

Improving water use efficiency

This trial is funded by the GRDC in collaboration with the University of Adelaide and CSIRO

Key findings

- WUE was generally low at the 4 sites in 2009, ranging from 9.1 kg wheat/mm/ha at Tarlee to 12.2 kg wheat/mm/ha at Spalding.

Why do the trial?

Impressive gains in improving crop and systems water use efficiency (WUE) have been captured by Australian farmers over the past 30 years and some farmers are achieving close to their environmentally attainable yields in most seasons.

This trial will investigate the reasons for these differences in WUE by continuing with trials established at 4 sites in 2008 on different soil types and rainfall zones in selected grower paddocks. The sites established are:

- Hart, 400mm annual rainfall, sandy clay loam
- Condowie, 350mm, sandy loam
- Spalding, 450mm, red brown earth
- Tarlee, 550mm, cracking red earth

How was it done?

Plot size 8m x 10m

Seeding date	Hart 18 th May	Fertiliser	Hart	DAP@60 kg/ha+2% Zn
	Condowie 30 th April		Condowie	DAP@40 kg/ha+2% Zn
	Spalding 9 th May		Spalding	DAP@85 kg/ha+2% Zn
	Tarlee 1 st June		Tarlee	DAP@130 kg/ha+2% Zn

Each trial was a randomised complete block design with 3 replicates and 5 crops.

The 5 crops are Gladius wheat, Keel barley, Buckley wheat hay, Kasper peas and Tornado canola, grown in rotation to ensure weed free plots are available for wheat in each successive season.

All trials were sown with 50mm chisel points and press wheels on 225mm (9") spacing.

All cereal grain plots were assessed for grain yield, protein, wheat screenings with a 2.0 mm screen and barley screenings with a 2.2 mm screen.

Break crops (hay, peas and canola) were not assessed for grain or hay quality.

The hay was cut and removed from the plots by hand and assessed for hay yield.

Drained upper limit and crop lower limit (wheat) were measured at each site in 2008 to calculate plant available water capacity (PAWC).

WUE was calculated for the cereal crops at each site using the French & Schultz formula.

Wheat

Yield potential = (GSR-110mm)*20 kg/mm/ha

Barley

Yield potential = (GSR-90mm)*20 kg/mm/ha

Results

The wheat WUE was generally low compared to previous seasons for the 4 sites in 2009, ranging from 9.1 kg/ha/mm at Tarlee to 12.2 kg/mm/ha at Spalding (Table 1).

The lower rainfall sites Condowie and Hart received slightly above average GSR and the Spalding and Tarlee sites received about 125mm greater GSR than the average. However, there were some periods across all sites during the 2009 season where temperatures were well above average, especially leading up to flowering, and where soil moisture was limiting. Incidences of frost also occurred. Pre-flowering stresses combined with high temperatures during grain fill are likely to be the cause of lower WUE values compared to other seasons. WUE at the Tarlee site would have also been restricted by a later sowing date.

Table 1. Soil type, average total and average growing season rainfall (GSR), 2009 total and 2009 GSR and wheat and barley water use efficiency (WUE) for the four WUE sites in 2009.

Site	Soil type	Average total rainfall	Average GSR (mm)	2009 total rainfall	2009 GSR	Wheat	Barley
						WUE (kg/ha/mm)	
Condowie	sandy loam	349	252	359	288	11.6	17.6
Hart	sandy, clay loam	400	305	394	322	11.0	11.0
Spalding	red brown earth	434	322	541	437	12.2	13.2
Tarlee	cracking red earth	469	350	531	477	9.1	10.0

Wheat grain yields ranged from 1.96 t/ha (Condowie) to 4.00 t/ha (Spalding) and barley grain yields ranged from 3.51 t/ha (Condowie) to 4.57 t/ha (Spalding) (Table 2).

Protein was lower in the wheat at the higher rainfall sites, Spalding (11.0%) and Tarlee (10.0%), and all values were above 10.0%.

Wheat screenings were all below 1.5%, with Hart having the lowest, 0.9%. Barley screenings were highest at Condowie (8.4%), Tarlee produced the second highest (3.3%) and the remaining 2 sites produced screenings below 1.3%.

Table 2. Grain yield (t/ha), protein (%) and screenings (%<2.0 mm for wheat and %<2.2mm for barley) at the four WUE sites in 2009.

Site	Crop	Grain yield (t/ha)	Protein (%)	Screenings (%)
Condowie	Wheat	1.96	13.7	1.4
	Barley	3.51	11.7	8.4
Hart	Wheat	2.46	11.4	0.9
	Barley	4.08	11.3	1.3
Spalding	Wheat	4.00	11.0	1.4
	Barley	4.57	10.7	1.2
Tarlee	Wheat	3.33	10.0	1.4
	Barley	3.57	11.2	3.3

Pea yields ranged from 0.77 t/ha at Condowie to 3.16 t/ha at Tarlee (Table 3).

Canola yield was highest at Spalding (2.13 t/ha). At Condowie, the lower rainfall site, the canola yield was 0.91 t/ha, highlighting the potential benefits of early sowing in marginal environments. The missing canola yield at Tarlee is the result of poor plant establishment.

Hay yields ranged from 4.03 t/ha at Condowie to 8.33 t/ha at Spalding.

Table 3. Grain and hay yields (t/ha) for the break crops, peas, canola and hay, at the four WUE sites in 2009.

Crop	Condowie	Hart	Spalding	Tarlee
Grain or hay yield (t/ha)				
Peas	0.77	1.90	1.72	3.16
Canola	0.91	0.96	2.13	na
Hay	4.03	4.07	8.33	8.03

Acknowledgements: Brian Kirchner, Andrew and Rowan Cootes and Mark Hill.