Conserving soil moisture, does stubble or a fallow help on Buntine sandplain?

Nadine Hollamby, Project Coordinator, Liebe Group

Aim

To determine if various farm management techniques improve the storage of out-of-season rainfall and whether this leads to improvements in crop growth and/or yield.

Background

After a decade of variable rainfall, in particular sporadic winter and summer rainfall, Liebe growers wanted a better understanding on how stubble management over the summer affects stored soil water, crop establishment, growth and crop yield. Storing more rainfall in the soils, compared to losing this rainfall to evaporation or weeds, can potentially increase yields by 0.3-0.5 t/ha (Oliver, 2011) and reduce the risk from drought. Therefore it is important to understand how much water your soils can hold (the plant available water capacity - PAWC), how much water can be stored over the summer (summer fallow efficiency) and how it is affected by summer stubble cover and rainfall distribution.

The Liebe Group - GRDC funded project has set-up 3 trials to examine these questions. With the assistance of CSIRO the data will be analysed for the 2011-2012 seasons and extended to other seasons with the use of crop simulation modelling (APSIM).

Trial Details

Property	Liebe Long Term Research Site, West Buntine
Plot size & replication	19m x 4m x 3 replicates
Soil type	Deep yellow sand
Soil pH (cacl)	Topsoil 5.5, Subsoil 4.6
EC	0.04 dS/m
Sowing date	30/5/11
Seeding rate	60Kg/ha Mace
Fertiliser	70 Kg/ha Agstar Extra + 50 Kg/ha Urea topdressed
Paddock rotation	08 wheat, 09 lupin, 10 wheat
Herbicides	30/5/11: 1.5 L/ha Sprayseed, 2.5 L/ha Boxergold pre sowing 4/7/11: 1 L/ha Jaguar 26/7/11: 0.5 L/ha Precept
Fungicide	19/8/11: 50 mL/ha Emporer
Growing Season Rainfall	295mm

Treatments

Treatment	Details	Date imposed
Fallow	Wheat crop sown then sprayed out before anthesis using a knockdown herbicide	August 2010
Burnt	Stubble was raking into a pile and burnt	March 2011
Standing stubble	Stubble harvested at 200mm above ground and spread (normal district practice)	December 2010
Flat stubble	Stubble flattened by dragging a chain dragged across the plot	January 2010

Results

By sacrificing the 2010 crop, yield in 2011 increased by 0.5 t/ha however, this was not significantly different from other treatments. The way in which stubble was managed made no difference to crop yield or protein (Table 1).

Table 1: Wheat yield and quality after stubble was burnt, flattered, left to stand or previous crop was fallowed.

	Yield (t/ha)	Protein (%)
Fallow	3.9	10.2
Burnt	3.4	9.9
Flat	3.3	9.8
Standing	3.1	9.8
LSD	*NS*	*NS*

