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

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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 of drought stress. 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 and how it is affected by summer stubble cover, fallow and rainfall distribution.

The type of fallow used in this trial was a short 'opportunistic' fallow, where the crop was planted but then sprayed out in August. This is opposed to a strategic fallow, where no crop is planted. This trial was set up in 2010 with crop yields being recorded in 2011 and 2012.

Trial Details

Property	Liebe Group Long Term Research Site, west of Buntine
Plot size & replication	19m x 4m x 3 replicates
Soil type	Deep yellow sand
Soil pH (CaCl2)	Topsoil 5.5, Subsoil 4.6
EC	0.04 dS/m
Sowing date	16/5/12
Seeding rate	4 kg/ha Telfer
Fertiliser	100 kg/ha Agstar Extra
Paddock rotation	2009 lupin, 2010 wheat, 2011 wheat
Herbicides	16/5/12: 2 L/ha Spray Seed, 1 kg/ha Atrazine, 1.5 L/ha Trifluralin 29/6/12: 1.1 kg/ha Atrazine 18/7/12: 500 mL/ha Clethodim 15/10/12: 1.7 L/ha Roundup Attack
Insecticide	16/5/12: 100 mL/ha Dominex 200 mL/ha Talstar 29/6/12: 100 mL/ha Dimetholoate, 100 mL/ha Cypermethrin
Growing Season Rainfall	162.5mm

Table 1: Trial treatments

Treatment	Details	Date imposed
Short Fallow	Wheat crop sown then sprayed out before anthesis using a knockdown herbicide	August 2011
Burnt	Stubble was raked into a pile and burnt	March 2011
Standing stubble	Stubble harvested at 200mm above ground and spread (normal district practice)	December 2011 and 2012
Flat stubble	Stubble flattened by dragging a chain dragged across the plot	January 2011 and 2012

Results

Fallowing the 2011 crop by spraying it out in August resulted in 45kg of extra nitrogen being available to the next crop comparing to continuous cropping with standing stubble, (Figure 1). This increase in nitrogen is likely to have occurred for two reasons. Firstly the same amount of fertiliser was applied across the trial and when the fallow plot was sprayed out in August 2011 there was likely to be unused nitrogen in the soil. Secondly, organic forms of nitrogen in the soil have mineralised over the 2011 growing season and summer and without a crop to use it this nitrogen was 'saved' for the next season.

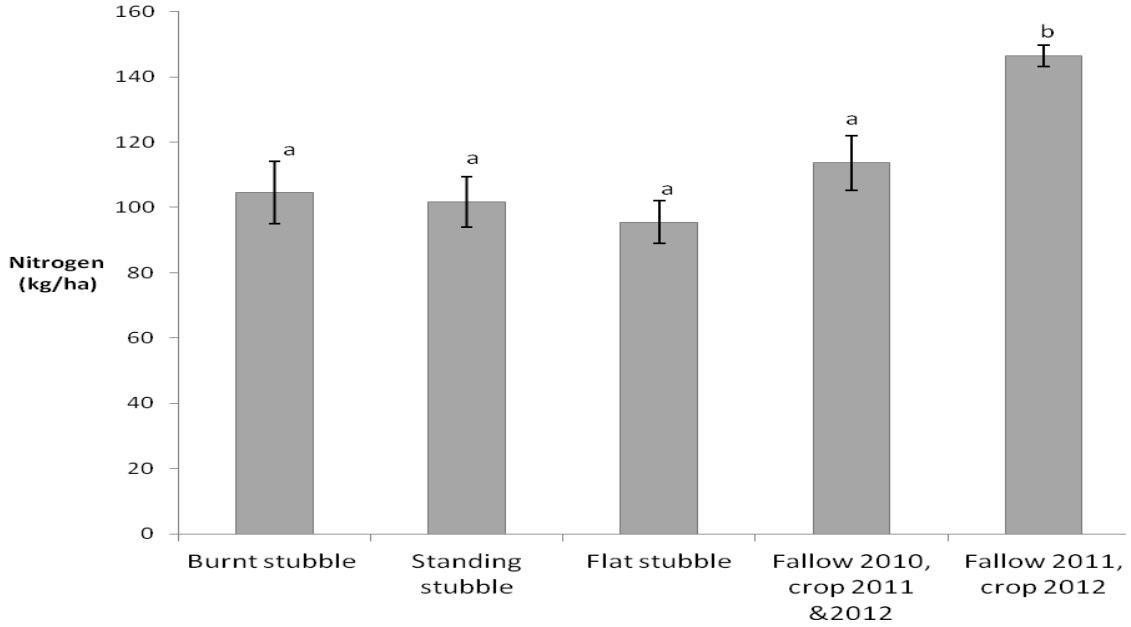

Figure 1: Total nitrogen (kg/ha) in the soil profile to a depth of 120cm in May 2012 before seeding canola for various stubble and fallow treatments. Treatments with the same letter above them are not significantly different from each other.

Imposing a spray fallow in August 2011 resulted in a 0.3 t/ha yield increase in 2012 compared to continuous cropping and standing stubble (Table 2). The extra soil nitrogen may have contributed to this yield increase. The biggest difference in nitrogen between the short fallow and continuous crop was in the 0-10cm layer with 67 kg/ha in the fallow and 37 kg/ha in the standing stubble.

