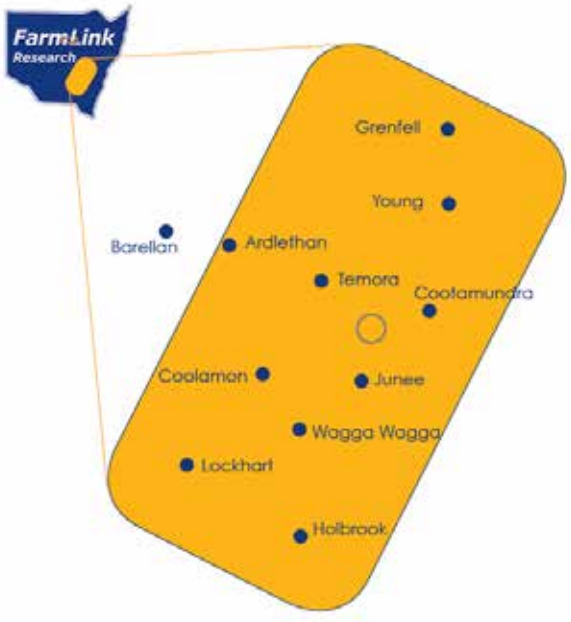
Increasing Soil Carbon

2014 Trial Site



Project Partners

FarmLink Research

GRAHAM CENTRE for Agricultural Innovation

NSW GOVERNMENT Department of Primary Industries

Funding Partner

clean energy future

Australian Government
Department of Agriculture

Enabling landholders to adopt profitable and sustainable carbon cropping practices

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Project Description

This project is FarmLink's contribution to a large federally funded Department of Agriculture project lead by the CSU Graham Centre. Farm practices to increase the sequestration of carbon in soil through different stubble/nutrient practices (from burnt to fully incorporated with nutrients is being tested), on 14 properties across the dryland and irrigated broadacre cropping regions of southern and central NSW and Victoria. Change in soil carbon in two years is being measured as well as any yield effects.

Aim

To test the practicality of increasing soil humic carbon on farm.

Methods

Initial Design

Farmer hosted paddock scale demonstration trials

- 2 location sites
- GPS capabilities for sowing and harvest as well as mapping
- Conduct operations in relation to the trial
- Observe trial protocols and guidelines

3 core treatments:

1. Standing Stubble
2. Incorporated - Nutrients
3. Incorporated + Nutrients

Each treatment repeated twice in two blocks.

No of strips = 2 blocks x 3 treatments x 2 repeats = 12 strips

Soil sampling:

- 3 sampling locations per strip/block
- 2 depths 0-10cm and 10-30cm
- 78 soil samples before and 78 after experiment/demonstration.

Stubble Incorporation:

- Speedtiller supplied by local machinery company

Nutrient Spreading

- Ute mounted trial spreader

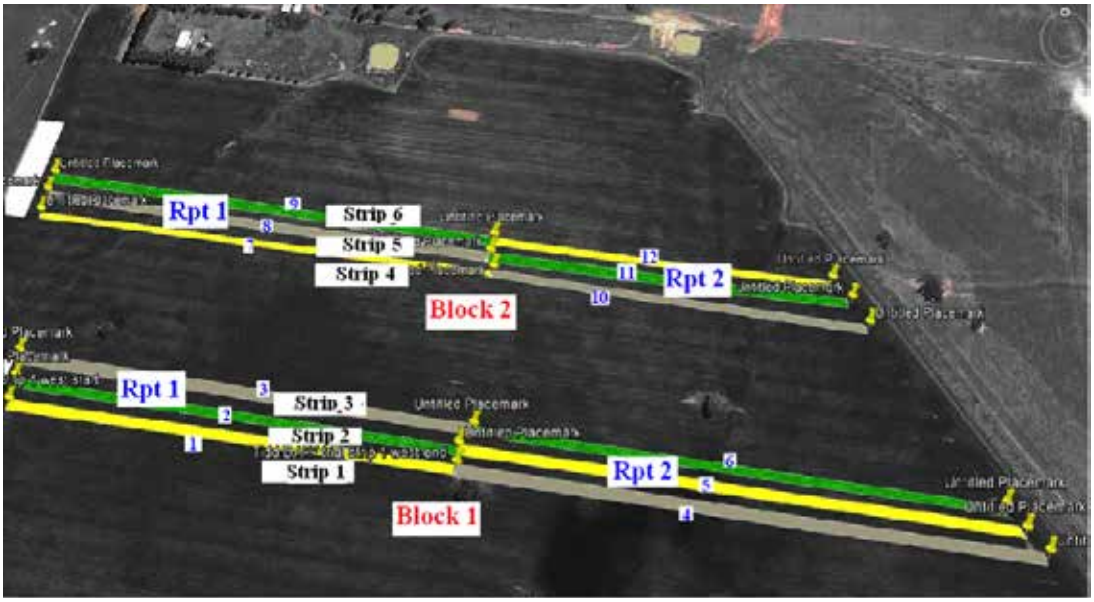
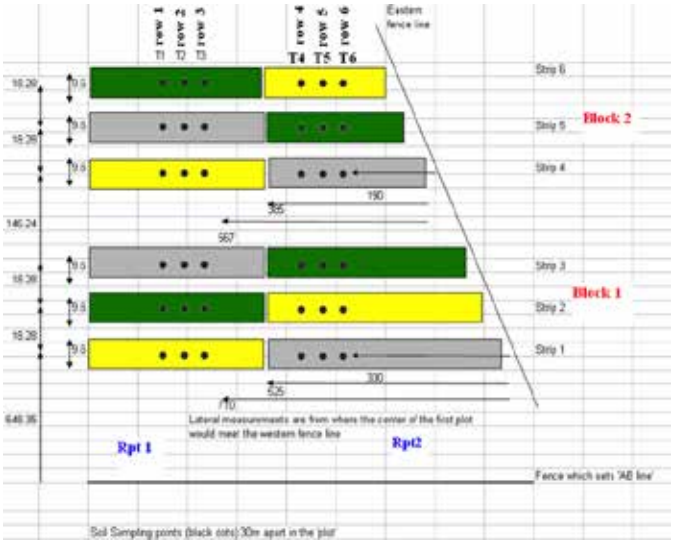


