Improving water use efficiency – reducing soil evaporation

This trial is funded by the GRDC and conducted in collaboration with Chris Lawson and Victor Sadras, SARDI, and Glenn McDonald from the University of Adelaide.

Key findings

- The addition of a straw layer acted to reduce evaporation and significantly increased grain yields and water use efficiency in 2012, at 4 field sites
- Soil evaporation also decreased with increasing light interception from larger crop canopies

Why do the trial?

Throughout southern Australia many trials have recently focussed on improving the retention of summer rainfall and have clearly shown that effective and early summer weed control increases stored soil moisture. Soil cover i.e stubble, throughout the summer period was shown to provide limited additional benefit.

This trial aimed to use a thick layer of cereal straw maintained within the growing season to focus on reducing the amount of moisture lost to soil evaporation. The trials were conducted on the previously established sites used in improving water use efficiency trials.

How was it done?

Plot size 8m x 10m

Seeding date	Hart 30th May 2012	**Fertiliser**	Hart	DAP @ 80kg/ha + 2% Zn
	Condowie 21st May		Condowie	DAP @ 65kg/ha + 2% Zn
	Spalding 17th May		Spalding	DAP @ 80kg/ha + 2% Zn
	Saddleworth 18th May		Saddleworth	DAP @ 100kg/ha + 2% Zn

Post emergent nitrogen:

The Hart site received 40kg N/ha on the 24th July and the other sites on the 13th August.

The extra nitrogen treatments received an extra 46kg N/ha on the 13th of August.

Each trial was a randomised complete block design with 3 replicates using Gladius wheat sown onto Gladius wheat.

The trials were sown into plots where in 2011 part of the plot was spread evenly with 6t/ha of oaten straw immediately after sowing. This straw layer provided about 95% soil cover. This straw layer had remained intact throughout the 2011 growing season, summer of 2011/2012 and autumn of 2012.

After sowing in 2012, half of the plot that was covered in 2011 was re-spread with 6t/ha oaten straw and the other half was raked clear of straw. In addition, 6t/ha oaten straw was spread onto half of the plot sown in 2012, which had no straw in 2011.

The trials were sown with 50mm chisel points and press wheels on 225mm (9”) row spacing. The soil was sampled down to 90cm for soil moisture on the 18th of May and averaged for 3 replicates.

All cereal grain plots were assessed for grain yield, protein, wheat screenings with a 2.0mm screen and barley screenings with a 2.2mm screen and retention with a 2.5mm screen.

Table 1. Pre-sowing total soil moisture (mm) down to 90cm at each site.

Site	Straw	0-20cm	20-50cm	50-90cm	Total
Condowie	Straw	25.6	45.6	75.0	146.2
	No straw	20.9	41.3	66.6	128.8
Hart	Straw	32.2	51.7	76.5	160.4
	No straw	34.6	51.4	78.1	164.1
Saddleworth	Straw	56.0	76.4	113.5	245.9
	No straw	54.2	84.7	94.4	233.3
Spalding	Straw	31.4	59.3	60.2	150.9
	No straw	28.5	53.5	53.1	135.1

Results

All the trials were dry sown in 2012 and combined with the varying layers of straw meant that crop emergence was highly variable and sometimes reduced in the straw plots. Higher weed burden in some of the straw plots also contributed to the variability in grain yields.

Pre-sowing soil moisture sampling between the plots covered with straw since sowing in 2011 and those with no extra straw have shown about a 15mm increase in soil moisture, down to 90cm. This ranged from 12mm at Saddleworth to 17mm at Condowie.

Across the four regional sites grain yields ranged from 1.66t/ha at Hart and Condowie up to 4.60t/ha at Saddleworth. At three of the sites the straw cover present from sowing in 2011 through to harvest in 2012 gave an increase in grain yield (Table 1). Compared to no extra straw this increase was 14% at Hart, 30% at Condowie and 43% at Spalding.

