Conserving soil moisture; does stubble or a fallow help on sandy soil?

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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 yield.

Background

Fallowing a paddock for 18 months can be a crop rotation tool to conserve soil moisture and thus reducing risk of crop failures in dry seasons following fallow. Its effectiveness depends on soil type and rainfall. Other benefits to fallow include weed control and nitrogen mineralisation. The use of a fallow is of interest to Liebe members who are getting out of sheep and lupins; two traditional paddock rotation tools.

In this trial the paddock was fallowed for 10 months by planting a crop then spraying it out in August to replicate a 'opportunistic' fallow that would be used in the event of high weed burden or extremely poor potential crop yield. Therefore results here differ from an 18 month fallow where no crop is planted.

The Liebe Group - GRDC funded project has set-up 3 trials to examine these questions, and 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	Keith Carter, east of Wubin
Plot size & replication	15m x 300m, not replicated
Soil type	Sand over gravel
Soil pH ($CaCl_2$)	0-10cm: 5.2 10-60cm: 4.8
EC	Non saline (0.15-0.32 dS/m)
Sowing date	10/5/12
Seeding rate	40 kg/ha Magenta wheat
Fertiliser	10/5/12: 70 kg/ha K-Till Extra, 50 L/ha Flexi-N banded 23/7/12: 20 L/ha Flexi-N
Paddock rotation	2009 pasture, 2010 wheat, 2011 wheat
Herbicide	3/2/12: 1.2 L/ha Glyphosate, 0.5 L/ha Ester 800, 0.15 L/ha Garlon 4/5/12: 120 g/ha Sakura, 0.1 L/ha Ester 800, 1.5 L/ha Roundup 13/8/12: 0.35 L/ha Paragon, 0.3 L/ha MCPA
Growing season rainfall	145mm

Table 1: Trial treatments

Treatment	Details	Date imposed
Fallow	Wheat crop sown then sprayed out before anthesis using a knockdown herbicide.	August 2011
Old fallow	Wheat crop was sown then sprayed out in August 2010, thus the 2012 crop is its second wheat since a fallow was imposed.	August 2010
Standing stubble	Stubble harvested at 200mm and spread (normal district practice).	December 2010/2011
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

Table 2: Wheat yield and quality after fallow or flattening stubble, east of Wubin 2012.

Treatment	Yield (t/ha)	% NN control*	Protein %	Hectolitre weight
Continuous crop with standing stubble	1.1	100	12	79
Old fallow	1.1	100	13	82
Flattened stubble	1.1	92	13	79
Continuous crop with standing stubble	1.2	100	12	82
Fallow	1.4	116	12	80

*NN is nearest neighbour control, which is a way of comparing treatments. Continuous crop with standing stubble is used as the control treatment in is trial. Different treatments (i.e. fallow) are compared to the nearest continuous cropped strip.

The fallow plot yielded 0.2 t/ha more than the continuously cropped strip alongside it. There appears to be no second year yield benefit from the old fallow plot which was fallowed in 2010 and cropped in 2011 and 2012. Flattening stubble had no effect on yield. This is an unreplicated demonstration so it is difficult to tell whether yield gains were due to natural variation such as soil type or an effect of the fallow.

Nitrogen

Nitrogen supply was good at the beginning of the season with an extra 52 kg/ha of nitrogen being present after the fallow (Table 3). The old fallow plot which was cropped in 2011 appears to be showing a second year residual benefit with an additional 29 kg/ha compared to the continuous crop. Most of this extra nitrogen was in the form of nitrate which has built up in the fallow plot as mineralisation that occurred over the season (particularly in wet, warm conditions) and was not used by a crop (Figure 1). Another 36 kg/ha of nitrogen was added as fertiliser during the season.

Table 3: Total nitrogen (ammonium and nitrate) in top 90cm of soil on 1st March 2012.

Treatment	Nitrogen in top 0-10cm	Nitrogen in subsoil 10-90cm.	Total Nitrogen (kg/ha)
Continuous crop	38	46	84
Fallow	77	59	136
Old fallow	58	55	113

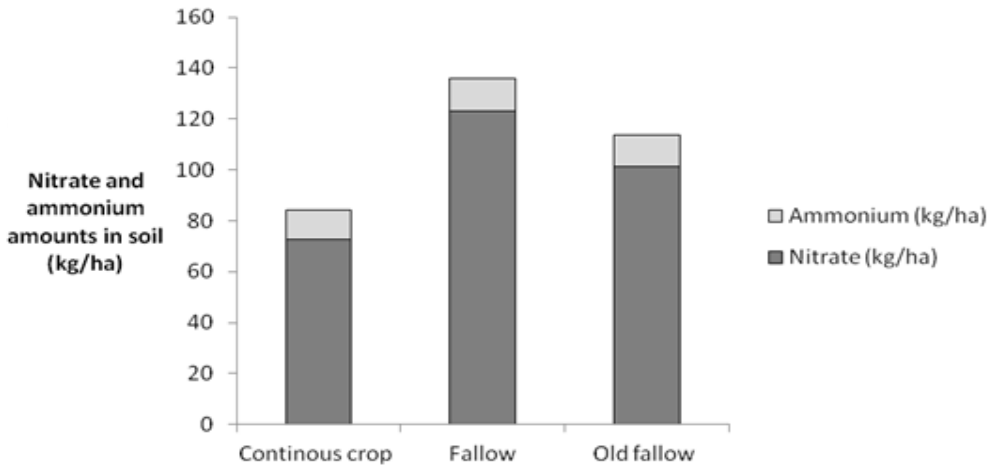

Figure 1: Nitrate (kg/ha) and ammonium (kg/ha) amounts in 0-90cm of soil under different management practices. Samples taken east of Wubin on 1st of March 2012.