Figure 1: Trial Plan - Tidd



Control	
Incorporated	
Incorporated + Nutients	

Figure 1: Trial Plan - Tidd

Figure 2: Incorporation treatments for strip 1 & 2 at Tidds' looking from west to east. Standing stubble buffer in between.

Results and Discussion

Initial Soil Carbon

Soil was sampled before treatments were established. This was to establish a benchmark or starting point for the trials. These initial soil samples were analysed for C fractions. Each C fraction was in turn considered as the response variable and analysed according to the imposed experimental design. This analysis found no significant 'treatment effects', i.e. there were no significant (P=5%) treatment effects at either depth for any of Total, Particulate, Humic of Recalcitrant Organic Carbon. This confirms that the experiment has commenced with no bias towards any treatment at either depth. The mean paddock values of the four soil carbon fractions of the two field trial sites are similar (Table 1).

Table 1: The mean composition (%) and its standard error (in parenthesise) of the different soil organic carbon fractions at both field sites.

Location	C fraction	Depth 1 (0-10 cm)	Depth 2 (10-30cm)
Tidd	Total	1.251 (0.075)	0.529 (0.038)
	Particulate	0.101 (0.009)	0.022 (0.005)
	Humic	0.619 (0.031)	0.347 (0.017)
	Recalcitrant	0.296 (0.023)	0.125 (0.014)
Ingold	Total	1.363 (0.097)	0.455 (0.089)
	Particulate	0.115 (0.018)	0.029 (0.015)
	Humic	0.681 (0.045)	0.296 (0.058)
	Recalcitrant	0.318 (0.021)	0.089 (0.021)

- At both depths about half of the soil carbon is in the desirable humic fraction. Very little is as particulate soil carbon.
- The % soil carbon content of the top 10 cm of the soil is almost twice that of the 10-30 cm layer. This is true for all fractions.
- Our original large blocks at Tidds' did not account for much variation but they did at Ingolds'. We investigated this using a hypothetical design with long six long treatment strips, two replicates of each treatment each sampled six times.

The blocked design requires an F value of 5.14 for a significance treatment effect while the unblocked design requires a much higher F value of 19.00, thus treatment effects would be much harder to detect. The blocked design requires a difference of 0.335% in total organic carbon between treatments for significance at the 5% level, whereas the unblocked design requires a much higher value of 0.530%. This difference would have to be even larger if fewer samples were taken per treatment strip, i.e. the precision of the estimates would be much lower.

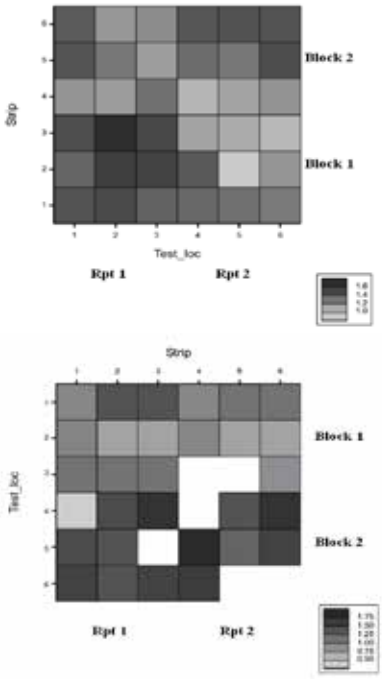


Figure 3: Initial total organic soil carbon content in the (0-10 cm increment)

TOP: Tidd

BOTTOM: Ingold

Figure 4: The photo above shows a Speedtiller just prior to incorporation of nutrient at Tidds', December 2014.