Table 1. Wheat grain yield for straw treatments applied at Condowie, Hart, Saddleworth and Spalding in either 2011 and / or *2012.*

Treatment		Hart	Saddleworth	Condowie	Spalding
Straw 2011	Straw 2012				
0	0	1.78	4.44	1.66	2.12
Yes	0	1.66	5.22	2.73	2.37
Yes	Yes	2.08	4.60	2.35	3.76
0	Yes	1.86	4.59	2.10	3.13
LSD (0.05)	Straw in 2011	ns	ns	0.4	ns
	Straw in 2012	ns	ns	ns	0.8
	Straw in both years	ns	ns	0.6	ns

At Condowie and Saddleworth the straw applied in 2011 and removed at sowing 2012 produced the greatest increase in yield compared to no straw, 39% and 15% respectively. This might be explained by the ability of these sites to store some of the above average rainfall from the 2011 harvest and summer.

Conversely, at Spalding the greatest influence on grain yield came from the straw applied in 2012 only, increasing grain yield by 32% compared to no straw.

The results from this trial work suggest that a thick layer of straw over summer can have a significant impact on subsequent grain yields. Logically, reducing the amount of sunlight hitting a soil surface, for instance by adding a layer of straw, will decrease the amount of moisture lost from soil evaporation. Figure 3 shows how the developing crop canopy at each of the sites was also able to reduce soil evaporation. As more light was intercepted by the crop canopies the proportion of water lost through soil evaporation decreased, thus leaving more water available for crop transpiration or growth.

Generating this sort of soil cover would be unrealistic in most paddocks and so future research will look at the benefits of standing stubble.

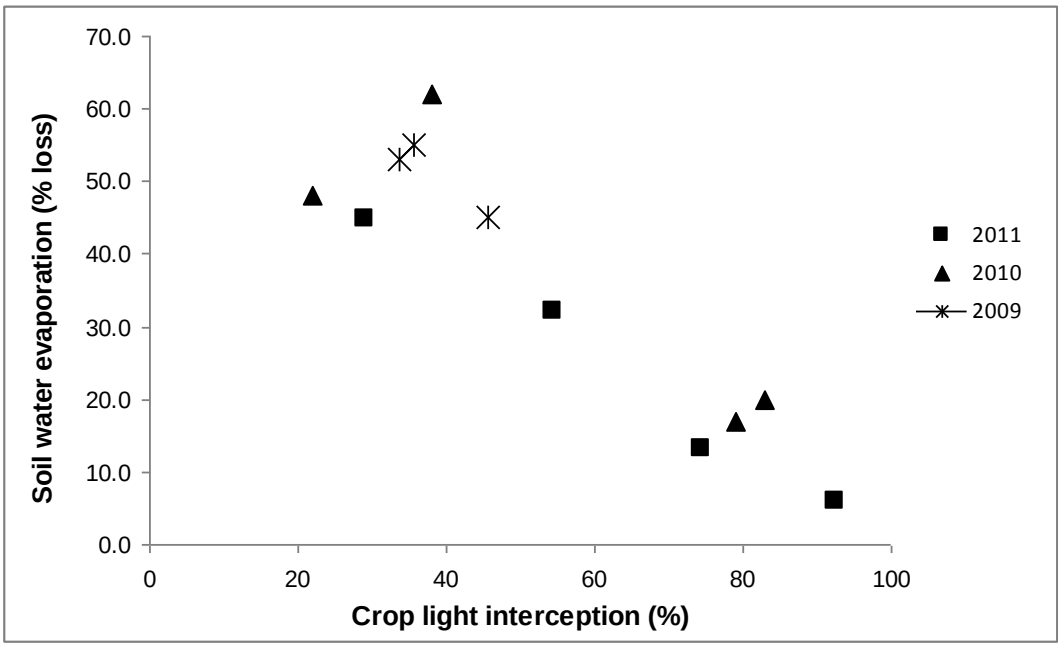

Figure 3: The percentage of total crop available water evaporated from the soil and the amount of light intercepted by the crop canopy during stem elongation at three sites in 2009 and 2010, and four sites in 2011.

Acknowledgements

The Hart Field-Site Group wish to thank Brian Kirchner and Simon Goldsmith, Andrew and Rowan Cootes, Michael and David Miller, David Hentschke and Matt Ashby for the use of their paddocks and cooperation with this trial work.