cm depth in Figure 3.

The water holding capacity of a self-mulching clay soil, as in this experiment, is approximately 120 mm whereas a red sodic soil is approximately 60 mm. Therefore in a similar season, a red sodic soil may have required 1 or 2 irrigations to reach the same yield as achieved from the zero irrigation treatment in this experiment.

Young plants were counted in late May to determine crop. establishment.

Soil water tension data was collected with a GBug logger, from gypsum blocks placed at depths of 15, 30, 60 and 90 cm.

All treatments received nitrogen prior to sowing, and two were topdressed on 15 July, prior to 10 mm rain.

Conclusions

The combination of the germination irrigation and average good rainfall resulted in the experiment having substantial levels of moisture in the soil profile going into winter. In this situation on a heavy self-mulching clay soil, one irrigation in the spring was sufficient for canola to achieve a high grain yield, even though rainfall was limited in spring.

In a season with near-average rainfall during spring, high yields would be possible without the need for any spring irrigations, provided a full soil moisture profile is achieved in winter on soils with high water holding capacity.

The results from this experiment are important to show that on a soil with high water holding capacity, high grain yields can be achieved with limited spring irrigations when the soil profile is full in early winter. This allows water to be used elsewhere on the farm where it may give higher economic returns.

Acknowledgements

This research was funded by the Grains Research & Development Corporation and NSW Department of Primary Industries. Excellent technical support by Tina Dunn, Craig Hodges and Chris Dawe has contributed significantly to the success of this project.

Further information

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

MAKING THE MOST OF SUMMER RAINS

Adrian Smith

Senior Lands Services Officer – Mixed Farming, Murray Local Land Services, Deniliquin

QUICK TAKE

- Summer rains can be viewed as an opportunity rather than just a cost to the farming system in terms of weed control, flystrike management and loss of quality of standing feed.
- For summer cropping, summer rain means reduced irrigation.
- For winter cropping, provided summer weeds are controlled, about one-third of the rain that falls in summer is available for the following winter crop.
- Native will respond almost immediately, producing highly digestible, high protein and generally nutritious feed.

With many paddocks in the southern Riverina receiving good summer rains, many farmers question the value of these rainfall events.

Whilst there is no doubt summer rainfall can cause headaches, and can be costly in terms of reducing the grazing quality of dry standing feeds and stubbles, and controlling flystrike outbreaks and the weeds that quickly germinate, the real question should be how can we make the most out of these summer rains — after all, we can't do much about *if, when* and *how* it falls!

You can use numbers and statistics to prove just about anything you want, but the reality is in the southern Riverina, we do actually receive *on average* around 40% of our annual rainfall in what many would call the non-growing period (November through to March). And whilst it can vary hugely (last year for example there was very little summer rain), it does perhaps show we need to better capture the potential benefits this rainfall can provide to our farming systems.

Prior to intensive agricultural development in our area, the landscape was dominated by perennial species — apart from the trees and larger shrubs, this included a range of grasses, shrubs and forbs. These perennials had the ability to grow all year round and quickly respond to any (summer) rainfall. More intensive production, both grazing and cropping, coupled with poor management of these perennials (overgrazing or no spelling to allow them to recover), has seen the removal of much of the 'perenniality' from our landscape.

Cropping

For those with irrigated summer crops….

The benefits are obvious for summer croppers — immediately it means reduced irrigation demand. And with low water availability, and the high cost of temporary water this year, there is an immediate benefit to your bottom line!

A simple conversion to remember is that a rainfall of 10 mm is equivalent to 0.1 ML/ha; 50 mm is 0.5 ML/ha, and for those under the right clouds, 100 mm of rain is equivalent to 1.0 ML/ha — a handy saving, particularly as rice water use has been running higher than average in the Murray Valley this year.

For those looking further ahead to their winter cropping programs, do these rainfall events provide any benefit?

The answer is yes — provided you control those summer weeds. A rough rule of thumb is for every 10 mm of rainfall that is conserved, about one-third or 3–4 mm will be available for the following winter crop. With summer falls in some areas approaching 100 mm (getting close to the equivalent of a 'pre-irrigation'), this is 'money in the bank' in terms of starting the winter crop with moisture in the soil profile.

When you consider that every millimetre of stored soil moisture results in around 20 kg/ha of wheat, or 15 kg/ha of canola, conserving 30 mm relates to a yield increase of around 0.5 t/ha, then the value of conserving any summer rain becomes an important economic consideration.

How you control those weeds is also an issue. Chemical fallowing will retain the highest volume of soil moisture and conserve stubbles, which reduce surface evaporation losses and the impact of heavy rainfall. Mechanical control will open up the soil, and result in greater loss of moisture due to evaporation but in some instances (and for a range of reasons) it may be the best option.

Grazing

For those with any perennial pastures…

The results will be immediate for perennial pastures — native grasses such as windmill grass, white top and native millet will respond almost immediately. We don't know precisely how much dry matter they produce, but we do know the feed the is highly digestible, typically high in protein and generally very nutritious.

Lucerne is very similar. It responds to rainfall also immediately, it is high in protein and very nutritious. Depending on the amount of rainfall received, a good dryland stand in our area may produce over 3 t/ha dry matter. Added to this is the benefit that lucerne will fix nitrogen (the more dry matter produced, the more nitrogen fixed), and will compete against summer weeds (particularly heliotrope). With these points in mind, the benefits of including lucerne as part of the farming system become very apparent. Producers need to be aware of the risks of grazing lucerne (such as bloat in cattle and red gut in sheep), but appropriate management will offset any potential downsides.

Other grazing species worthy of consideration are the forage shrubs, such as saltbush. While their response to rain may not be as immediate as the pasture species, because of their generally deeper root system forage shrubs will be able to make longer-term use of any large rainfall events that fill up the deeper soil profile. Whilst many of the forage shrubs on their own do not make up a balanced diet for sheep or cattle (saltbush for example is high in protein but low in energy), when used in conjunction with standing feed or other forms of roughage, they can provide an excellent source of nutrition, at least to maintain the condition of livestock.

One of the quandaries around the forage shrubs, saltbush in particular, is the divergent views that producers (and others) have about in their value. Some see them as the 'silver bullet' in terms of the forage they can produce (particularly in dry times), whilst others see them as a waste of time and money. The real value of forage shrubs lie somewhere between — they are simply part of a balanced diet that livestock consume.

In the Riverina, on average around 40% of annual rainfall is received in the period November through to March.

Once there are perennials in your farming system, it is important to retain them — as they can be expensive to establish. This is a whole other topic but it is essential that all perennials are given the chance to recover, regrow, set seed or build up root reserves. The quickest way to remove them is to overgraze them. Managing perennials correctly is essential.

What's the take home message?

Whatever your view of these summer rainfall events, the bottom line is they do, and will continue to, occur. They can be extremely variable — within a locality and from year to year — but summer rain does contribute, on average, a significant proportion of annual rainfall in our region.

The real trick for producers lies in making the most out of them!

Further information

Adrian Smith
T: 03 5880 1412
M: 0447 778 515
E: adrian.smith@lls.nsw.gov.au

FACTORS TO CONSIDER BEFORE DRAINING RICE

David Troldahl

Research & Development Agronomist, NSW Department of Primary Industries, Yanco

QUICK TAKE

- Early drainage can cause haying off and severe economic penalties as a result of low wholegrain millout.
- Check weather conditions for the next ten days before deciding to drain.
- Each paddock is different. Assess each paddock individually to determine when it is ready to drain.

The timing of draining rice for harvest is one of the most important and difficult decisions in rice growing. Too early and the crop may hay off, too late and the paddock may not dry out.

The main objective of drainage is to allow the rice plants to reach physiological maturity, when the grain moisture is approximately 26–28%, which will maximise yield potential and wholegrain millout. At the same time, drainage management must ensure that harvest machinery can be supported and will not damage the soil surface by the time the grain moisture gets to 22%.