At Tidds' a single yield estimate was made for each treatment strip. At Ingolds' five estimates were made per strip from the header yield monitor. This restricted analysis of the Tidd data to ANOVA but allowed the use of REML to examine spatial patterns in the Ingold data.

Yield data for Tidds' is captured in Table 2 and for Ingolds' is captured in Table 3 for 2013 and 2014. Yield results at Tidds' in 2014 used a weigh-bin to record data for each treatment strip as they were harvested. At Ingolds', yield monitor data was made available post harvest for analysis

The stubble incorporation treatments did not affect canola yield at either location but yield was much higher at the Ingold site. At Tidds' in 2013 yield ranged from 0.94 to 0.99 t/ha with a mean of 0.97t/ha and showed no significant difference between the treatments. Similarly at Ingolds' 2013 yield ranged from 2.46-2.56 t/ha with a mean of 3.17 t/ha showing no significant difference between treatments.

Location	Stubble treatment			Mean of all treatments
	Retained	Incorporated	Incorporated + nutrients	
Tidd	0.943	0.962	0.992	0.966
Ingold	2.469	2.563	2.545	2.495

The Least Significant Difference between treatments is 0.277 t/ha at Tidds and 0.285 t/ha at Ingolds.

Location	Stubble treatment			Mean of all treatments
	Retained	Incorporated	Incorporated + nutrients	
Tidd	2.68	2.74	2.64	2.69
Ingold	3.62	2.98	2.92	3.17

Further analysis of yield data from 2014 is still in progress at time this report was compiled.

The stubble incorporation treatments had no significant effect on wheat yield at Tidds' again in 2014. However, at Ingolds' there is a significant difference between the retained stubble and the incorporated treatments at the 5% level of significance – although there is no difference between the nutrient treatments on the incorporated stubble.

Table 2: The yield (t/ha) of Canola under three stubble treatments at two locations.

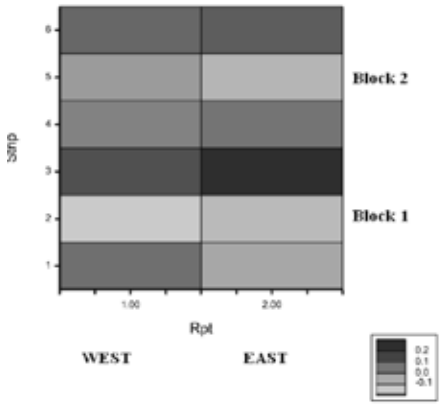


Figure 5: Variation (t/ha) from mean yield indifferent plots/strips at Tidds 2013

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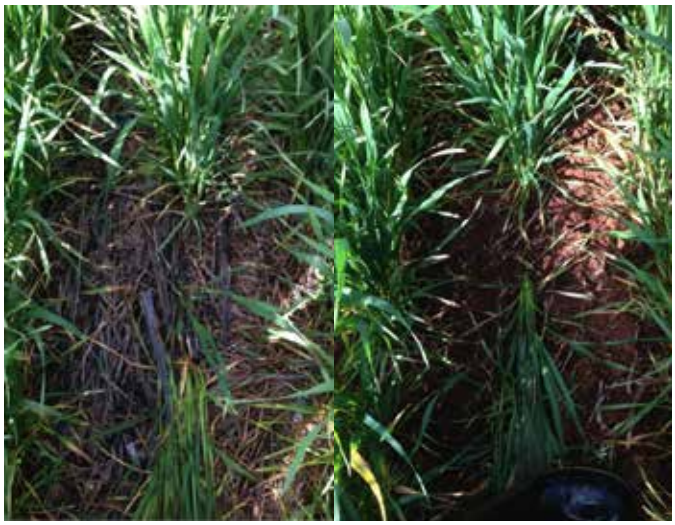

Figure 6: Standing stubble on left v Incorporated at Ingolds' 2/9/14

Farming Soil Carbon – Possibility and Profitability

Compiled by: Iain Hume, NSW DPI, Wagga Wagga for FarmLink Winter bus tour

Carbon Input

The increase in humic soil carbon is calculated by assuming that 1 t of stubble contains 450 kg of C and 70% of C is lost in mineralization. So the maximum possible input of C is 137 kg per t of stubble.