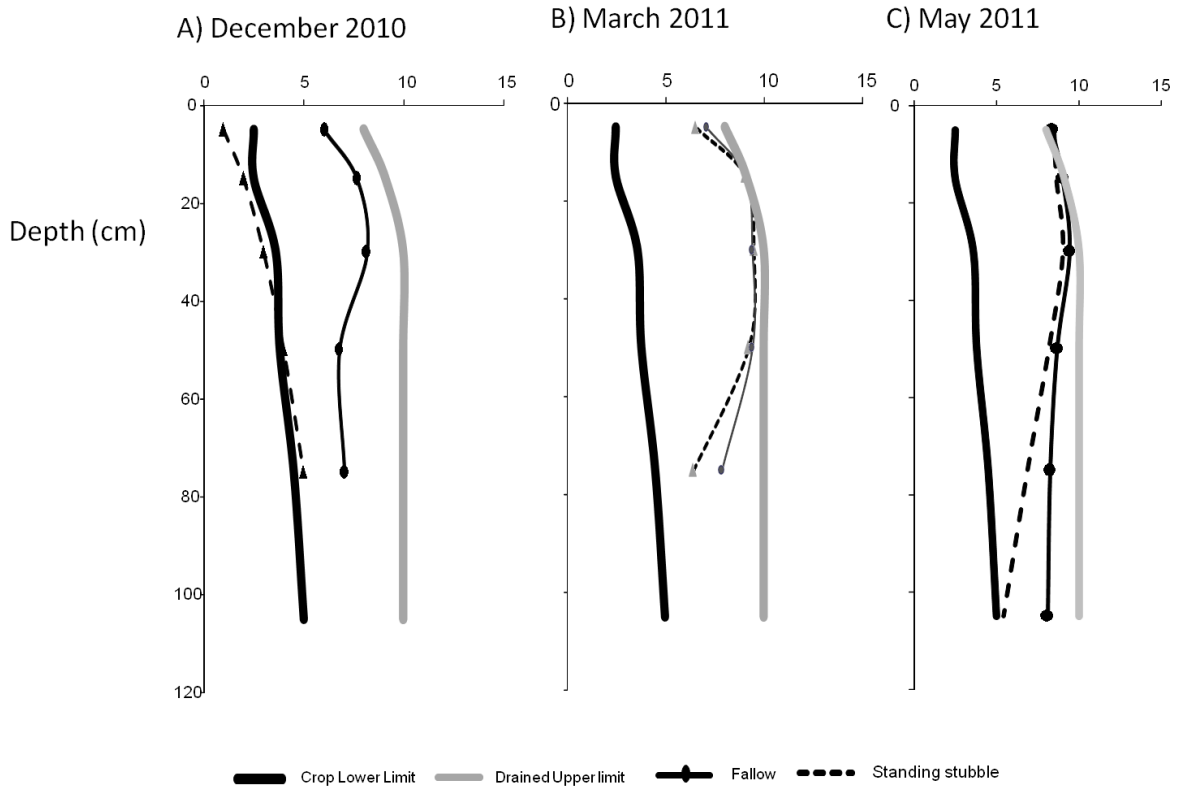

Figure 1: Soil water content at three times during the year under a fallow (crop sprayed out in August) compared to crop grown to maturity which leaves standing stubble, west of Buntine. Note: December and March sampling only conducted to 80cm, May sampling to 100cm.

Figure 1A shows that the fallow treatment has more water in the soil than the standing stubble in December because in a fallow situation this moisture is not being used by the crop and is 'saved' if it is below the evaporation zone. March rainfall wet the top 0-50cm of soil, pushing soil moisture close to the Drained Upper Limit for all treatments (Figure 1B). Due to this rain event the benefit of 'saving' water by using a fallow was not as great as would be expected in a dry summer. However, the fallow did have more water at depth which may have been protected from evaporation (Figure 1B). This extra water deep in the profile was still present in May (Figure 1C).

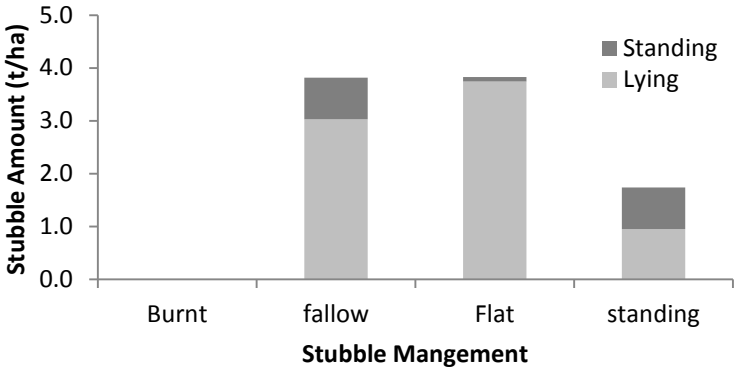

Figure 2: Stubble amounts at seeding in May 2011, west of Buntine.

Table 2: Stored soil water over the summer and just prior to sowing, the rainfall since 1st Dec 2010 and the fallow efficiency of this rainfall on deep yellow sand in Buntine PAWC to 0.9m = 88mm.

Date	Rainfall (1st Dec to date)	Stored soil water (to 0.9m) (mm)			Storage efficiency over period (stored water /rainfall)		
		Burnt	Flat	Standing	Burnt	Flat	Standing
15th December	0	0	0	0			
9th March	56	38	36	39	68%	64%	70%
8th April	64	29	28	22	45%	44%	34%
24th May	93	40	43	39	43%	46%	42%

At the beginning of the summer, after large rainfall events, the standing stubble treatment had 70% of rainfall stored in the soil (Table 2). However, by seeding time the storage efficiency has decreased to 42%. A storage efficiency of between 70-40% is good for this soil type. According to APSIM modelling (Agricultural Production Systems Simulator) over the last 50 years a good sand with good weed control and stubble cover can expect to hold about 40% of the rainfall it receives. The other 60-70% of rainfall is mostly lost to evaporation (which in summer can be as high as 10 mm/day) with some rainfall also lost to runoff or drainage below the root zone when the rain falls in large amounts. The summer storage efficiency varies from year to year depending on the pattern of summer rainfall. In this trial having burnt stubble did not significantly reduce storage efficiency (Table 2). However, computer modelling for the Dalwallinu area shows that stubble cover of 3 t/ha slightly increased stored soil moisture but not in all years. In this trial the orientation of stubble (either lying or standing) doesn't change evaporation, which is consistent with observations in other research and computer modelling.

Comments

While stubble delays evaporation it cannot prevent it. In this trial and season, stubble amount and orientation did not change crop yield or the amount of moisture in the soil. However, past research and grower practice has documented the importance of retaining stubble for a number of other reasons such as wind erosion prevention, water infiltration, nutrient cycling and carbon storage. The implementation of a fallow did enable some extra moisture to be stored deep in the sub soil; however, this did not lead to a significant yield increase in 2011 on this soil type.

Acknowledgements
GRDC for funding the work through LLE00006, 'Improved stubble & soil management for sustainable farming systems in the Liebe area'.

Paper reviewed by: Chris O'Callaghan, Liebe Group
References
Oliver YM, Robertson MJR. *Benefit from long and short fallow in Liebe area: Soil water, stubble management and yield.* Liebe Crop Updates 2011.

Contact
Nadine Hollamby, Liebe Group
nadine@liebegroup.org.au
(08) 9661 0570