The period for grain ripening, draining and harvest occurs in mid–late autumn when the weather conditions can be very variable. The ripening and harvest period of 2013 was particularly hot and quite a number of growers were caught out, leading to haying off of crops and very low grain moisture at harvest. Seasonal variation from year to year is what makes the 'when to drain' question so challenging.

Once flowering is finished, the deep water that was used to protect the crop during microspore and flowering can used up by the crop. The water is allowed to drop down to a very shallow level on the top side of the bay, with only a small amount of fresh water flowing into the bay to maintain the shallow level until the crop is ready to drain.

Factors to consider

There are a number of factors that need to be considered when deciding when to drain rice, in order to maximise yield potential and wholegrain millout. These include:

- sowing method – aerial or drill sown
- variety
- paddock layout – natural contour or lasered
- crop maturity in relation to predicted weather conditions
- soil types and drainage characteristics of the paddock.

The method of sowing has a large impact on the time to drain. Drill sown rice is usually established on lasered paddocks where

When determining the timing of drainage, it is important to select representative panicles and squeeze the glumes to determine the stage of grain development. Photo: Tina Dunn

the water can be put on and off quickly and easily. Whereas aerial sown rice is more likely to be established in contour layouts where drainage may take longer. Aerial sown paddocks will also tend to be left a bit rougher to avoid seedling drift at establishment, which can cause uneven drying of the bay.

New rice varieties are much more synchronous in flowering than those of the past, where varieties such as Amaroo were renowned for late tillers. Reiziq, Sherpa and Langi flower in a shorter time and are therefore easier to judge for the level of maturity around drainage time.

There are three stages in the grain development that growers need to know, in order understand the ideal time of drainage for crops that mature at different times of the season.

1. **Late milky stage** is where the grain is full inside the glumes. When squeezed between thumbnail and forefinger a white liquid comes out.
2. **Late dough stage** is where the grain is full and firm but can still be cut in half by the thumbnail.
3. **Physiological maturity** where most grains are hard and grain moisture is about 26–28%. The grain at this stage will not require moisture or nutrients from the plant.

Table 1 shows the grain development stage required before drainage commences for fields with different drying rates and crops with different maturity times.

Short-term weather forecasting has over the last few years become much more accurate, particularly where temperatures are concerned. This information is critical in decision making about drainage, combined with knowing soil type and its drying capabilities, and crop maturity stage.

All these factors need to be taken into consideration for each paddock when deciding to drain, as each paddock will be different to the next.

Drain or lock-up?

The practice of "lock-up" is not recommended as it often leads to uneven soil moisture across the field due to variability in soil surface levels and soil types across the field. This can lead to some areas of the field being dry before they are ready to drain, thus causing "haying off".

Table 1. Stage of grain development required at drainage, based on time of maturity. These criteria should be used as a guide only.

Time of crop maturity	Quick drying field – Landformed layout – Drill sown	Slow drying field – Contour layout – Aerial sown
Late February to early March	Late dough stage	No milky grains
Early March to mid-March	No milky grains	5% milky grains
Late March to early April	5% milky grains	10–15% milky grains

Source: Rice Primefact – Factors to consider when draining rice.

Critical decision

The timing of draining rice bays for harvest is one of the most important and difficult decisions of rice growing; and it will have a major impact on the total yield and wholegrain mill out of the rice crop. The decision made at this time of year must take into account several factors, such as sowing method, variety and layout, but it must also contend with variable factors of seasonal conditions and the weather conditions in the days after the decision is made.

Further information

David Troldahl
T: 02 6951 2546
E: david.troldahl@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au/agriculture/broadacre/summer-crops/rice/factors-to-consider-when-draining-rice

The condition of channels and drains will influence the efficient and timely management of drainage. Aquatic weeds, such as Chara, will slow water drainage from rice bays. Photo: Brian Dunn.

IRRIGATED WHEAT & CANOLA PRODUCTION IN 2014

John Lacy
Agricultural Consultant, Finley

QUICK TAKE

- Despite good extension and uptake of recommended management for high yielding crop production systems, many farmers are not opting into these systems in seasons of low allocations.
- A farmer survey at Finley in 2014 showed that there was not enough water, suitable layouts, suitable soil types, rotations and labour to allow all paddocks to be targeted for high yielding production systems.
- While yield may have been similar or greater in the high input systems, water use efficiency was higher systems in one or more of the systems with lower water inputs.
- It is important that best management packages be developed for lower yielding as well as for higher yielding varieties and systems.

In low allocation seasons like 2014–15, the availability and price of market water becomes important as farmers make decisions on whether they could make a profit from buying market water to help maintain their cropping programs.

Allocations vary between high and low each season, so different decisions are made each year on how to use water allocation, depending on cropping enterprises, crop rotations and the requirements of the bank.

For over a decade, there has been great research and extension on high yields of irrigated wheat. Extension documents such as *Growing eight tonnes a hectare of irrigated wheat in southern NSW* (Primefact 197 by Lacy and Giblin, produced in 2006) have been widely used in eastern Australia as a template for targeting wheat yields of 8 t/ha.

However, the catch with high yielding cropping systems is that more irrigation water is needed.

In most seasons there is simply not enough water for targeting eight tonnes of wheat or four tonnes of canola in every paddock; and in addition there are layout, labour and rotation considerations. Farmers also have to consider the water requirements for mainstream summer crops such as rice, corn and cotton.

WUE x irrigation system

Farmer records of irrigated wheat and canola crops for the Finley Discussion Groups are usually classed in order of highest to lowest, based on yield and water use efficiency (WUE). While these results have been very useful, in 2014 it was decided to separate the records and results into irrigation systems.

Wheat

There were seven types of irrigated wheat systems in use by group members in 2014. The systems were:

- spray irrigation
- flood with water use >2.0 ML/ha (spring irrigation)
- flood with water use 1.5–2.0 ML/ha (2 spring irrigations)
- flood with water use <1.5 ML/ha (1 spring irrigation)
- flood pre-irrigation plus spring irrigation
- grazing and grain
- no irrigation water use.

Survey results from the Finley Discussion groups in 2014 indicated that there was insufficient water availability, suitable layouts, soil types, rotations and labour, to allow all paddocks to be targeted for high yielding crops.

Table 1. Results of different irrigated wheat systems in 2014, as recorded by farmers in the Finley Discussion Groups

System	No. crops	Yield t/ha	WUE kg/mm	Irrigation water use ML/ha	Total nitrogen as kg/ha urea
Spray	7	6.2	14	2.1	299
Flood >2 ML spring	13	6.4	13	2.8	246
Flood 1.5–2 ML spring	8	6.2	16.9	1.6	170
Flood <1.5 ML spring	12	4.2	13.7	1.0	181
Flood pre-irr/spring	12	4.9	12	2.4	224
Grazing	5	4.3	10.7	1.2	240
No irrigation	7	2.9	15.5	0	137

Table 2. Results of different irrigated canola systems in 2014, as recorded by farmers in the Finley Discussion Groups

Irrigation system	No. crops	Yield t/ha	WUE kg/mm	Irrigation water use ML/ha	Total nitrogen as kg/ha urea
Spray	6	2.9	7.1	2.1	310
Flood >1 ML spring	10	2.4	7.7	1.1	196
Flood <1.0 ML spring	10	2.4	8.6	0.8	184
Flood pre-irr/spring	5	2.3	7.1	1.4	207
Grazing	2	2.0	5.9	1.3	223
No irrigation	3	2.2	9.1	0	192

In 2014, 20 crops (or 31%) were grown using the 8 tonne system, with spray irrigation or irrigation with more than 2 ML/ha (Table 1). There were 44 crops (or 69%) grown in other systems.

Surprisingly, the 1.5–2 ML/ha system had comparative yields and a much better WUE at 16.9 kg/mm, compared with the >2 ML/ha system at 13 kg/mm.

When irrigation water is short the aim is to grow as many kg/mm or tonnes/ML of grain as possible, rather than maximise t/ha.