The Carbon Farming Scheme valued Carbon at

$22.70/t, however the price of C sold to trading market was $3.10/t on June 2014.

The break even cost of field operations, calculated by subtracting the carbon value from the incorporation and fertiliser costs are significant (Tables 4 - 6).

Operation	10 t wheat stubble	6 t Canola Stubble
Incorporation [1]	$30.00	$30.00
Fertiliser	$62.82	$15.13
Spreading [3]	$2.00	$2.00
Total	$94.82	$47.13
Less C valued @ $22.7/t	-$31.00	-$18.60
Total Cost	**$66.92**	**$28.53**

Table 4: Cost benefit calculation

Product	Wheat			Canola		
	kg	$/kg	$/t stubble	Kg	$/kg	$/t stubble
DAP	9	0.72	6.44	3	0.72	2.13
Urea	1	0.54	0.54	1	0.54	0.39
Total	**10**		**6.98**	**4**		**2.52**

Table 5: Fertiliser needs per t of Stubble

	$/t	Freight	$/t landed
DAP	675	40	715
MAP	665	40	705
Super	283	40	323
Urea	502	40	542

Table 6: Fertiliser costs (1st June 2014)

Sources

1: Based on 6ha/hr and $40 fuel

3:http://www.depi.vic.gov.au/agriculture-and-food/dairy/pastures-management/fertilising-dairy-pastures/how-to-calculate-fertiliser-rates-and-costs

Profitability

The costs of fertiliser and incorporation could be covered by extra yield. The following figures show the increase in yield needed to break even for a range of grain prices and a value of between 0 and 20$/t for Carbon. These yield increases are large and have not been seen in our trials.

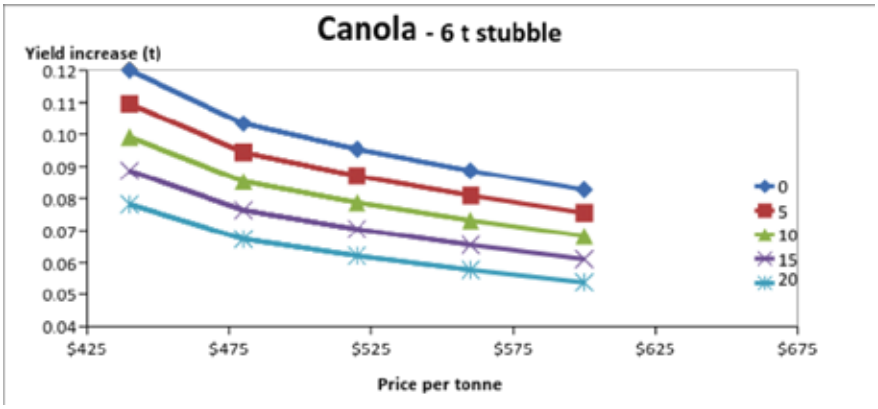

Figure 7: The breakeven yield increase of wheat under different price regimes.

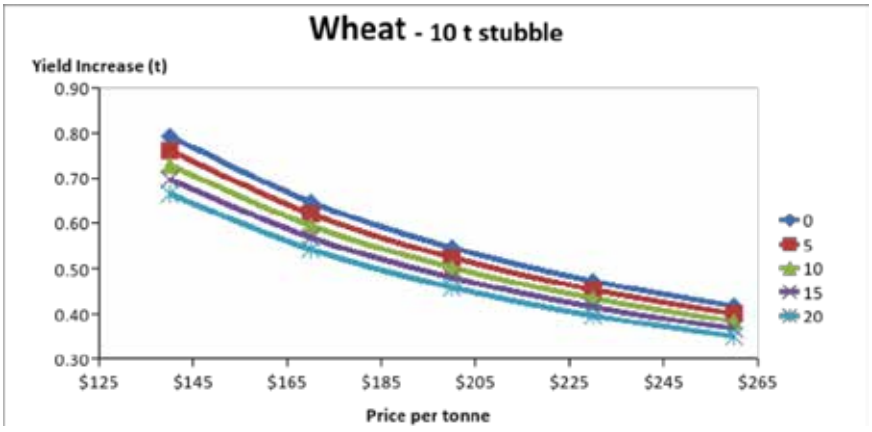

Figure 8: The breakeven yield increase of wheat under different price regimes.

Acknowledgements

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Thank you to the Derek and Alexander Ingold and Geoff Tidd for hosting these trials and allowing us frequent access for data collection and for their efforts especially at harvest to accommodate our sampling and weighing. Thank you as well to Paul Bailes from Norwood Ag for the demonstration and use of the Speedtiller for our incorporation treatments. This project was funded by the Department of Agriculture 'Action on the Ground' .