Variety specific agronomy for southern irrigated cropping systems

CROP	Wheat
IRRIGATION AREA	South-east South Australia
LOCATION	Bool Lagoon

Key findings

- Growers should utilise the tools, knowledge and rule of thumb guidelines accessible on the GRDC website.
- The correct variety should be sown at the correct time for maximum yield potential.
- Be prepared to sow early in a suitable paddock, knowing that seasonal conditions can dictate the success of dual purpose crops.
- Don't graze too early and remove stock before stem elongation (growth stage Z30).

Introduction

Irrigated wheat experiments were conducted at Bool Lagoon in the south-east region of South Australia between 2014 and 2016 as part of the 'Southern irrigated cereal and canola varieties achieving target yields' project (DAN00198). The objective was to improve irrigated cereal production through identification of varieties and agronomic practices with superior performance under irrigation.

In 2014, spring and winter wheat responses to various nitrogen and fungicide regimes were evaluated. In 2015 and 2016, the experiments focused on irrigated dual purpose wheat crops under different management regimes including sowing date, nitrogen rate and grazing intensity. These experiments were undertaken in response to MacKillop Farm Management Group (MFMG) growers highlighting the need to investigate the effect of management practices on dual purpose wheat under irrigation in the south-east region.

Seasonal reviews

The experiment site received its lowest rainfall on record in 2014 and highest rainfall on record in 2016 (Table 1). These extreme rainfall conditions had a strong influence on experiment results. In 2014 there was no significant interaction with grain yield and different nitrogen or fungicide regimes, and in 2016 the very wet conditions resulted in some experiment treatments being abandoned.

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Table 1 Experiment site annual rainfall (mm) (2014–16), long-term average rainfall, lowest annual rainfall recorded and highest annual rainfall recorded (source: www.bom.gov.au Bool Lagoon Station 26103, Lat. 37.13°S and Long 140.73°E).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	25.0	6.2	18.0	45.4	33.4	123.6	58.0	27.0	38.2	12.4	16.8	12.6	416.6
2015	48.2	1.4	14.8	24.2	79.2	40.2	64.4	40.0	34.0	1.6	49.0	13.2	410.2
2016	13.6	28.6	22.8	27.2	76.6	91.4	126.9	116.2	103.0	99.0	26.0	42.4	773.7
LT Mean	31.0	20.6	28.3	31.9	47.3	68.8	81.5	87.4	55.4	40.9	35.0	35.4	559.3
Lowest	0.8	1.2	4.2	10.0	10.8	13.0	37.5	25.4	26.2	1.6	8.9	8.0	410.2
Highest	138.4	49.6	73.4	72.2	97.0	146.8	126.9	166.4	103.0	99.0	81.6	116.2	773.7

Experiment site

Table 2 Experiment site details, 2014–16.