Canola

There were six types of irrigated canola systems in use by group members in 2014. The systems were:

- spray irrigation
- flood with water use >1.0 ML/ha (spring irrigation)
- flood with water use <1 ML/ha (1 spring irrigation)
- flood pre-irrigation plus spring irrigation
- grazing and grain
- no irrigation water use.

In 2014, 16 crops (or 35%) were grown using the 3.5–4.0 tonne system, with spray irrigation or irrigation with more than 1 ML/ha (Table 2). There were 30 crops (or 65%) grown in other systems.

As observed with the wheat results, the <1.0 ML/ha system had equal yields and a better WUE (8.6 kg/mm) compared with the >1 ML/ha system (7.7 kg/mm).

Relative yield targets for canola were lower than wheat as it has been harder to grow 3.5–4t/ha of canola that it has 8t/ha wheat. Accordingly, farmers reduce the risk associated with growing canola by using less inputs and spring water.

What have we learnt?

- Farmers used a range of irrigated cropping systems in a low allocation season.
- There was not enough water, suitable layouts and soil types, rotations and labour to allow all paddocks to be targeted for high yield systems.
- A significant number of crops were not high target-yield systems.
- It's important for research to continue to find higher yielding varieties and collaborate with extension to develop agronomy packages for higher yielding varieties.
- It's also important to develop better best management packages for the other systems particularly if they have higher WUE than the high yielding systems.

Further information

John Lacy
T: 0427 311 821
E: johnmarglace@hotmail.com

UPGRADING TO SAVE WATER

Bridget Ransome

Infrastructure Project Team Lead,
Waterfind Australia

Irrigators in the southern Murray–Darling Basin have been upgrading their irrigation layouts and infrastructure and making significant operational savings in terms of water use, by participating in the Australian Government's On-Farm Irrigation Efficiency Program ***(the Programme).***

The Programme is one of the key mechanisms to 'bridge the gap,' obtaining water to achieve the sustainable diversion limits set out in the Murray–Darling Basin Plan and consists of three main components:

- projects to upgrade on-farm irrigation infrastructure
- direct purchase of water
- improvements to water supply systems.

Round Five of the Programme will commence in 2015 and will support projects located in the New South Wales zone of the southern basin of the greater Murray–Darling Basin. It will be the final round of the Programme funded under the national *Sustainable Rural Water Use and Infrastructure Program* which is investing in rural water use, management and efficiency, including improved water knowledge, market reform and water purchase for the environment.

Through the Programme, dairy farmer Dehne Vinnicombe increased efficiency and production, whilst reducing the amount of water required to irrigate his 217 hectare dairy property at Jarklin, south of Kerang in Victoria.

Dehne gained operational efficiencies by laser levelling over 90 ha, re-configuring the irrigation bays to even out wetting across the width of bays, upgrading and increasing channel capacity and infrastructure in order to maximise flows, and introducing an efficient re-use system to his farm. Installation of auto irrigation actuators, moisture probes and associated software and radio units will allow him to carry out in-field moisture management and achieve effective use of labour during watering periods.

The upgrade resulted in an estimated water saving of 2.9 ML/ha and he has returned 218 ML of water to the Commonwealth for use by the Commonwealth Environmental Water Holder (CEWH). In addition to the water savings, Dehne has recognised an increase in production and major savings in labour.

"Automation has allowed me to eliminate over-watering, which with high flows I could lose up to 40% of the water I put on," said Dehne. He also indicated that his usual stress levels coming into a watering period have now virtually disappeared and that has given him the flexibility to focus on other jobs on the farm.

Joe and Alice Dal Broi of Benerembah, near Griffith in New South Wales, also participated in the Programme. They made major changes to the design of their fields, taking them from a traditional contour layout to a bankless channel layout. The upgrade has allowed for fast-flow irrigation suited to a wider range of row and broadacre crops including rice, cotton, winter cereals, oilseeds and irrigated pulses.

The Dal Broi project saw the removal and replacement of all existing rice contour banks and old supply drainage channels with a bankless channel layout spaced to allow for replicated sets of row crop equipment. In order to do this, approximately 122,000 m^3 of soil was moved to create terraced bays and side ditches that make up the bankless channel structures.

Significant savings in time required to water individual bays, through high flow rates, and water savings of 1.3 ML/ha have been achieved due to the new layouts. As a result of this project, Joe and Alice have subsequently returned 170 ML to the CEWH.

"This Programme lets farmers get on to their upgrade work quickly and get it done over a shorter timeframe, which is valuable for unproductive paddocks,' said Joe.

Both the Vinnicombe and Dal Broi projects formed part of Rounds Three and Four of the *On-Farm Irrigation Efficiency Program*, of which Waterfind was one of several delivery partners appointed. Waterfind was responsible for managing over $25 million of funds to support irrigators in New South Wales, Victoria and South Australia to make their irrigation systems more efficient, and in exchange, transfer their water savings to the Commonwealth. The CEWH will hold and provide water for environmental watering in the Murray-Darling Basin, according to its annual program.

More information about the Programme and case studies of projects carried out can be found on the website of the Australian Government Department of the Environment:

www.environment.gov.au/water/rural-water/srwui/on-farm-irrigation-efficiency-program

Further information

Bridget Ransome
T: 1800 890 285
E: on-farmiep@waterfind.com.au
W: www.waterfind.com.au

COMMENT

FUTURE RESEARCH & INNOVATION IN IRRIGATED AGRICULTURE

Warren Muirhead

Retired CSIRO scientist & 2014 recipient of the IREC Lifetime Achievement Award

Irrigated agriculture in the Murrumbidgee Valley has benefited from local research and innovation since irrigation commenced over 100 years ago.

The research, innovation and extension to address regional challenges during this time was primarily provided by the state Agriculture Department, CSIRO and, in more recent years, universities and private consultants, with increasing funds provided by industry.

The Irrigation Research and Extension Committee (IREC) provided an invaluable role in ensuring that researchers clearly understood the needs of irrigators and that the research results were communicated to them, particularly through organising field days and its publication, the *Farmers' Newsletter.*

A major change took place in the last couple of years when the State Government of New South Wales ceased extension services and CSIRO decided that it was closing its Griffith Laboratory in 2016.

Surprisingly, farmer organisations raised little opposition to these changes!

Is there need for continued research?

I believe that for a prosperous irrigation community to continue in the region, irrigated agriculture will reap rewards from independent research leading to improved returns from more efficient and sustainable production.

There is no doubt that major innovations in irrigation management will occur in the future and it is likely that those irrigators participating in its development will have most to gain. However, two questions need to be asked:

- Do irrigators see a need for this research? and if so,
- Who is best able to provide it?

My concern is that irrigator support for independent research is declining as evidenced by their reduced involvement in recent years in the IREC subcommittees and acceptance of the withdrawal of government research and extension services with little objection. However, support for industry Research and Development Corporations, such as that provided to the rice and cotton enterprises with research and extension services, remains strong.

What is the role of CSIRO Griffith?

For sentimental reasons, I would like to see the CSIRO Griffith Laboratory continue providing research to irrigators and although greatly reduced in size, the staff are dedicated and highly competent. However, realistically, the CSIRO management in Canberra is not committed to close involvement with irrigators, possibly due to declining government support for research generally. This has been demonstrated in the last few years, when these managers have failed to attend important IREC management meetings to plan a path for future research and innovation.

Is the same trend occurring at the state government level?

I believe it is, as evidenced by the recent rapid withdrawal of extension services.

Who else can undertake independent RD&E?

Extensive research and extension is now carried out by companies providing goods and services, such as fertiliser companies. However, it may not be independent as it could be linked to sales of product and the results are unlikely to be shared with competitors.

It is likely that more research and innovation funded by the Research and Development Corporations will be carried out by private consultants. My experience suggests that they often lack the resources and research facilities to measure the relevant physical and chemical processes that will lead to sound innovative practices. Furthermore, they are reluctant to share the knowledge gained without charging a fee for their services.

