CWFS
Central West Farming Systems Inc.

AgGrow
AGRONOMY + RESEARCH

GRDC
Grains Research & Development Corporation
Your GRDC working with you

LONG TERM TILLAGE AND ROTATION TRIAL

Merriwagga 1999-2014

FARMERS ADVANCING RESEARCH

LONG TERM TILLAGE & ROTATION TRIAL

KEY POINTS

* No till treatments have been higher yielding and more profitable in continuous cropping rotations. Cultivation has increased yield and profit in 18 month fallow rotations.

* Two cereals followed by a break crop of either fieldpeas or canola no till has been the most profitable rotation. Interestingly 16 years continuous wheat has not been too far behind.

*Weed spectrum and numbers have changed dramatically within rotations and tillage methods. Interestingly no till treatments have hosted less weeds than cultivated treatments.

*One year of no pre emergent herbicide has taken the trial back 6 years and allowed large numbers of ryegrass to again become established and set seed.

BACKGROUND

The Merriwagga tillage and rotation trial was established in 1999 aimed at comparing no till farming techniques against conventional farming methods over 5 different cropping rotations.

This trial has been managed by local growers and NSW DPI district agronomists Myles Parker and Barry Haskins, and is now managed by Ag Grow Agronomy and research on behalf of Merriwagga growers and our research partner Central West Farming Systems Inc.

During this time this trial has hosted thousands of farmers from across Australia and even the world in a practical learning environment where differences in farming systems can be visually experienced and discussed.

TRIAL DETAILS

The trial is situated approximately 10km west of Merriwagga NSW. Soils are red sandy loams with an underlying calcareous subsoil. They are typically low in organic carbon, pH 5.5-6.5 and have a tendancy to erode with wind and water.

Each plot is 1ha in size, and each treatment is replicated 3 times. This adds to a total of 30ha.

Tillage teatments

No-till

- all weed control by herbicides or narrow windrow burning
- sown with NDF single disc seeder
- stubble retained where possible

Conventional

- weed control both by herbicides and cultivation
- sown with NDF single disc seeder
- stubble incorporated.

Rotations

Continuous wheat

Rotation 1 and 2 - Two cereals followed by a break crop such as peas or canola.

Wheat - Fallow - Wheat

Wheat - Ley - Fallow - Wheat (note this rotation has simply been Wheat - Fallow - Wheat since 2005, and alternates with the above wheat - fallow - wheat rotation.

Table 1: Rotational history since 2010.

Treatment	Tillage	Rotation				
		2010	2011	2012	2013	2014
wheat/ley /fallow /wheat	conventional	Fallow	Wheat	Fallow	Wheat	Fallow
	no till	Fallow	Wheat	Fallow	Wheat	Fallow
rotational continuous 1	conventional	Wheat	Canola	Wheat	Wheat	Lupins
	no till	Wheat	Canola	Wheat	Wheat	Lupins
rotational continuous 2	conventional	Wheat	Wheat	Canola	Wheat	Wheat
	no till	Wheat	Wheat	Canola	Wheat	Wheat
wheat/fallow/wheat	conventional	Wheat	Fallow	Wheat	Fallow	Wheat
	no till	Wheat	Fallow	Wheat	Fallow	Wheat
continuous wheat	no till	Wheat	Wheat	Wheat	Wheat	Wheat
	conventional	Wheat	Wheat	Wheat	Wheat	Wheat

Figure1: An aerial image of the trial showing the layout of the trial and various rotations.

RESULTS AND DISCUSSION

There are many measurements and experiences from this trial. This report will briefly focus on the key outcomes being economic comparisons, nutrition and weeds. There has also been some interesting research on root diseases however this information is not reported in this document.

Economic comparisons

After 16 years there are some very clear trends that have emerged. It is important to note that all costs are calculated at locally validated contract rates. This is very different to the costs a typical farmer would apply, but it allows a very good comparison of the real costs associated with each farming system.

a) No till farming methods have maintained or increased yield in continuous cropping rotations. This is not the case when a fallow is included in the rotation, and in this case cultivation has increased yields in most but not all seasons.

