LONG TERM TILLAGE AND ROTATION TRIAL

2015 Results – Merriwagga 1999-2015

KEY MESSAGES

- No till treatments, for all rotations, were slightly higher yielding than the conventional tillage treatments for wheat. The yield of peas, in rotation 2, was very low in this trial as a result of the season and Sakura® damage.
- Rotations including a fallow, such as the WFW treatment, had lower weed numbers compared to continuous cropped rotations. The continuous wheat rotation, both conventional and no till treatments, had a large number of ryegrass, even with Sakura®.
- Profit and income for 2015 was highest in the no till wheat/ley/fallow/wheat rotation, and lowest in Rotation 2.
- 17 years of no till wheat on wheat is still second for profitability.

Background

Established in 1999 and now in its 17th year, the Merriwagga tillage and rotation trial was set up to compare no till farming techniques against conventional farming methods over 5 different cropping rotations.

In 2015 the site was managed by Ag Grow Agronomy and Research, on behalf of Merriwagga growers and our research partner Central West Farming Systems Inc.

Trial details

Situated 10km west of Merriwagga NSW, the site consists of a total of 30ha. There are 10 treatments in total replicated 3 times, with each plot 1ha in size.

The treatments consist of·

2 tillage treatments

1. No Till: where all weed control is by either herbicides or narrow windrow burning, the plots are sown with a NDF single disc seeder and stubble retained where possible.
2. Conventional· where weed control is both by herbicides and cultivation, the plots are sown with a NDF single disc seeder and stubble is incorporated.

5 Rotations

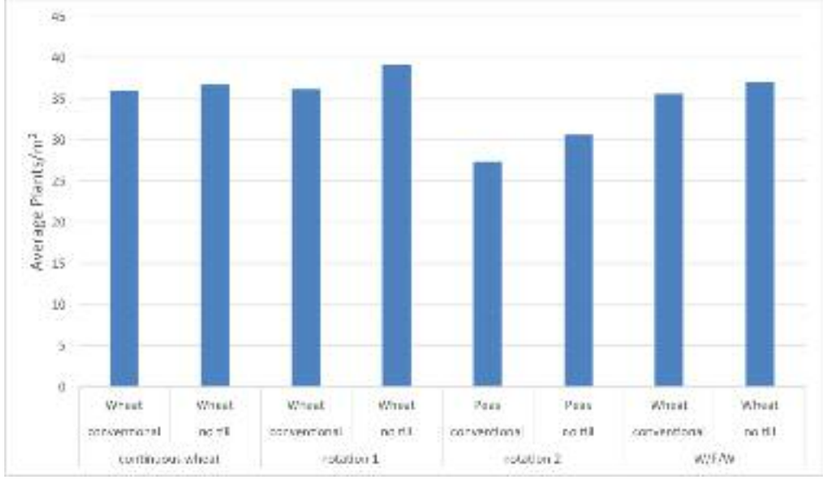
1. Continuous wheat
2. Rotation 1 - Two cereals followed by a break crop such as peas or canola.
3. Rotation 2 - Two cereals followed by a break crop such as peas or canola, not in synchronisation with continuous rotation 1.
4. Wheat - Fallow - Wheat
5. Wheat - Ley - Fallow - Wheat· this rotation has been Wheat - Fallow - Wheat since 2005, and alternates with the above wheat - fallow - wheat rotation.

A summary of the treatments and rotations for the past five years are shown in Table 1.

TABLE 1 Treatments and Rotational history for the past five years.

Treatment	Tillage	Rotation				
		2011	2012	2013	2014	2015
wheat/ley /fallow /wheat	conventional	Wheat	Fallow	Wheat	Fallow	Wheat
	no till	Wheat	Fallow	Wheat	Fallow	Wheat
rotation 1	conventional	Canola	Wheat	Wheat	Lupins	Wheat
	no till	Canola	Wheat	Wheat	Lupins	Wheat
rotation 2	conventional	Wheat	Canola	Wheat	Wheat	Peas
	no till	Wheat	Canola	Wheat	Wheat	Peas
wheat/fallow/wheat	conventional	Fallow	Wheat	Fallow	Wheat	Fallow
	no till	Fallow	Wheat	Fallow	Wheat	Fallow
continuous wheat	no till	Wheat	Wheat	Wheat	Wheat	Wheat
	conventional	Wheat	Wheat	Wheat	Wheat	Wheat

FIGURE 1 Figure 1· Establishment counts for each treatment of the long term trial 2015.