I believe universities potentially have the broad range of disciplines (e.g. scientific, agricultural, economic, social and environmental) that are required to provide the research and innovation needs of this regional, irrigation community. Keen postgraduate students working with experienced supervisors and irrigators would be able to carry out effective research leading to unbiased and financially viable solutions. Graduating students entering the irrigation industry could provide a vital two-way flow of information between the irrigator and the university.

Irrigators must have their say

It is vital that irrigators participate in this debate on the future of irrigation research in the region that has the potential to lead to a more prosperous irrigation community.

Contact

Warren Muirhead
E: warren.muirhead@bigpond.com

UNMANNED AERIAL VEHICLES (UAVS) – ARE THEY HERE TO HELP?

Lachlan Caldwell

Lachlan Fertilizers Rural

The article is adapted from a paper prepared for the GRDC Research Updates, February 2015

QUICK TAKE

- Drones and unmanned aerial vehicles (UAVs) are the hot new thing in Precision Ag circles. They will complement, not replace, current methods of gathering imagery.
- UAVs have exciting potential in delivering rapid and accurate spatial data when fitted with appropriate sensors. Agronomists can use this data for identifying variability in crop biomass production to address yield limiting issues prior to being visible by eye.
- Limitations may exist in flight times, platform cost and software.
- The technology is evolving very quickly, and useable options with quick turnaround times will be available in the near future.

Aerial imaging has been available for a long time, with many types of aircraft fitted with cameras and sensors to gather data in airborne applications. With the progression of consumer-based electronic technologies, along with a history of development in military situations, the relatively sudden rise of drones and UAVs has been triggered by widespread affordability.

Typically, UAVs are being used to carry cameras and small sensors into the sky, in a similar fashion to larger aircraft. Many industries have realised this potential and UAVs are now commonplace in real estate, cinematography and law enforcement, for example. As such, agriculture is seen as a potentially huge market for these technologies.

UAVs come in many different types, shapes and sizes, and each one has advantages in different situations or use patterns. Platform designs available and key characteristics, are listed as follows.

Traditional helicopters

- Ability to hover for extended periods.
- Precise flying and the ability to carry large payloads.
- Relatively short flying times, typically with petrol field engines.
- Usually expensive to purchase.

Traditional plane style

- Longer flight times with very good stability, even in high wind environments.
- Petrol or electric driven motors.
- Larger wingspans which may limit portability.

Multi-rotors

- Helicopter-styled aircraft with multiple rotors.
- Ability to hover and have high manoeuvrability.
- Relatively short flight times.

The choice of which platform is best, will ultimately come down to the end use. For example, if imaging is needed across large broadacre farms, then a UAV with long flight times and large wingspans for stability will be the more appropriate type. On the other hand, if imaging is needed across smaller areas with many obstacles and an ability to hover and go back to points of interest, then a multi-rotor design will be more suited.

The UAV is the vehicle used to traverse a predetermined area or transect, and the vehicles are used to carry a varying array of sensors to gather data from these areas. For use in agriculture, typical sensors range from simple cameras (like GoPros) to modified digital infrared cameras, to more dedicated multispectral imagery cameras.

UAVs in agronomy

While there is definite potential for the use of UAVs in agriculture, three key goals need to be met for successful uptake and adoption. Firstly, the platform needs to be simple and easy to operate. Potential users should not need a strong history/competency in remote controlled aircraft and electronics to successfully use UAVs. Secondly, the platforms will need to have robust designs that are able to handle the daily rigour of farm and agronomy use.

Currently, consumer-grade UAVs appear not to have the robust design and construction to handle these conditions. Lastly, the systems need to be economical and usable. The price point of this technology needs to make it feasible for many growers/advisers to consider purchasing, and a turnkey operation is a necessity. With many advisers short of time in their schedules, using UAVs would need to create instant and usable information, rather than requiring post-processing and revisiting.

Currently on an international level in agriculture, there is a range of potential and current uses of UAVs. Such examples include:

- GPS mapping farms/orchards
- 3D digital elevation mapping for drainage
- NDVI biomass mapping of crops
- aerial photography
- GPS location of resistant weed populations
- crop insurance assessments.

For application in agronomy, the most attractive use of UAVs focuses on the creation of NDVI imagery across crops and pastures. While NDVI imagery is nothing new, the use of UAVs creates a new level of opportunity for agronomists to maximise crop yields through monitoring NDVI images throughout the season to identify areas of limitation. This will allow spatial locations of lower biomass zones to be identified on a very accurate level in a short time frame. Typically UAVs will have centimetre-level pixel accuracy and can be flown immediately and on overcast cloudy days due to their low altitude of operation — under 123 metres (400 feet). In contrast, satellite imagery will have less resolution quality and a delayed time frame, and therefore, cannot generate quality imagery in cloudy conditions. Despite this, satellite imagery currently has a lower cost point and is easily applicable across large areas with a minimal labour requirement. In these scenarios, there is a need for each type of imagery according to the different requirements. The future of crop imagery will appear to include a mix of satellite and UAV data rather than one or the other becoming obsolete.

Current limitations

When examining potential UAVs for collecting NDVI data, the major limitation is the processing time and requirements to convert data into a usable form. The most common UAVs in use in agriculture carry modified infrared cameras that capture GPS referenced digital photos across the target area. On landing, the data is removed from the UAV and processed to produce an NDVI image. The image can then be converted into a form to work with a GPS-enabled device in the field. This process is being refined, with anticipation that data may be streamed directly to the 'cloud' from the UAV and then straight back to the ground for display on a mobile device. Once this data is usable, then the ground truthing and agronomic interpretation begins.

Limitations also exist in terms of regulations and certification required for the UAVs to be operated in a commercial manner. The UAV industry is relatively new, and the industry bodies governing aviation still see UAVs as a 'grey area', however training and licensing is required to ensure safety and compliance. This certification also comes at cost, which creates additional economic pressure on the justification of using UAVs. Operational guidelines are also present that require maximum operational heights and restricted use in built up areas.

Due to the early stages of UAV technology and the speed at which new manufacturers are emerging, perhaps investing in the technology now may be a limitation within 1–2 years as new technology becomes available. As this happens, the price will also level out to a more justifiable level. Today, UAV platforms that have the robustness and ability for agronomy use are in the vicinity of $25,000. It would be expected that just like GPS Autosteer, this will dramatically change in the near to mid future.

Where are the opportunities?

Along with data processing and 'turnaround' refinements, the development of new sensors will create new opportunities for the role of UAVs in agronomy. For example, in the United States, radar technology is being used on UAVs to measure bulk density of soil for the identification of compacted layers. Variable depth deep ripping is then being trialled based on the UAV data.

Opportunities definitely exist in agronomy for UAVs to be a valuable scouting tool that strongly complements the current use of satellite imagery. When the technology evolves to provide quick on the spot conversion of data collected from flight to imagery, adoption will increase.

As crop management becomes timelier and advisers are making input decisions based on spatial levels, rather than paddock levels, then the benefit of UAVs will be fully realised. With the use of mobile devices increasing and the possibility of UAV data viewable within minutes, the power of proactive agronomy should be realised, which will help increase yields and profitability.

Currently UAVs are a new technology and as such, in the early days of real world development in agriculture. However, at the end of the day, UAVs need to deliver positive economic value to the grower rather than simply being another tool available in the Precision Ag toolbox. UAVs have the ability to gather spatial information but it is up to the end-user to turn that information into profit.

Further information

Lachlan Caldwell
M: 0427 816 897
E: lcaldwell@lachfert.com.au

A NEW ADDRESS FOR RICE INFORMATION

Gae Plunkett
Rice Industry Extension Coordinator

The Rice Extension web pages are the new destination for rice information. These pages will be a one-stop-shop to go to when you need information on all the facets of operating a rice-based farming system.

Located on the SunRice Grower Services website, the new Rice Extension web pages aim to incorporate all the available rice growing information as well as up-to-date research and development results for growers, researchers and agronomists across the Australian rice industry.