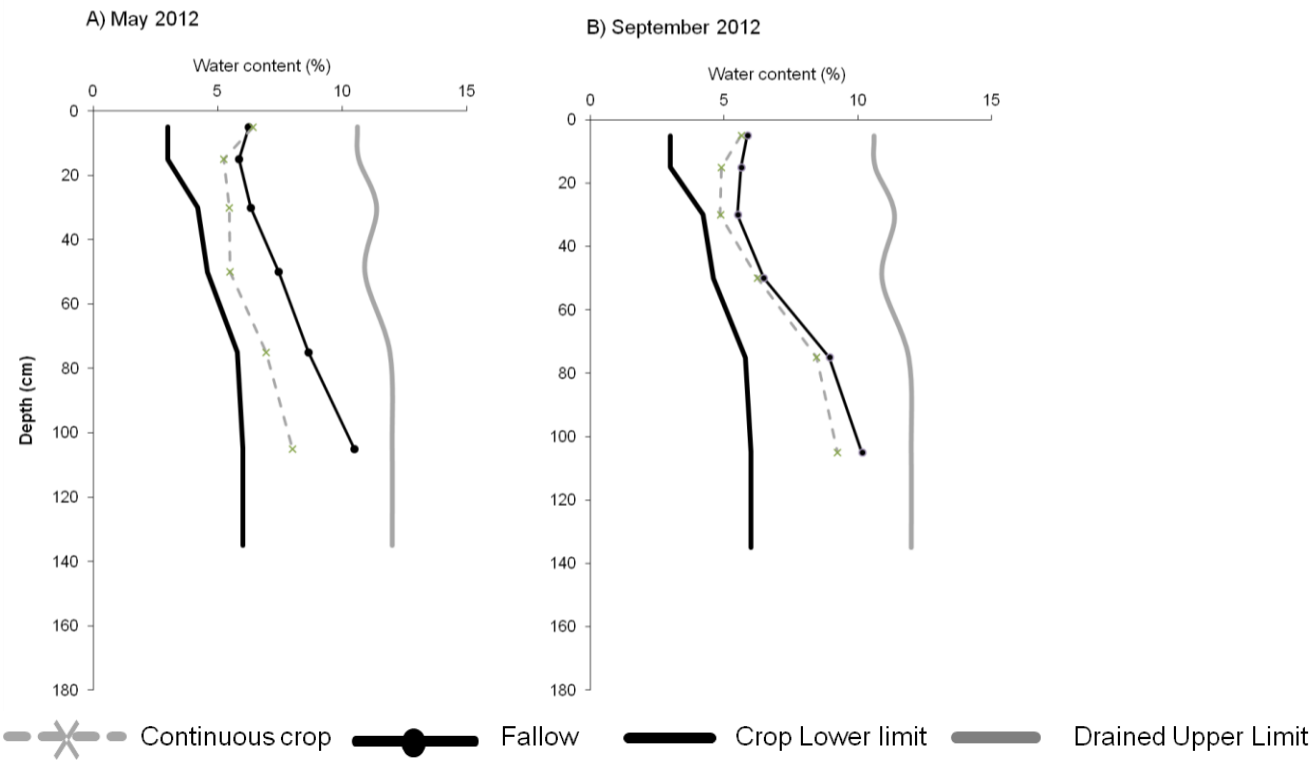

Figure 2: Soil moisture on a sand over gravel, east of Wubin in May (A) and September (B).

Figure 2a shows that in May 2012 the fallow did contain more water down the soil profile, from about 40cm compared to a continuous crop. At this depth evaporation rates are low. The extra water could be the reason for the crop which followed the fallow, yielding 0.2 t/ha more than continuous cropping. By September 2012 (Figure 2b) the fallow and continuous crop plots have the same amount of water. This is because the plant roots are now growing in the sub soil using the 'extra saved' water.

Comments

This is the second season in which this trial has been run and the fallow has yielded higher than continuous cropping in both 2011 (0.4 t/ha) and 2012 (0.2 t/ha). Other research indicates that fallows produce yield benefits in dry seasons which are not the case in the crop in 2011, which received 231mm for the growing season. The yield difference in 2011 was therefore more likely to have been the result of extra nitrogen in the soil, or weed or disease control rather than soil water benefits, however, these were not measured.

Farm economics need to be carefully considered before implementing a fallow, the opportunity cost of not producing a crop needs to be weighed up, and benefits of yield, extra N, weed control and disease breaks carefully factored into the decision.

In 2012 the yield benefit from fallow was 0.2 t/ha and likely to be due to extra nitrogen and water being present in the soil. However, this is an unreplicated demonstration and thus it is hard to tell whether yield differences are the result of fallow or random variation in the paddock.

Acknowledgements

GRDC for funding the trial and Keith Carter & Co for hosting the trial.

Paper reviewed by: Chris O'Callaghan, Liebe Group

References

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