Site detail	2014	2015	2016
Soil	Alkaline shallow medium-heavy clay over limestone		
Previous crop	Persian clover	Persian clover	Persian clover
Sowing date (SD)	13 June	SD 1: 19 March (winter wheat) SD 2: 14 April (winter and spring wheat) SD 3: 14 May (winter and spring wheat) SD 4: 19 June (spring wheat)	SD 1: 14 April (winter wheat) SD 2: 2 May (winter and spring wheat) SD 3: 20 May (winter and spring wheat) SD 4: 1 June (winter and spring wheat)
Row spacing	150 mm	150 mm	150 mm
Irrigation	2.0 ML/ha spring irrigation	2.0 ML/ha spring irrigation	None applied
Starter fertiliser	DAP/SOA blend (19:13:0:9 of N:P:K:S) 140 kg/ha Impact® 400 mL/ha	DAP/SOA blend (19:13:0:9 of N:P:K:S) 140 kg/ha Impact® 400 mL/ha	DAP/SOA blend (19:13:0:9 of N:P:K:S) 140 kg/ha Impact® 400 mL/ha
Herbicides, fungicides and insecticides	RoundUp® 2 L/ha Sakura® 118 g/ha Dual Gold® 250 mL/ha Diuron 900 mL/ha MouseOff® 1 kg/ha Snail bait 5 kg/ha Suprathion® 200 mL/ha Buctril® MA 2 L/ha	RoundUp® 2.5 L/ha Goal™ 75 mL/ha Sakura® 118 g/ha Avadex® Xtra 1.6 L/ha MouseOff® 1 kg/ha 100 ml/ha Hussar® OD 100 mL/ha Starane™ Advanced 900 mL/ha BS1000 250 mL/ha Axe® 200 mL/ha Snail bait 5 kg/ha Soprano® 500 mL/ha Cogito® 250 mL/ha	Roundup® 4 L/ha Goal™ 75 mL/ha Lontrel™ Advanced 75 mL/ha WetterTX™ 200 mL/ha Avadex® Xtra 2 L/ha Sakura® 118 g/ha Snail bait 5 kg/ha Axe® 200 mL/ha Alpha Forte® 100 mL/ha Hussar® OD 100 mL/ha BS1000 250 mL/ha Prosaro® 300 mL/ha BS1000 500 mL/ha
Harvest date	6 January 2015	23 December 2015	SD 1: 23 December 2016 SD 2, 3, 4: 4 January 2017

Treatments

In 2014, the nitrogen experiment evaluated five nitrogen rates (Table 3) and the fungicide experiment evaluated four fungicide treatments (Table 4). Five wheat varieties with varying maturities were used in both experiments: LongReach Trojan⁽ᵈ⁾ (mid-fast maturing spring type), SQP Revenue⁽ᵈ⁾ (slow winter type), Manning⁽ᵈ⁾ (very slow winter type), Forrest⁽ᵈ⁾ (very slow spring type) and Einstein (late winter type). The nitrogen experiment had 300 mL/ha of Prosaro® fungicide applied on 17 September 2014 and the fungicide experiment had 60 kg N/ha applied on 9 September 2014.

Table 3 Nitrogen rates and wheat growth stage of application.

Treatment	Nitrogen rate	Growth stage applied
1	75 kg N/ha	31
2	150 kg N/ha	31
3	150 kg N/ha 50 kg N/ha	31 39
4	50 kg N/ha 100 kg N/ha 50 kg N/ha	22 31 39
5	Nil	-

Table 4 Fungicide treatments and wheat growth stage of application.

Treatment	Fungicide treatment	Growth stage applied
1	Triad 1 L/ha Triad 1 L/ha	31 39
2	Prosaro® 300 mL/ha + BS1000 500 mL/ha Prosaro® 300 mL/ha + BS1000 500 mL/ha	31 39
3	Amistar Xtra® 400 mL/ha Amistar Xtra® 400 mL/ha	31 39
4	Amistar Xtra® 400 mL/ha + Moddus Evo® 200 mL/ha + Errex® 1 L/ha Amistar Xtra® 400 mL/ha	31 39

In 2015 and 2016, two varieties – LongReach Trojan⁽ᵈ⁾ and Manning⁽ᵈ⁾ – were sown at four different sowing dates (Table 2). These varieties were selected from the 2014 experiment results as being high yielding spring (LongReach Trojan⁽ᵈ⁾) and winter (Manning⁽ᵈ⁾) wheat cultivars. Plots were either grazed (simulated with a mower) (Figure 1) or un-grazed. Grazing was targeted when plants were well anchored and to allow lock up by growth stage 30. In 2015, a post grazing application of either 300 kg N/ha (High N) or 150 kg N/ha (Low N) was applied, and in 2016 either 75 kg N/ha (High N) or 40 kg N/ha (Low N) was applied.

Figure 1 A grazed (mower simulated) treatment on the left compared with un-grazed treatment on the right.

Results and discussion

In 2014, plant establishment counts, days to first flower, normalised difference vegetation index (NDVI), plant height, grain yield and grain quality were recorded in both experiments.