There are sections on crop management, farming systems, crop protection, water and the environment, and managing the business. A news and events section is located on the home page with upcoming dates listed to ensure you don't miss attending the important happenings on the rice growing calendar. Additionally, for further reading, there is a section which contains research papers, digital books and links to other websites. A highlight of this section is the publication *Production of Quality Rice in South Eastern Australia* and the *Rice Field Guide to Pests Diseases and Weeds*, which are considered the reference books for rice growers.

To view the Rice Extension web pages, visit **www.sunrice.com.au** and click on the Grower Services tab. If you already have login details and a password, enter these here.

If you do not have a password and you would like to access the Rice Extension pages, open the Email Form on the login page and email your details to Grower Services to request access to the site.

When you are in the RICE EXTENSION tab you can navigate your way through to all the information from short articles to detailed technical papers.

The advantage of the site is that all new information from a variety of sources and organisations can be uploaded promptly, and as information becomes out of date it will be removed. So you can be sure you can easily access the best information when researching rice production.

A feature will be the inclusion of new ways of delivering information such as YouTube videos and podcasts. In keeping with new ways, blogs from our Rice Industry Graduates and electronic newsletters will be delivered in a timely manner. As well as current season and historical temperature and evapotranspiration data to assist you to monitor your crop water use and crop growth, other tools are under development by the Rice Extension team and our partners. These will include panicle initiation predictors, sowing date references, budgeting and water use calculators that will assist you in managing for a productive rice crop.

Rice Extension is your industry-funded team. Login to the site and let us know what you think. If you have any ideas for future additions or suggestions for improvements, there is a Feedback Form on the site for you to contact us, or phone us: Gae Plunkett, Murrumbidgee, 0419 790 019 and Troy Mauger, Murray, 0417 375 168.

Further information

Gae Plunkett
M: 0419 790 019
E: gplunkett@rga.org.au

The Farming Systems page on the Rice Extension portal; the index on the left hand side is used to navigate through all the types of information available.

- Chemicals
- Soil & Tissue Testing
- Farm GPS Mapping Service
- Equipment Hire
- On-Farm Delivery
- Fertilisers
- Fertiliser Application
- Nutrients - liquid and soluble
- Safety Equipment
- Animal Care

For all your requirements, call the team at:

Griffith	02 6964 2999
Leeton	02 6953 3803
Coleambally	02 6954 4152
Hay	02 6993 3299
Jerilderie	03 5886 1529

www.miarural.com.au

AUSTRALIAN GROWN

AUSTRALIAN MADE AND OWNED

UniGrain Pty Ltd
ABN 67 120 061 841

Buyers and processors of ...

Milling Oats, Faba Beans, Field Peas and other grains.

Oat Contracts are available for harvest delivery into Edge of the Outback Grains at Deniliquin, Findlay's Grain Storage at Barellan and Akazien Hof Grain & Fertilizer at Coleambally.

Low Risk - Great Price - Market Flexibility

For more information, please contact:

Trevor Bray
Ph: (03) 5345 6224
M: 0431 659 376
Email: tbray@unigrain.com.au

Michael Vaccari
Ph: (03) 5223 6688
M: 0402 893 595
Email: michaelv@unigrain.com.au

THE EFFECT OF RICE WATER MANAGEMENT ON GREENHOUSE GAS EMISSIONS

Wendy C. Quayle[1], Brian Dunn[2] & Hiz Jamali[1]

[1] CSIRO Agriculture Flagship, Griffith; [2] NSW Department of Primary Industries, Yanco

QUICK TAKE

- In a rice experiment at Yanco Agricultural Institute, seasonal methane emissions were reduced by more than 90% in a drill sown rice crop with delayed permanent water compared with a crop with conventional watering (permanent ponding).
- Overall global warming potential, based on both methane and nitrous oxide emissions, was reduced by approximately 70% in delayed permanent water treatments compared with conventional watering , and there was no significant effect on yield.
- Global warming potential of the delayed permanent water system was estimated at about 160 kg CO_2-e per tonne of grain and 553 kg CO_2-e per tonne of grain for the conventionally managed crop.

Research at Yanco Agricultural Institute has shown that the practice of delayed permanent water in rice crops has the potential to reduce the global warming effect of a rice crop by up to 79% compared with a conventionally watered (permanently ponded) drill sown crop. Further, this benefit was measured without any impact on yield.

A field experiment was conducted to compare how different water management strategies affected emissions of the key greenhouse gases, methane (CH_4) and nitrous oxide (N_2O), from rice production in Australia during the 2010–11 rice growing season. The experiment was designed and conducted such that yield potential was not compromised and crop management practices were commercially relevant.

For a drill sown rice crop, a conventional treatment (permanent ponding from the 3-leaf stage) was compared with two delayed permanent water (DPW) treatments, irrigated from sowing at intervals of 80 mm and 130 mm of cumulative reference evapotranspiration (ETo), followed by permanent water 10–20 days prior to panicle initiation (PI).

The main objective of the experiment was to show how different irrigation water management strategies may mitigate global warming potential from Australian rice production, with little impact on yield.

The experiment

The field experiment was conducted over the 2010–11 rice growing season (October–May) at the Yanco Agricultural Research Institute.

The field measurements were made within the experimental layout of a larger, delayed permanent water trial, conducted by Brian Dunn (NSW DPI) and reported in previous editions of this magazine.

Measurements for greenhouse gas emissions were taken from gas chambers installed in plots of 72 m^2 where three different water management treatments were carried out. Chambers were set up in three replicates of the set of treatments.

Irrigation management

There were three water management treatments in the experiment:

1) **Conventional drill sown irrigation (conventional)** — the crop was flush irrigated twice after sowing and permanent water applied thirty-nine days after sowing on 19 November.
2) **Delayed permanent water applied at ETo 80 mm (DPW 80 mm ET)** — the crop was flush irrigated twice at 80 mm cumulative net reference evapotranspiration (ETo - rain) before permanent water was applied 10 days prior to panicle initiation (PI) on 1 January.
3) **Delayed permanent water applied at ETo 130 mm (DPW 130 mm ET)** — the crop was flush irrigated once at 130 mm cumulative net reference evapotranspiration (ETo - rain) before permanent water was applied 10 days prior to PI, on 1 January.

The flush irrigations involved filling the bays with water to a depth of 5 cm, and holding the water on the bays for three hours

before draining. Evapotranspiration values obtained from the CSIRO Griffith weather station (**www.irrigateway.net**) and crop coefficients (Kc) of 0.6, 0.8 and 1.0 were used for the periods 1–15 November 2010, 16–30 November 2010 and December 2010, respectively, to calculate irrigation scheduling for the DPW treatments.

The spring of 2010 was especially wet with 208 mm of rain received between sowing and application of permanent water for the DPW treatments.

Crop management

The medium grain variety, Sherpa, was drill sown on 11 October 2010 at 150 kg/ha using a disc drill at 18 cm row spacing into cultivated and levelled soil. All treatments received a post sowing–pre emergence weed control application, which is generally recommended for drill sown rice. In addition, the conventional treatment received 3.7 L/ha of molinate. All treatments received a split application of 200 kg N/ha as urea, with two application timings. The crop season calendar is shown in Table 1.

Gas measurements

Methane and nitrous oxide samples were collected from static chambers approximately once per week (depending on irrigation and rainfall) from sowing in early October up to the application of permanent water in early January, and thereafter once as the paddock dried in readiness for harvest.

The chambers enclosed an area of soil and captured the gases that were given off into the headspace atmosphere of the chamber over a specific time period. Gas from the chambers was sampled periodically during the closure period (usually one hour). The emission of gases was calculated by the increase in gas concentration that was measured in each sample over the sampling period. Measurements from the sampling were used to calculate the mass of gas (kilograms of carbon dioxide equivalent) emitted from each hectare in one day.

Results & discussion

Methane emissions during the rice growing season

The amount (or mass) of methane emitted from one hectare per day was calculated for each irrigation treatment and then extrapolated to estimate whole season emissions.