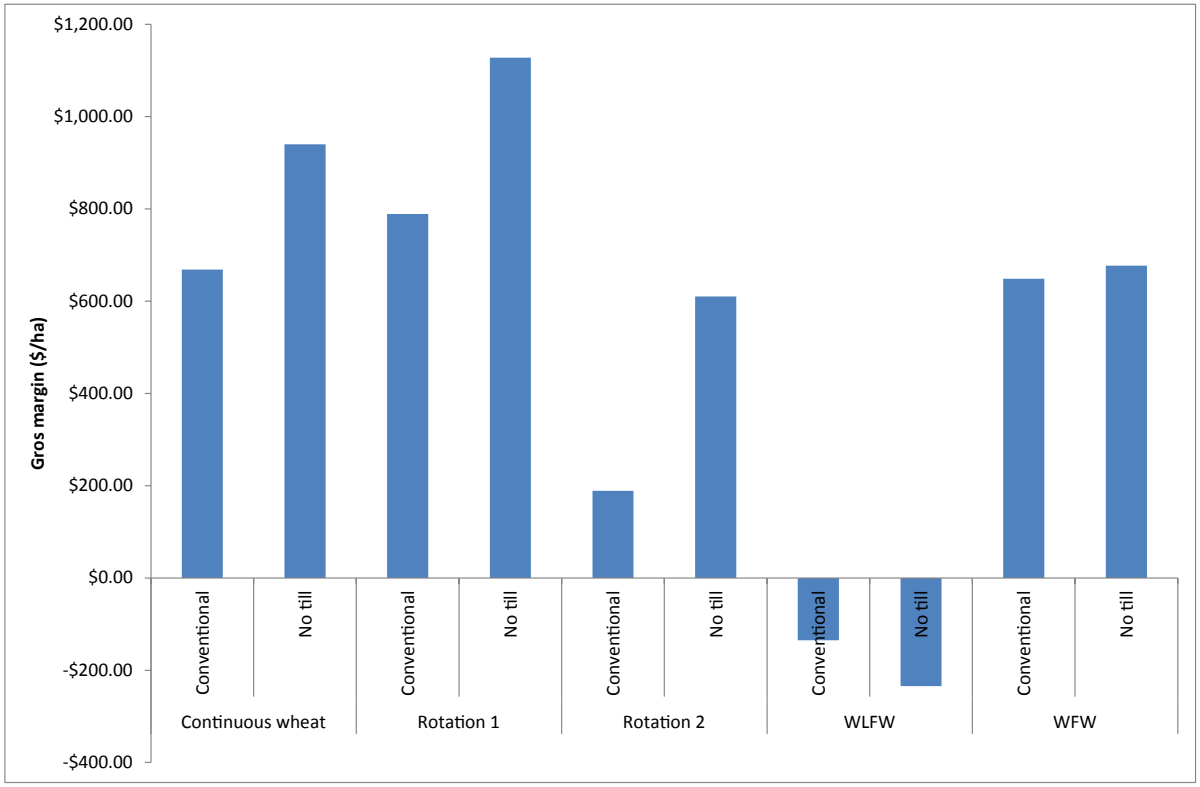
b) When using contract rates, growing crops with no till farming techniques has been on average 15% cheaper than when cultivation is used.

c) The most profitable rotation has been two cereals followed by a break crop of either peas, lupins or canola under a no till system. Interestingly a continuous wheat rotation no till is a close second. Agronomically the continuous wheat rotation has higher risks of crop failure due to higher weed numbers, lower nutrition and subsoil moisture reserves and higher presence of root diseases. This trial has proven however that in this environment this rotation has still performed exceptionally well.

Figure 2: Yield, protein, costs and profit for each Treatment in 2014. Note WLFW was in fallow, hence no yield reported.

		Yield (kg/ha)	Protein (%)	Costs ($/ha)	Profit ($/ha)
Continuous wheat	conventional	1458	8.1	$267.00	$90.31
	no till	1356	8.2	$222.00	$110.10
Rotation 1	conventional	657		$256.00	$39.50
	no till	580		$211.00	$50.00
Rotation 2	conventional	1490	8.6	$267.00	$98.03
	no till	1540	8.7	$222.00	$155.38
WFW	conventional	2089	9.7	$346.72	$268.61
	no till	2583	9.8	$269.30	$363.09
WLFW	conventional			$78.00	-$78.00
	no till			$78.00	-$78.00

Figure 3: Long term (1999-2014) gross margins for each treatment.