There was a significant difference in grain yield only (not quality) between varieties, regardless of nitrogen or fungicide treatments (Table 5). Therefore, different management regimes did not significantly interact with grain yields.

Table 5 Variety grain yield (t/ha) averaged across all treatments in the nitrogen and fungicide experiment.

Wheat variety	Grain yield (t/ha)	
	Nitrogen experiment	Fungicide experiment
Einstein	5.0	4.7
Forrest⟠	5.8	5.6
Manning⟠	5.8	6.0
SQP Revenue⟠	5.6	5.5
LongReach Trojan⟠	7.0	6.6
Mean	5.9	5.7
l.s.d. (*P* <0.001)	2.8	3.2

In summary, the 2014 experiment showed grain yield differences between varieties but not interactions between grain yield and different management treatments imposed. The exceptionally dry weather conditions were not conducive to nitrogen or fungicide management (minimal disease pressure) experiments, even with additional irrigation.

The mid-fast maturing spring type LongReach Trojan⟠ was better suited to the dry conditions and shorter season compared with the longer season Einstein (the poorest performing variety in both experiments), not being suited to the heat stress at flowering given the seasonal conditions.

In 2015 and 2016, plant establishment counts, NDVI, dry matter production pre and post grazing, feed test analysis of dry matter, biomass at flowering, grain yield and grain quality were recorded.

In 2015, dry matter production of Manning$^{\phi}$ did not significantly vary between the sowing dates producing an average 957 kg/ha of dry matter when grazed (Figure 2). In contrast, LongReach Trojan$^{\phi}$ produced a greater amount of dry matter from SD 3 compared to the other sowing dates (Figure 2).

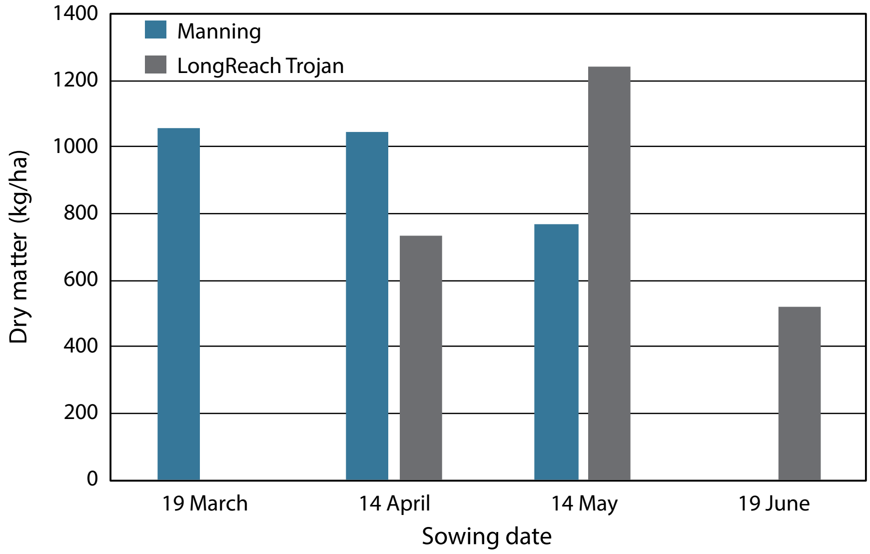

Figure 2 Dry matter production (kg/ha) of Manning$^{\phi}$ and LongReach Trojan$^{\phi}$ sown on three sowing dates in 2015.

There were no yield penalties for grazing Manning$^{\phi}$ in 2015, nor did sowing date or nitrogen rate interact with grain yield. On average, Manning$^{\phi}$ yielded 7.9 t/ha (Table 6). LongReach Trojan$^{\phi}$ did incur a yield penalty when grazed (average yield when grazed was 4.1 t/ha and the average yield when un-grazed was 6.8 t/ha). Grain yield decreased with delayed sowing dates (SD 2 yielded 5.9 t/ha, SD 3 yielded 5.3 t/ha and SD 4 yielded 4.9 t/ha). The combined interaction of grazing and time of sowing had a significant impact on grain yield (Table 7). Nitrogen regime did not significantly interact with grain yield.