The methane emitted from the conventional treatment was significantly higher than that emitted from either of the DPW treatments (Figure 1). The results show that DPW management strategies reduced seasonal methane emissions by 93% compared with the conventional (permanent ponding) water management practice for drill sown rice. The mean methane emission rates throughout the season were calculated as:

1) Conventional – 168 kg CH_4-C/ha/season
2) DPW 80 mm ET – 43 kg CH_4-C/ha/season
3) DPW 130 mm ET – 31 kg CH_4-C/ha/season

The amount of methane emitted from rice crops varies significantly, dependent on climate and agronomic practice. Methane emissions from this study were within the range of those recorded from rice crops in the USA, which has a similar rice growing environment, and at the lower end of the range of methane emissions recorded from many different countries globally. Some of the reasons for lower methane emissions from temperate rice may be due the fact that rice fields tend to be managed with relatively deep water to protect the plant against temperature stress, particularly

Table 1. Rice crop season calendar for the trial site, 2010–11

Agronomic practice	Conventional	DPW 80 mm ET	DPW 130 mm ET
Soil cultivation and landforming	1– 6 September	1–6 September	1–6 September
Chamber installed	19 September	19 September	19 September
Sowing	11 October	11 October	11 October
Weed and pest control	21 October	21 October	21 October
Weed control	—	16 November	16 November
¾ Urea-N applied	19 November	—	—
Permanent water and weed control	19 November	—	—
Flush irrigation	—	25 November	—
¼ Urea-N applied mid-tillering	—	7 December	7 December
Flush irrigation	—	20 December	20 December
¼ Urea-N applied	1 January	—	—
¾ Urea-N applied	—	1 January	1 January
Permanent water applied	1 January	1 January	1 January
Water drained	14 March	5 April	5 April
Harvest	13 April	27 April	27 April

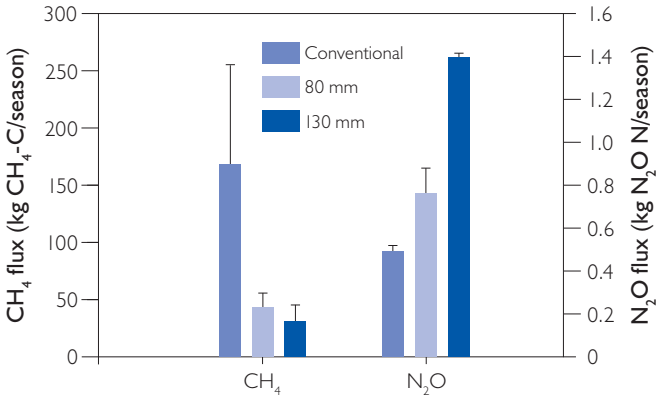

Figure 1. Comparison of calculated seasonal emissions of methane (CH_4-C) and nitrous oxide (N_2O-N) for three rice water management treatments.

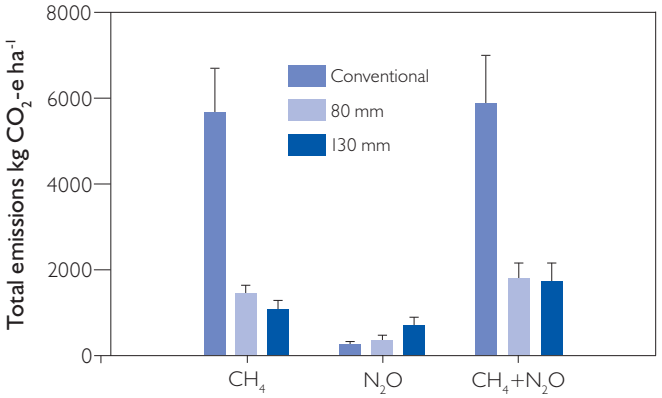

Figure 2. Comparison of global warming potential for three different rice water management strategies.

Research showed that delayed permanent water in drill sown rice crops has the potential to reduce the global warming effect of a rice crop by up to 79% compared with a conventionally watered crop.

around panicle initiation and early pollen microspore. Therefore, in Australian crops, the rhizosphere is likely being maintained overall at a lower temperature than subtropical or tropical crops. A second reason may be due to the lack of large inputs of organic matter. Rice stubble is usually burnt and mineral fertilisers are used rather than manures. Other reasons may be related to conditions typically experienced in Australia, where climatic, light and soil conditions are favourable for producing very high yields and usually varieties are selected that have a relatively high harvest index.

Nitrous oxide emissions during the rice growing season

The amount (or mass) of nitrous oxide (N_2O) emitted from one hectare per day was calculated for each water treatment (Figure 1) and the mean N_2O emission rates throughout the season were extrapolated as:

1) Conventional – 0.5 kg N_2O-N/ha/season

2) DPW 80 mm ET – 0.8 kg N_2O-N/ha/season

3) DPW 130 mm ET – 1.4 kg N_2O-N/ha/season

Over the entire season the amount of nitrous oxide emitted from the conventionally managed crop was approximately half that of the DPW treatments, and 64% of emissions were measured immediately prior to application of permanent water, coinciding with rainfall events that would have stimulated nitrous oxide production in the soil.

The seasonal emission for nitrous oxide in the conventional treatment is somewhat higher than those measured recently in Californian water seeded (aerial sown) rice, i.e. 494 g vs. 312 g N_2O-N/ha, perhaps due to the emissions that were measured immediately prior to permanent water being applied. These results are consistent with other studies which have reported that typically >50% of annual nitrous oxide emissions occur outside the rice growing season. Nitrous oxide emissions from flooded rice fields at Deniliquin were previously measured in a rotation, where legumes had been used to build up soil nitrogen between rice crops. Maximum gas emissions were much higher in that study, peaking at 240 g N_2O-N/ha/day, one day after floodwater was applied, compared with a maximum of 47.6 g N_2O-N/ha/day two days after the flush irrigation (130 mm ET) in this experiment. The out of season emissions observed in this and previous work highlight the need to undertake whole of system measurements when determining the sustainability of rice production, in terms of greenhouse gas emissions.

Combined climatic impact of nitrous oxide & methane emissions

Total seasonal global warming potential from each treatment was calculated as:

1) Conventional – 5862 (± 1089) kg CO_2-e/ha

2) DPW 80 mm ET – 1784 (±339) kg CO_2-e/ha

3) DPW 130 mm ET – 1707 (±455) kg CO_2-e/ha

The global warming potential of the conventional water management system was significantly higher than the delayed water treatments (Figure 2). Therefore, the delayed permanent water treatments reduced overall global warming potential by approximately 70% compared with conventional water management, where water is ponded for the whole season. In the conventional treatment, methane accounted for 96% of total CO_2-e emissions whilst in the two DPW treatments, the contribution of nitrous oxide was 20% (ETo 80mm) and 39% (ETo 130 mm) of total CO_2-e emissions. Therefore mitigation efforts for rice production should focus on reducing methane rather than nitrous oxide emissions overall. The results are similar to other reported global warming potentials for rice, approximately 5200 kg CO_2-e/ha for flooded rice in Thailand, and 4231 CO_2-e/ha measured in California.

Water management & yield

There was no significant difference in grain yield between the irrigation treatments and the average grain yield across the trial was 10.6 t/ha. This suggests that delayed permanent water may be effective at reducing emissions intensity (the kilograms of CO_2-e produced per tonne of grain), which is important for the development of sustainable farming strategies. In this experiment, the emissions intensity for each treatment was:

1) Conventional – 553 kg CO_2-e/t
2) DPW 80 mm ET – 168 kg CO_2-e/t
3) DPW 130 mm ET – 161 (±455) kg CO_2-e/t

There are very few reports of emissions intensity data available. In comparison, an average emissions intensity of 3757 kg CO_2-e/ha has been determined from a data survey from permanently flooded rice crops, grown in a number of different countries with an average yield of 6.05 t/ha. Using N_2O emission intensity values only, for cotton grown in Australia, emissions intensity was estimated a 162.3–327 kg CO_2-e/t lint yield and 67–82.6 kg CO_2-e/t from irrigated wheat.