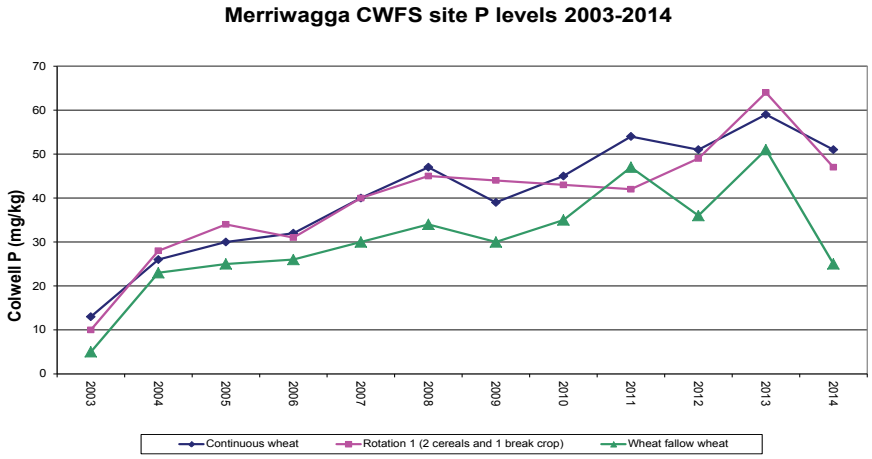


Nutrition

Variation in soil nutrition between no till and cultivated treatments has not been proven. There has however been consistent differences between rotations. In general rotations with a fallow and/or peas have measured significantly higher soil nitrogen status. This is to be expected.

Another interesting trend has been the steady increase in soil colwell phosphorous. This may be due to the fact that during the drought we were adding more phosphorous than we were taking out. This has not been the case since 2010 and yet the trend of inceasing soil phosphorous has continued.

Figure 4: Soil P Curves of each treatment from 2003 to 2014.



Weeds

Differences in weed numbers and weed spectrum have been measured in this trial between rotations and tillage.

In general, no till rotations have hosted less weeds than cultivated rotations. This is thought to be as a result of better herbicide efficacy in no till systems with pre emergent herbicides and also the increased weed persistence through seed burial in cultivated systems.

This trend has been measured through the life of the trial, and has been more noticable in the last 6 years.

It has also been noted that no till tends to favour shallow germinating weeds such as ryegrass, whilst cultivated systems favour weeds such as fumitory, mustards, wild oats etc that like soil stimulation or seed burial for germination.

As expected, rotations with fallows tend to be the cleanest for weeds. Rotations with fieldpeas and lupins often host higher levels of fumitory, a major weed in this trial. Continuous wheat rotations were at a stage where ryegrass was outcompeting the crop by 2007, however well planned pre emergent herbicide strategies reduced ryegrass levels where they were not that different to other rotations, until 2014.

In 2014, the trial was sown without a pre emergent herbicide. This was done for research purposes and was a major mistake, as even though the trial had been clean for atleast 4-5 years, the seed bank was still obviously high enough to create a massive growth of weeds, in particular ryegrass. No post emergent herbicide options work at this site for ryegrass.

Figure 5: Weed counts for each treatment measured before post emergent herbicides were applied in 2014, and a final score of ryegrass weediness at the end of the season.

		Average Weeds per treatment (weeds/m2) June 6th						Ryegrass score at end of season (0-10, 0 = clean)
		Ryegrass	Black Oats	Fumitory	Mustard	Turnip	Other	
WLFW	conventional	0.00	0.00	2.67	0.33	0.00	5.00	0.0
	no till	0.00	0.00					0.0
Rotation 1	conventional	4.67	3.00	3.67	0.00	0.33	3.67	1.3
	no till	3.33	0.67	9.67	0.00	0.33	1.00	0.0
Rotation 2	conventional	27.00	12.67	6.67	0.00	1.33	4.33	8.0
	no till	0.00	0.00	155.33	0.00	1.67	1.67	4.3
WFW	conventional	2.67	2.00	0.33	1.33	8.00	0.67	3.7
	no till	0.00	0.33	1.00	0.33	4.67	4.33	0.3
Continuous wheat	conventional	6.67	1.33	4.00	0.00	0.33	2.67	5.3
	no till	6.67	3.00	16.33	0.33	1.33	7.67	6.0