Table 2: Yield and oil content for 2012 canola crop grown after spray fallow of previous wheat crop or continuous cropping with stubble burnt, flattened or left standing at Buntine.

Treatment	Yield	Oil
Fallow 2011, crop 2012	1.1 *a*	41.8 *a*
Continuous crop, Burnt stubble	0.9 *b*	43.1 *b*
Fallow 2010, crop 2011&2012	0.9 *b*	42.6 *ab*
Continuous crop, Standing stubble	0.8 *bc*	43.3 *b*
Continuous crop, Flat stubble	0.7 *c*	43.5 *b*
LSD	*0.16*	*1.0*

Note: Treatments with the same letter next to them are not significantly different from each other.

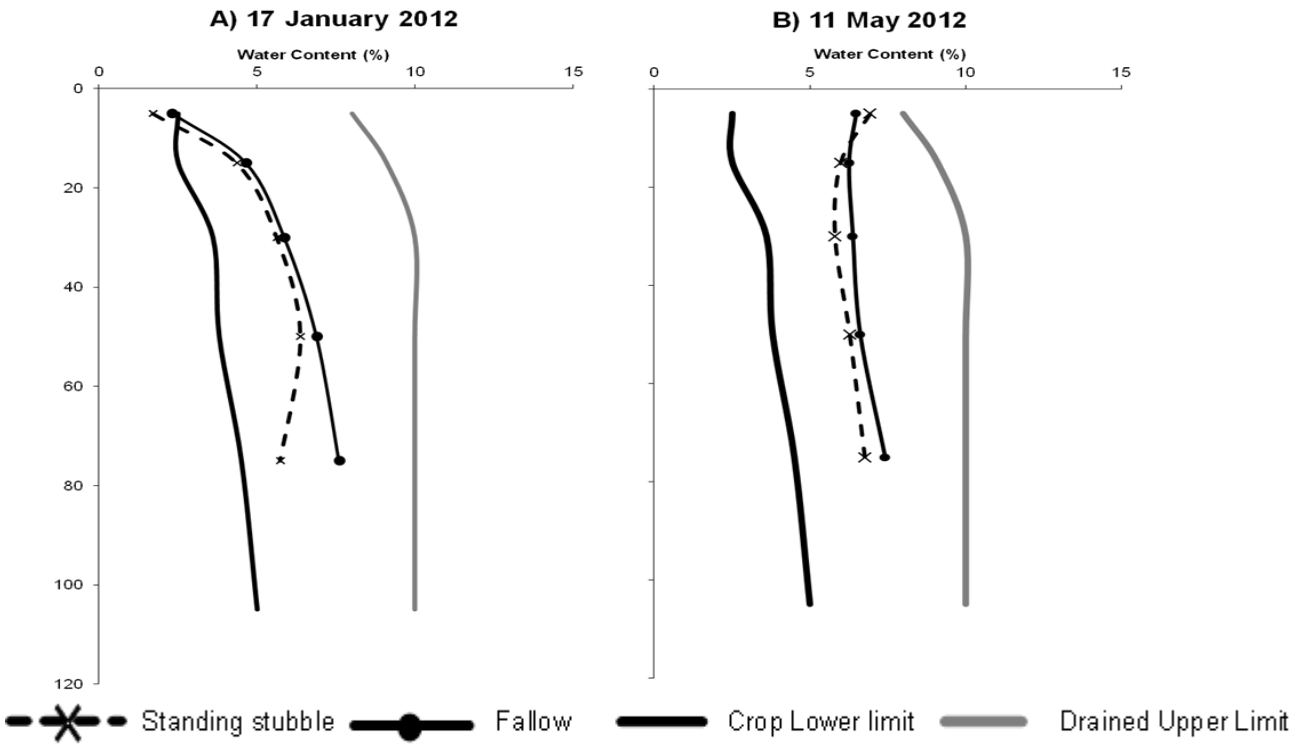

Figure 2: Soil water content at two times during the year under a fallow (previous crop sprayed out in August) compared to crop grown to full maturity which leaves standing stubble west of Buntine.

There were no large differences in stored soil water between the fallow and a normal standing stubble with continuous crop (Figure 2). In January there appeared to be slightly more water in the fallow at depth (Figure 2a) but by time the crop was seeded in May no subsoil difference was detected. An early rainfall event of 16mm at the end of April increased the moisture in the top soil in Figure 2b. It is unlikely that the yield benefit from the short fallow was due to soil moisture.

Comments

- Spraying out the crop in August to produce a short fallow increased the yield of the next crop by 0.3 t/ha compared to continuous cropping. Increased nitrogen mineralisation contributed to this yield benefit.
- The short fallow did not increase soil water storage.
- Water and nitrogen benefits are just two aspects of agronomy which could have contributed to the yield increase. Other agronomic factors which were not studied in this trial but are known benefits of fallow are weed control and disease breaks.
- This type of yellow sand is not typically the sort of soil type considered economical to fallow. The probability of getting a yield benefit over 1 t/ha on sand in Dalwallinu is 4%, compared to 11% in clay soils. (Oliver & Hollamby, 2012). Wind erosion is also a risk in this soil type.

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