Conclusions

This study has investigated how rice farming practices that use delayed permanent water management techniques affect the emissions of the greenhouse gases nitrous oxide and methane. From the information gained, an emissions intensity (the kilograms of CO_2-e produced per tonne of grain) was determined, which allows an evaluation of sustainability for food production and climate change.

Seasonal methane emissions were reduced by more than 90% using delayed permanent water compared with conventionally irrigated drill sown treatments, where the duration of permanent water was approximately two months longer.

Although nitrous oxide emissions comprised up to 39% of total emissions in the delayed permanent water treatments, most of these (64%) were emitted prior to the sowing date. Therefore, methane emissions should remain the focus of efforts to reduce greenhouse gas emissions in rice production.

Global warming potential was reduced by 70% using delayed permanent water compared with the conventional water management strategy and there was no difference in yields across the treatments.

Further information

Wendy Quayle
T: 02 6960 1537
M: 0417 436 775
E: Wendy.Quayle@csiro.au

CROPSOL

Irrigation Monitoring – soil moisture systems, water flow, water level & wastewater monitoring, Irrigation Agronomy Services

Irrigation automation & control – remote management of bore & river pumps, pressurised irrigation systems, water stops, livestock troughs, & surface irrigation systems.

79 Banna Ave, Griffith NSW, 2680
www.cropsol.com.au | (02) 6962 9407

irribiz

- Drip Irrigation
- Water Filtration
- Project Design & Development
- Service & Maintenance
- Pressure Pumps
- Warehouse

Don't waste a drop

Irribiz brings over 60 years experience in technical and irrigation project installation and management.

We can help you make each drop count. Irribiz is a division of ICI Industries

PHONE 1300 IRRIBIZ
www.irribiz.com.au

20 Bridge Road Griffith NSW 2680 Ph 02 6964 7299
43 Moore Street Robinvale VIC 3549 Ph 03 5026 3477

Find us at facebook.com/iciindustries

YENDA PRODS CO-OP SOCIETY LTD
S&B Riverina Water Engineering
YENDA • GRIFFITH • LEETON
"Your Partners in Farming"

Yenda Producers Co-operative Society Ltd

General Merchants, Fertiliser Spreading

Suppliers of all growers' requirements

YENDA
Peter Reynolds 0429 696 695
Steven Serafin 0427 566 692
James Mann 0427 566 673
Tom Brewer 0437 566 689

LEETON
Sam McGrath 0427 566 653
Geoff Miller 0427 566 691
Matthew Watson 0427 566 656

GRIFFITH
Paul Geddes 0427 566 676
Geoff Bray 0427 566 665
Peter Hill 0427 566 650
Stuart Jeffers 0427 566 669

Fertilisers • Fertiliser spreading • Fencing materials
Agronomic advice • Animal health • Dried Prune Agents
Fuels and Oils • Herbicides • Cartage • Hardware

Yenda: (02) 6961 3300 Leeton: (02) 6953 9000 Griffith: (02) 6966 8900

VIRUS DEVELOPMENT IN CANOLA CROPS DURING 2014

Joop van Leur[1], Kurt Lindbeck[1], Mohammad Aftab[2], Angela Freeman[2] & Don McCaffery[1]

[1] New South Wales Department of Primary Industries; [2] Department of Environment and Primary Industries Victoria

The article is adapted from a paper prepared for the GRDC Research Updates, February 2015

QUICK TAKE

- In 2014, *beet western yellows virus* was found in most tested canola crops throughout NSW. However, substantial yield losses appeared to be limited to a few paddocks where early infection occurred.
- *Beet western yellows virus* infects a wide range of crops and weeds, and its main vector is the *green peach aphid*.
- Virus control strategies should be based on preventing infection, e.g. seed treatment, as infected plants cannot be cured. Canola crops should be checked early in the season for aphids and if found, an effective insecticide applied.
- There is no indication to date that the occurrence of beet western yellows virus in canola poses a threat to neighbouring pulse crops.

A survey of canola in 2014 showed the presence of beet western yellows virus in most tested crops in New South Wales. It is recommended that virus control strategies should be based on preventing infection as infected plants cannot be cured.

Three viruses have been reported on canola and mustard in Australia:

- *beet western yellows virus* (BWYV)
- *turnip mosaic virus* (TuMV)
- *cauliflower mosaic virus* (CaMV).

Beet western yellows virus is a persistently transmitted virus, with the *green peach aphid* (*Myzus persicae*) as its main vector. *Turnip mosaic virus* and *cauliflower mosaic virus* are non-persistently transmitted and can be spread by a wide range of aphid species.

Earlier surveys in Western Australia and NSW recorded generally low infection levels of these viruses, except for occasionally high incidences of *beet western yellows virus* in canola and *turnip mosaic virus* in mustard.

Research in Western Australia on the potential impact of *beet western yellows virus* on canola production indicated that the virus could cause significant yield losses if infection occurred at an early plant development stage, although it caused no plant death.

Unusually high *green peach aphid* infestations levels were recorded in South Australia during the 2014 autumn, causing extensive *beet western yellows virus* infection. The severe plant stunting observed after the early virus infection in a large number of paddocks caused widespread concern to canola growers in other states and prompted a number of initiatives to quantify the scale of virus infections in canola crops, to estimate risks to other crops and to advise on possible control strategies.

Canola virus survey 2014

Following reports of severe *beet western yellows virus* infection in South Australian and Victorian canola crops, a sampling protocol was developed in July 2014 and distributed to NSW agronomists and canola growers. Participants were requested to submit samples (youngest fully expanded leaves or flower stem tips) of both virus-symptomatic (reddening and/or yellowing of the leaves, stunting) and healthy looking plants, in order to relate field symptoms to virus infection.

By the end of August a total of 3909 plant samples from commercial canola crops were processed, representing 150 sites (including 14 from Victoria and two from Tasmania). The majority of the NSW samples originated from the major canola growing districts of the southern region.

Beet western yellows virus was detected in 119 out of the 134 NSW sites sampled. There was a clear trend of the higher infection levels in southern NSW compared with central and northern regions of the state (Table 1).

Turnip mosaic virus was common on the Liverpool Plains and found to have a severe impact in several canola paddocks. This virus was also detected in commercial crops in a paddock near Forbes and one near Coolah, and in an experimental field near

Goulburn. Canola-virulent *turnip mosaic virus* strains are still rare in Australian commercial crops but have the potential to spread and cause significant damage to the Australian canola industry.

Comparing the incidence of *beet western yellows virus* between symptomatic and non-symptomatic canola plants from the 58 NSW sites from which paired samples were submitted, showed generally a higher *beet western yellows virus* incidence in the symptomatic samples. However, non-symptomatic samples were rarely found to be free of *beet western yellows virus*. This highlights the difficulties in distinguishing *beet western yellows virus* symptoms from those symptoms caused by other abiotic stress factors, like nutrient deficiencies or drought stress.

Variety differences for BWYV resistance

Initial sampling of the canola National Variety Trials (NVT) at different locations in central and northern NSW was carried out during August. The Gilgandra and Wellington trials were selected for further sampling as the initial sampling showed moderate levels of infection; sites with very high levels of infection were unlikely to show varietal differentiation.

Testing for *beet western yellows virus* presence was also carried out at the blackleg testing sites of the National Canola Pathology Project. Table 2 shows the percentage of samples that tested positive for *beet western yellows virus* for the 18 named varieties tested at both sites. Incidence of *beet western yellows virus* between both sites was significantly correlated ($r = 0.50$, $P = 0.01$), but large differences could be observed.

ATR-Stingray[A] was the only variety found free of *beet western yellows virus* at the Gilgandra and Wellington NVT sites. This result supports the observations made in South Australia where ATR-Stingray[A] appeared to be the best performing variety under severe *beet western yellows virus* pressure. However, other testing of the varieties ATR-Stingray[A] and Thumper TT at NVT sites throughout NSW, Victoria and Western Australia showed no difference between these two varieties and *beet western yellows virus* incidences of up to 60% in ATR-Stingray[A].