Table 6 Grain yield (t/ha) of Manning⁽ᴾ⁾ wheat at different sowing dates, grazing treatments and nitrogen regimes.

Sowing date	Grazing treatment	Grain yield (t/ha)	
		High N	Low N
1. 19 March	Graze	7.7	7.7
	No graze	8.8	7.8
2. 14 April	Graze	8.2	8.1
	No graze	7.7	8.2
3. 14 May	Graze	7.5	7.4
	No graze	8.1	8.3
4. 19 June	Graze	-	-
	No graze	-	-
	Mean	7.9	
	P value (.0.05)	n.s.	n.s.

LongReach Trojan⁽ᴾ⁾ in the nitrogen management irrigated wheat experiment at Bool Lagoon, 15 September 2015.

Table 7 Grain yield of LongReach Trojan⁽ᵈ⁾ wheat (t/ha) at different sowing dates, grazing treatments and nitrogen regimes.

Sowing date	Grazing treatment	Grain yield (t/ha)	
		High N	Low N
1. 19 March	Graze	-	-
	No graze	-	-
2. 14 April	Graze	5.5	5.2
	No graze	6.4	6.7
3. 14 May	Graze	3.9	3.5
	No graze	6.9	6.9
4. 19 June	Graze	3.1	3.1
	No graze	6.8	7.3
	Mean	5.4	
	P value (0.05)	<0.001	
	l.s.d.	0.77	

The high growing season rainfall experienced in 2016 resulted in that year's experiment being exceptionally wet from June onwards, experiencing variable and lengthy waterlogging. As a consequence, grazing treatments were not imposed on Manning⁽ᵈ⁾ at SD 3 and SD 4 as there was insufficient dry matter to remove and mowing would have resulted in damage to the experiment plots. These plots still received the assigned nitrogen treatments.

The 2016 experiment results were highly variable and must be interpreted with caution. Dry matter production and grain yield were well below that of the 2015 experiment. Manning⁽ᵈ⁾ dry matter production averaged 504 kg/ha and did not vary between different sowing dates. LongReach Trojan⁽ᵈ⁾ dry matter production was exceptionally low (212 kg/ha). The experiment site had an average grain yield of 2.2 t/ha with grazing significantly decreasing the yields of both Manning⁽ᵈ⁾ and LongReach Trojan⁽ᵈ⁾.

The project

This variety specific agronomy package (VSAP) is an output of the 'Southern irrigated cereal and canola varieties achieving target yields' project (DAN00198; 2014–17). It summarises the research outcomes from experiments that were conducted in this research node on this crop type.

The objective of the project was to demonstrate an increase in irrigated cereal and canola production, and ultimately water use efficiency, through improvement of grower and adviser knowledge of high yielding cereal and canola varieties and specific agronomy management that will increase production and improve profitability under irrigation.

The project area extended from the Lachlan Valley in NSW to Victoria, Tasmania and across to south-eastern South Australia. The project comprised a series of research experiments to identify the optimum cereal and canola varieties and agronomic management practices for irrigated cereal and canola production in south-eastern Australia. Specific research questions were tailored to the geographic area, or research node.

Organisations that have contributed to the project by conducting research experiments and the location of their research node are NSW DPI (Murrumbidgee Valley, NSW; Murray Valley, NSW), Victorian Irrigated Cropping Council (Northern Victoria), Southern Farming Systems (Tasmania), MacKillop Farm Management Group (south-east South Australia), Central West Farming Systems (Lachlan Valley, NSW) and AgGrow Agronomy & Research (Lachlan Valley, NSW).

In addition to the VSAPs, the project also produced an irrigated wheat production manual and an irrigated canola production manual (available by contacting the author) and an extensive database of experiment results.

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