Informing investment in irrigated grains R&D in southern NSW

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Key findings

- Analysis of wheat crops sown after rice harvest in the Murray Irrigation Ltd districts (MIL) found that increasing yields required different management depending on soil type and irrigation layout.
- Four management factors that limit winter crop yields were identified: waterlogging, late season water stress, under-fertilisation and low soil pH.
- In the MIL districts alone, increasing wheat yields after rice from the current median to the 80th percentile would result in an additional 20,000–30,000 tonnes per annum ($4–6 million at $200/t).
- If all rice areas were sown to wheat after harvest every year and 80th percentile yields achieved, an additional 128,000–138,000 tonnes of wheat would be produced ($26–$28 million at $200/t).

Introduction

Toohey and Chaffey (2006) examined the potential of irrigated grain production in the southern Murray–Darling Basin. The study had three key findings:

1. There is a need to lift irrigated grain productivity and profitability and to achieve higher efficiencies from using irrigation water because of cut-backs in water entitlements.
2. Irrigated wheat water use efficiency is low. In 2006, average wheat yields of 3.0 t/ha achieved 10 kg/mm/ha. There is the potential for improvement to 22 kg/mm/ha with yields of 10.4 t/ha – a figure being achieved in variety trials and by some growers.
3. Farm gate value for all crops studied was $176 million in 2006. If yields rose to best trial levels, farm gate value would nearly double to $347.7 million (at 2006 values).

Despite efforts since 2006 (e.g. the identification and development of cereal varieties for irrigation in the 'High yielding genotypes of winter cereals for irrigated regions of south east Australia project'), this situation is largely unchanged.

A new project being conducted by the Irrigated Cropping Council, NSW DPI, Deakin University, Murray Local Land Service and Precision Agriculture, with financial support from GRDC, started in July 2014. The long-term objective is to 'increase grain production and profitability from surface irrigated soils in the GRDC Southern Region by improving the understanding of the interaction between crops, soils, and irrigation and their effects on crop production'.

The first question that will be answered is 'What increase in grain production can we realistically expect from irrigated grains in the GRDC Southern Region if major constraints can be overcome?'

Grower survey of yield expectations

An online survey (2014) of irrigation areas in northern Victoria and southern NSW asked irrigated growers what their average and expected yields, and best ever yields were. The rationale behind this was if a best yield can be achieved once, then it should be possible to achieve it again. Our goal is to establish why it isn't achieved regularly and see if we can overcome the barriers. One hundred responses to the survey were received from irrigators with a wide range of farming systems. The results (Table 1) support the contention that there is significant potential to increase yields in all crops across the region: 2.0 t/ha for cereals and 0.8 t/ha for oilseeds.

Table 1. Expected and best ever yields of a range of crops grown in the irrigation areas of the southern Murray–Darling Basin based on a grower survey.

	Rice (t/ha)	Cotton (bales/ha)	Soy (t/ha)	Wheat (t/ha)	Barley (t/ha)	Canola (t/ha)	Faba bean (t/ha)	Chickpea (t/ha)
Expected yield (t/ha)	10.1	10.1	3.1	4.7	4.0	2.3	3.9	2.5
Best ever yield (t/ha)	12.1	12.8	3.9	6.6	5.9	3.1	4.6	3.4
Yield gap (t/ha)	2.0	2.6	0.9	1.9	1.8	0.7	0.8	0.9
Total no. responses	46	9	16	78	47	53	14	3

Table 2. Potential yield (median and 80th percentile) and yield gap for estimated areas of the Murray Irrigation Ltd area planted to wheat in rice layouts in 2013 and 2014.

Year	Surface drainage	Bay	Bay	Bay	Contour	Contour	Contour
	Internal soil drainage	*Fair*	*Poor*	*Very poor*	*Fair*	*Poor*	*Very poor*
2013	Median yield	3.5	3.5	3.2	2.9	2.3	2.8
	80th percentile yield	5.8	5.5	4.2	4.1	3.1	3.8
	Yield gap	2.2	1.9	1.1	1.1	0.8	1.1
2014	Median yield	3.6	3.6	2.4	2.3	2.1	2.2
	80th percentile yield	7.0	7.0	3.2	2.9	2.5	2.8
	Yield gap	3.4	3.4	0.9	0.6	0.4	0.6

Using GIS and satellite imagery to inform and prioritise R&D investment

Big data from GIS and satellite imagery were used to determine if yield increases are realistically achievable, to examine factors behind lower than expected yields, and to identify priority areas for R&D investment. Only the MIL districts were examined because digitised soil maps of the MIA are not currently available (work to include the MIA in this analysis is currently underway).

There are 145,500 ha of basin (contour) irrigation systems in the MIL districts. The area was categorised based on surface drainage and internal soil drainage. Using Landsat normalised difference vegetation index (NDVI) imagery taken in late August–early September we estimated the mid-season biomass of wheat sown after rice in these layouts in 2013 and 2014 and compared the NDVI readings with header grain yield from paddocks that had not been water-stressed in spring. This enabled an estimate of potential (non-water limited) yield of wheat sown after rice across the MIL districts categorised according to surface drainage and soil type.

Median and 80th percentile yields were obtained from the frequency distributions of the estimated yields in each drainage category. Table 2 shows the 80th percentile yields that were assumed to be achievable through better crop management. These can be summarised as follows:

1. On soils with better internal drainage (i.e. red–brown earths, transitional red–brown earths and self-mulching clays):
   - landforming to improve surface drainage will lift wheat yields by around 1.2 t/ha
   - better crop management can increase wheat yields by 2–3 t/ha in landformed bays
   - improving crop management in combination with landforming produces the greatest yield increases (3–5 t/ha).
2. On soils with very poor internal drainage (i.e. non self-mulching clays):
   - landforming to improve surface drainage will lift wheat yields by only 0.4 t/ha
   - better crop management only results in significantly better yields if paddocks are not subjected to waterlogging (e.g. 0.5 t/ha in 2014 when the autumn was wet compared with 1.0 t/ha in 2013 when the autumn was dry).

If yields from wheat sown immediately after rice can be lifted from the current median to the 80th percentile (Table 2), then there is the potential to increase wheat production in the MIL districts by 20,000–30,000 tonnes per annum ($4–6 million p.a. at $200/t).

If all the area under rice in the MIL districts was sown to wheat immediately after rice, and 80th percentile yields were achieved, then an additional 128,000–138,000 tonnes of wheat would be produced ($26–28 million p.a. at $200/t).

Caution is needed as these figures are based on potential yields estimated from NDVI and do not take into account the rice area sown to wheat after a fallow. It also omits border check and sprinkler systems and doesn't include the irrigated cropping areas of northern Victoria and the Murrumbidgee Valley. Despite this, it is the first time that wheat crop production has been estimated across an irrigation

district using objective data. This has allowed RD&E areas to be identified and prioritised, potential returns from that investment to be estimated, and provided a method by which we might monitor our progress.

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Reference

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