

Conserving soil moisture, does stubble or fallow help on a farm scale?

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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 - Red loamy duplex

Property	Keith Carter, Jibberding
Plot size & replication	15m x 300m not replicated
Soil type	Red loamy duplex (York gum)
Soil pH (CaCl ₂)	4.6 surface, 4.8-5.1 at 10-40cm, 6.4-7.8 at 40-100cm
EC (1:5)	Non saline (0.15-0.32 dS/m)
Seeding date	24/5/11
Fertiliser	24/5/11: 70 kg/ha Agstar, 36 L/ha Flexi-N 18/7/11: 40 L/ha Flex-N
Paddock rotation	2009 peas, 2010 wheat
Herbicide	18/1/11: 350 mL/ha Sprayseed, 200 mL/ha Ester, 70 mL/ha Garlon 15/3/11: 1.1 L/ha Roundup, 500 mL/ha Ester, 100 mL/ha Garlon, 10 g/ha Metsulfuron 24/5/11: 1.5 L/ha Gladiator, 1.3 L/ha Triflurin, 10 mL/ha AuSu ² , 300 mL/ha Diuron 24/6/11: 200 mL/ha Precept, 400 mL/ha LVE-MCPA
Growing season rainfall	231mm

Trial details – Sand over gravel

Property	Keith Carter, Jibberding
Plot size & replication	15m x 300m not replicated
Soil type	Sand over gravel (Sugar bush)
Soil pH (CaCl ₂)	5.2 surface, 4.8-5.2 at 10-100cm depth
EC (1:5)	Non saline (0.12-0.18 dS/m)
Seeding date	25/5/11
Fertiliser	25/5/11: 70 kg/ha Agstar, 40 L/ha Flexi-N 16/7/11: 40 L/ha Flexi-N 29/8/11: 20 L/ha Flexi-N

Paddock rotation	2009 mixed pasture, 2010 wheat
Herbicide	25/2/11: 600 mL/ha Sprayseed, 400 mL/ha Ester, 100 mL/ha Garlon 25/3/11: 1.4 L/ha PowerMax, 5 g/ha Metsulfuron 25/5/11: 1.2 L/ha Roundup PowerMax, 1.4 L/ha Triflurin, 0.3 L/ha Diuron, 10 mL/ha li700 30/5/11: 1 L/ha Sprayseed, 0.3 L/ha Gramoxone, , 20 mL/ha Logran
Growing season rainfall	242.7 mm

Treatments

Treatment	Details	Date imposed
Fallow	Wheat crop sown then sprayed out before anthesis using a Glyphosate	August 2010
Bare	Stubble was raking into a pile, piles burnt	March 2011
Standing stubble	Stubble harvested at 200mm and spread (normal district practice)	December 2010
Flat stubble	Stubble flattened by dragging a chain between two vehicles. This practice was once used in district but is now rarely seen	January 2010

Results

Spraying out the 2010 crop in August to create a fallow increased yield of the 2011 crop by 0.7 t/ha on the red loamy duplex and 0.4 t/ha on the sand over gravel (Figure 1). Whether the stubble was standing, flat or removed (bare) made no difference to yield on either soil type.

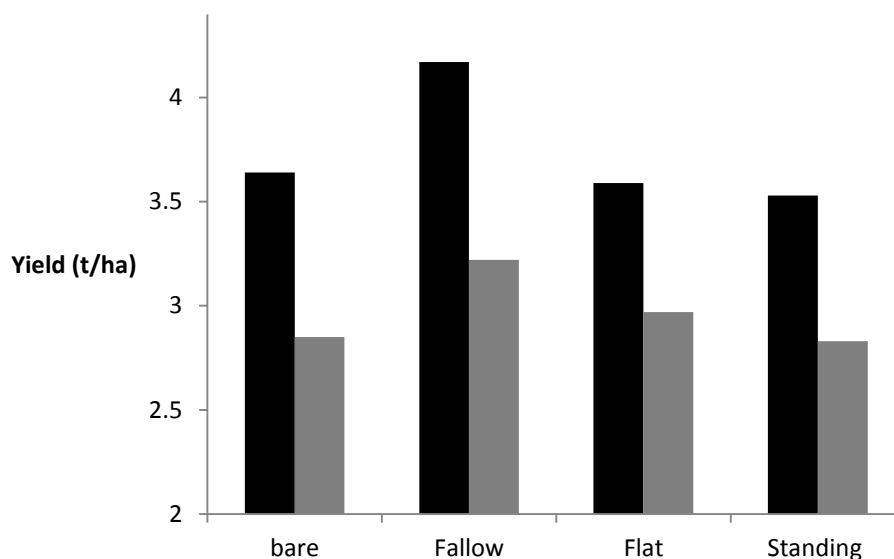


Figure 1: Wheat yield on a red loamy duplex (black) and sand over gravel (grey) after different stubble management practices.

What is PAWC and PAW?

The Plant Available Water Capacity (PAWC) is the amount of water a soil can hold that is available for use by the crops. It is the difference between the soil water measured at Crop Lower Limit (CLL) which the extent to which a particular crop can extract water from a particular soil type. This was the soil water content measured in December 2010 at each site as there has been no large end of season rainfall and is the solid black lines in Figure 2. Drained Upper Limit (DUL) is the amount of water that a soil is able to hold after drainage has ceased, often taken at wettest time of year or from ponding a large amount of water in the profile and allowing drainage to occur. DUL is indicated by the solid grey lines in Figure

2. The Plant Available Water Capacity is affected by the soil type (soil texture), soil constraints and the crop rooting depth. Only data from the light soil is shown in this report because PAWC has not been correctly measured for the red loamy duplex demo trial. The sites had good weed control.