Viruses in NSW pulse crops during 2014

Surveys of virus development in pulse crops in northern NSW are undertaken yearly through random and selected sampling of commercial and experimental crops. At the start of the 2014 season unusually high infestations of cowpea aphids (*Aphis craccivora*) were observed in early sown faba bean crops in southern Queensland and north and central NSW. Shortly after severe aphid feeding damage, high incidences of bean yellow mosaic virus were found. However, aphid presence during the remainder of the season was limited and little or no virus development was observed in later sown pulse crops like chickpea.

In view of the high levels of *beet western yellows virus* in canola, particular attention was given to the development of this virus in pulse crops as *beet western yellows virus* can infect both. Results of surveys during both 2013 and 2014 of pulse crops grown in the vicinity of canola do not support the hypothesis that later sown pulse crops are at risk from *beet western yellows virus* inoculum originating from early sown canola crops.

Earlier reports attributed severe crop losses in pulse crops to *beet western yellows virus*. However, recent findings by Dr Murray Sharman (QDAFF) demonstrated that in some cases this was due to the newly described *phasey bean virus*, which was previously thought to be a strain of *beet western yellows virus*. However, the ecology of *phasey bean virus* is completely different and although the virus affects a wide range of pulses, it does not infect canola. Also, its main vector appears to be the cowpea aphid rather than

Which virus is which?

International research has shown that *beet western yellows virus* is diverse and the virus has been re-classified in several species, the most important being *beet western yellows virus* (BWYV) and the closely related *turnip yellows virus* (TuYV).

Recent molecular research in the virology laboratories of the Queensland Department of Agriculture, Fisheries and Forestry (QDAFF) and the Department of Agriculture and Food, Western Australia (DAFWA) on strains originating from canola as well as pulse crops showed these to be *turnip yellows virus*.

Biologically, both virus species are very similar in vectors and host range. In order to avoid confusion we will continue to refer to the virus as *beet western yellows virus* (or BWYV) for industry publications rather than *beet western yellows virus* (syn. *turnip yellows virus*) or BWYV (syn. TuYV); or more correctly, *turnip yellows virus* (TuYV).

Table 1. Incidence[1] of *beet western yellows virus* in NSW canola July – August 2014. Incidence reported as the number of samples in each infection class.

NSW region[2]	Number[3]	Number of samples per infection class						Ave. % infection
		0%	>0 ≤10%	>10 ≤25%	>25 ≤50%	>50 <100%	100%	
South	86	3	6	4	15	35	23	68
Central	31	4	3	7	4	12	1	43
North	17	8	4	1	1	2	1	17

[1] Incidence based on tissue blot immunoassay (TBIA).

[2] South; sampling sites south of West Wyalong, North; sampling sites north of Dubbo

[3] Paired samples (symptomatic and non-symptomatic plants from the same paddock) were combined.

Table 2. *Beet western yellows virus* incidence[1] in 18 canola varieties tested in the National Variety Trials at Wellington and Gilgandra, September 2014.

Name	Gilgandra	Wellington	Average
ATR-Stingray[A]	0	0	0
Hyola®450TT	7	10	8
Hyola®474CL	3	17	10
Hyola®577CL	10	10	10
CB Atomic HT	17	13	15
Pioneer®44Y87 (CL)	7	27	17
Monola™515TT	20	13	17
Pioneer®44Y89 (CL)	13	23	18
Hyola®559TT	7	30	18
Hyola®650TT	27	13	20
Pioneer®45Y88 (CL)	23	20	22
ATR-Bonito[A]	24	20	22
ATR-Gem[A]	21	27	24
ATR-Wahoo[A]	27	23	25
Hyola®575CL	23	30	27
Pioneer®45Y86 (CL)	30	33	32
Archer	17	50	33
Hyola®750TT	43	43	43

[1] % BWYV positive plants as determined by TBIA, averaged over 10 randomly collected plants in each of three replicates

the green peach aphid, the main *beet western yellows virus* vector.

Conclusion

Although differences between varieties in *beet western yellows virus* incidences were found in the NVT trial sites, these are preliminary results and should be confirmed in follow-up trials.

At this stage there is no irrefutable evidence that useful differences in *beet western yellows virus* resistance are present among Australian canola varieties. Future plant testing for *beet western yellows virus* presence in variety resistance evaluation trials should also be done earlier in the season (at the beginning of flowering) as early infections have the potential to inflict most damage.

Virus control strategies should be preventive. Poorly growing, low density crops are more vulnerable to aphid infection. Recommended agronomic practices should be followed that result in good crop establishment and vigorous early plant growth. Sowing in standing wheat stubble lowers aphid landing rates. Proper weed control will reduce *beet western yellows virus* inoculum as the virus has a very wide host range.

It is of particular importance that canola seed is treated properly using neonicotinoid insecticides. The seed treatment will provide a certain level of protection during the early, critical, plant growth stage. Growers should carefully monitor canola crops during this period and apply effective insecticides when aphids are noticed in the crop.

Further information

Joop van Leur
T: 02 6763 1204
M: 0427 928 018
E: joop.vanleur@dpi.nsw.gov.au

GRDC project codes

DAN00179, DAN00202, DAV00134

IREC Executive Committee

IREC Chairman	Rob Houghton	T: 0428 559 249	E: robhoughton2@gmail.com
IREC Deputy Chairman	Kieran O'Keeffe	T: 0427 207 406	E: kieran.okeeffe@cottoninfo.net.au
Executive Officer	Iva Quarisa	T: 0402 069 643	E: iva@irec.org.au
Secretary	Hayley Wordsworth	T: 02 6960 1550	E: irec@irec.org.au
Cropping & Water Management Subcommittee	vacant		
Horticultural Crops & Permanent Plantings Subcommittee	vacant		
MIA Fruit Fly Campaign Committee	John Davidson	T: 02 6951 2200	E: davidsonjc@bigpond.com
Vegetable Industry	Sandra McDougall	T: 0427 401 466	E: sandra.mcdougall@dpi.nsw.gov.au
Griffith & District Citrus Growers	Bob Sjollema	T: 0434 401 777	E: rsjollema@hotmail.com
Leeton District Citrus Growers	Sam Ciccia	T: 02 6955 6441	
Wine Grapes Industry	Kristy Bartrop	T: 0422 717 573	E: kbartrop@wgmb.net.au
Rice Research & Development Committee	Drew Braithwaite	T: 02 6963 4204	E: dbraith01@yahoo.com.au
Ricegrowers' Association of Australia	Andrew Bomm	T: 02 6953 0433	E: abomm@rga.org.au
Ricegrowers' Ltd. (SunRice)	Alan Walsh	T: 03 5882 4330	E: walsh6@ozsky.net
Maize Industry	Bernie Walsh	T: 0427 478 227	E: walshfarms@bigpond.com
Cotton Industry	Kieran O'Keeffe	T: 0427 207 406	E: kieran.okeeffe@cottoninfo.net.au
Murrumbidgee Irrigation	Sigrid Tijs	T: 02 6962 0200	E: sigrid.tijs@mirrigation.com.au
Coleambally Irrigation	Mike Ridley	T: 02 6954 4003	E: mridley@colyirr.com.au
Charles Sturt University	Toni Nugent	T: 0418 974 775	E: tnugent@csu.edu.au
CSIRO Land & Water	John Hornbuckle	T: 02 6960 1500	E: john.hornbuckle@csiro.au
NSW Department of Primary Industries	Deb Slinger	T: 0427 026 207	E: deb.slinger@dpi.nsw.gov.au
Murrumbidgee Private Irrigators Inc.	Iva Quarisa	T: 0402 069 643	E: ivaquarisa@gmail.com
Riverina Local Land Services	Anna Wilson	T: 0428 964 785	E: anna.wilson@lls.nsw.gov.au

Advertisers index

Booth Associates 21

Cropsol 35

Irribiz 36

MIA Rural Services 31

PHL Surveyors 39

Rubicon (IREC Bronze Sponsor) 19

Southern Cotton (IREC Gold Sponsor) 5

Unigrain 31

Yenda Producers 36

RURAL INDUSTRIES
Research & Development Corporation