Figure 6: Long Term Gross Margin Table 1999 to 2014

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	1999-2014
Continuous wheat	**Conventional**	$33.40	$330.78	$51.93	-$129.78	$250.16	-$74.41	$31.48	-$121.40	-$182.70	-$50.52	-$116.18	$300.64	$98.64	$40.97	$114.87	$90.31	**$668.20**
	No till	$65.68	$188.23	$69.64	-$129.78	$266.66	-$64.71	$45.14	-$85.95	-$134.79	$18.06	-$66.53	$359.69	$50.40	$64.28	$183.91	$110.10	**$940.04**
Rotation 1	**Conventional**	$81.74	$343.81	-$159.89	-$129.78	$274.13	-$9.88	-$2.07	-$90.65	-$224.60	-$99.95	-$91.38	$335.64	$345.15	$25.39	$151.72	$39.50	**$788.88**
	No till	$88.69	$225.23	-$156.86	-$129.78	$305.93	-$10.10	$20.30	$48.77	-$146.99	-$103.50	-$64.68	$436.69	$308.85	$41.01	$214.17	$50.00	**$1,127.73**
Rotation 2	**Conventional**	$9.23	$49.54	$112.81	-$129.78	$53.33	-$37.13	$72.00	-$153.47	-$189.50	-$25.17	-$217.53	$342.64	$85.10	-$67.69	$186.28	$98.03	**$188.71**
	No till	$81.65	$50.71	$57.97	-$129.78	$61.61	-$80.56	$71.61	-$80.96	-$132.69	-$0.02	-$167.69	$443.69	$62.47	-$59.25	$275.95	$155.38	**$610.09**
WLFW	**Conventional**	-$18.00	-$21.00	$77.93	$0.00	-$57.00	$73.04	$217.91	-$121.06	-$61.70	-$119.88	-$33.24	-$126.77	$110.72	-$159.42	$181.48	-$78.00	**-$134.98**
	No till	-$18.00	-$21.00	-$17.72	$0.00	-$46.50	-$81.96	$179.20	-$47.56	-$74.10	-$96.10	-$30.11	-$148.04	$108.88	-$126.50	$263.18	-$78.00	**-$234.32**
WFW	**Conventional**	-$58.76	$351.00	-$64.91	-$129.78	-$57.00	$96.50	$0.00	$178.91	-$112.72	$58.83	-$77.78	$265.86	-$113.55	$43.10	-$79.72	$348.33	**$648.31**
	No till	-$23.76	$201.91	-$54.28	-$129.78	-$46.50	-$60.72	$0.00	$213.23	-$66.22	$26.06	-$58.81	$297.88	-$109.25	$123.80	-$47.73	$410.82	**$676.65**
Average		**$24.19**	**$169.92**	**-$8.34**	**-$103.82**	**$100.48**	**-$24.99**	**$63.56**	**-$26.02**	**-$132.60**	**-$39.22**	**-$92.39**	**$250.79**	**$94.74**	**-$7.43**	**$144.41**	**$114.65**	**$527.93**
		6th June sowing. Average year, but underperformed due to dry spring.	Mid May sowing. Wet spring and wet harvest.	1st June sowing. Dry spring and low yields	Didn't sow. No fallow rain or rain incrop. Driest year on record.	Wet summer, early April sowing. Good rain in spring.	Late break, no stored moisture. Sowing June 6th. Dry spring.	Late break, no stored moisture. Sowing 18th June. Wet spring but too late for this trial.	Late break, no stored moisture. Sown 18th June. Dry spring.	Very dry summer, 23rd May sowing, but no spring rain. Crop virtually died.	Moderate soil moisture. 7th May sowing. Dry spring.	Moderate soil moisture. Late break, sowing 11th June. Dry spring.	Moderate soil moisture, ealy break. Sown 30th April. Locusts an issue. Very wet spring and harvest.	Moderate soil moisture. Early break, sown 3rd May. Mice an issue. Average spring.	Very wet summer. Soil profiile full. Sown 3rd May. Very dry spring.	Moderate soil moisture. Sowing 29th May. Low spring rainfall but timely.	Moderate soil moisture. Sowing 3rd May. Low spring rainfall and very dry and hot from July onwards.	

ACKNOWLEDGEMENTS

Ag Grow Agronomy and Research and Central West Farming Systems would like to acknowledge Ian Barber “Sylvanham” for undertaking various activities such as sowing and harvesting the trial, as well as other local farmers in their efforts to help make this trial what it is.

Also we would like to thank David Coddington and Pioneer Dupont for their continued support by providing a weighbin at harvest.

Further contacts

Barry Haskins	Ag Grow Agronomist	barry@aggrowagronomy.com.au
John Small	Central West Farming Systems	john.small@industry.nsw.gov.au

GRDC PROJECT CWF00018 - MAINTAINING PROFITABLE FARMING SYSTEMS WITH RETAINED STUBBLE IN CENTRAL WEST NSW.