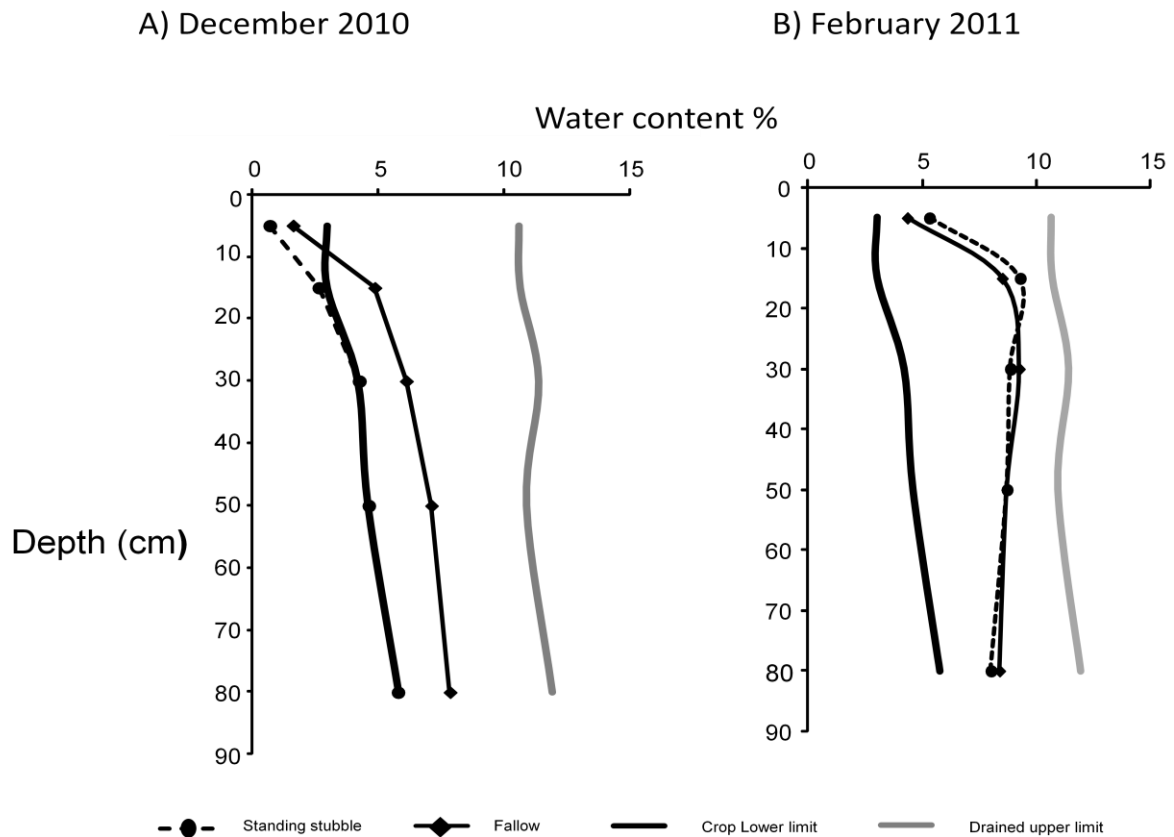


Figure 2: Soil moisture on sand over gravel west of Wubin just after harvest (A) and after a large rainfall event (B).

Imposing a fallow (spraying the 2010 crop in August) resulted in more soil water in the soil after harvest (Figure 2A), however, after a 50mm rainfall event in February the amount of water in the soil increased considerably for both the fallow plot and standing stubble (Figure 2B). Therefore any moisture ‘savings’ from the fallow were lost as the soil profile fills up with summer rain.

In February the sandy soil had stored 36% of rainfall, however, by May this had decreased to 16% (22mm out of 138 mm of rainfall) probably due to evaporation which can be up to 10 mm/day in summer (Table1). A stored water efficiency of 36% is considered good however, 16% is considered poor. In comparison the APSIM computer model for a good sand in Perenjori with good weed control and high stubble load can store 38% of rainfall. However, if weed control is poor and there is no stubble to protect from, storage was 27%. There are small but not important differences in storage efficiency depending on whether stubble is flat, standing or burnt.

Table 1: Stored soil water over the summer and just prior to sowing, the rainfall since 1st December 2010 and the fallow efficiency of this rainfall on the sand over gravel 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	1.3						
28 th Feb	92.3	30	33	33	33%	36%	36%
12 th April	112.8	35	30	31	31%	27%	27%
20 th May	138.3	*	28	22		20%	16%

Comments

Imposing a fallow from August onwards increased yield slightly in 2011 (0.7 t/ha in the red duplex soil and 0.4 t/ha in the sand over gravel), Figure 1. As this was not a fully replicated trial it is hard to tell if this yield difference is a significant increase. In a wet year such as 2011 it is unlikely the yield benefit was due to stored soil moisture but rather from difference in nitrogen content in the soil and other agronomic benefits of a fallow. These areas will be further investigated in the coming year.

Acknowledgements

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

Keith Carter & Co. for hosting the trial.

Paper reviewed by: Chris O'Callaghan, Liebe Group.

References

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