Results and discussion

The wheat used in this trial was Suntop. It was sown 2nd May, with 50 kg/ha MAP and with a NDF disc. The peas in the trial were Sturt and were sown 2nd June with 70 kg/ha MAP/SOA.

Total rainfall for 2015 was 273mm, with 222mm falling in the growing season (April to October).

This report will focus on the measurements and assessments taken in 2015 as well as the key outcomes of nutrition, weeds and economics. Establishment, weed pressure, grain yield and quality, were all assessed in 2015 and the results are below.

Establishment

Plant counts were taken early July. Establishment was relatively even across the treatments.

Plant counts for the wheat plots ranged from 36 plants/m2 for the conventional wheat/fallow/wheat to 39 plants/m2 for the no till rotation 1.

For peas, as part of rotation 2, plant counts were 27 plants/m^2 for the conventional treatments and 31 plants/m2 for the no till treatments (figure 1).

Weeds

Each treatment was assessed for the type and density of the main weeds, as shown in table 2. The main weeds observed in the trial were ryegrass, black oats, fumitory, mustard and turnip. Other weeds in the trial included clover, milk thistle, heliotrope, skeleton weed, lupins, brome grass and spiny emex.

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

As observed in previous seasons, where rotations include a fallow, as in the WFW treatment, weed numbers tended to be lower.

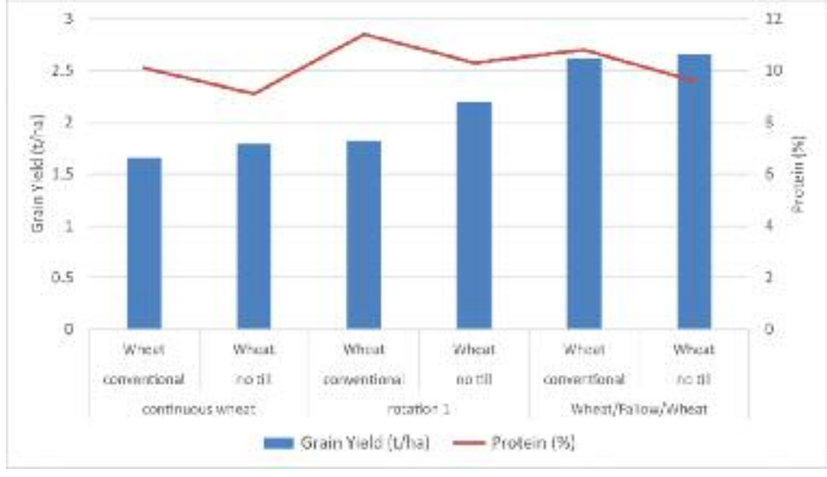
The continuous wheat rotation, for both conventional and no till, had a large number of ryegrass, as did the conventional treatment of rotation 2, which was wheat last year. Rotation 1, coming out of lupins last year had a large number of broadleaf weeds in 2015.

For all treatments conventional tillage had a higher population of ryegrass than the no-till. This is likely as a result of the pre-emergent herbicides not working as well in a cultivated system. Broadleaf weeds, such as fumitory, were generally higher in no till across the treatments.

TABLE 2 Weed counts for each treatment of the long term trial, measured before post emergent herbicides were applied in 2015.

Treatment	Tillage	Average Weeds per treatment (weeds/m^2) August 26th					
		Ryegrass	Black Oats	Fumitory	Mustard	Turnip	Other
WFW	conventional			5	56	15	28
	no till			1	26	36	21
Rotation 1	conventional	7	2	41	142	34	34
	no till		2	47	232	66	34
Rotation 2	conventional	247	5	11	8	2	30
	no till	42	24	107	32	4	9
WFW	conventional	Fallow sprayed					
	no till	Fallow sprayed					
Continuous wheat	conventional	528	5	9	58	6	14
	no till	145	8	16	107	22	10

FIGURE 2 Grain Yield for each wheat treatment of the long term trial 2015.



Grain Yield and Grain Quality

The average grain yield of wheat in this trial in 2015 was 2.13 t/ha.

The lowest yielding treatment was the conventional continuous wheat yielding 1.67 t/ha. The highest yielding treatment was the no till WFW yielding 2.66 t/ha (figure 2).

For each of the rotations the no till treatments were slightly higher yielding than the conventional tillage treatments.

As a result of the season and herbicide damage, yields of the peas in rotation 2 were very low yielding, yielding less than 0.5 t/ha. Grain protein of the wheat ranged from 9.4% for the conventional continuous wheat rotation to 11.4% for the conventional rotation 1 treatment (figure 2).

FIGURE 3 Soil P Curves for each treatment from 2003 to 2015.

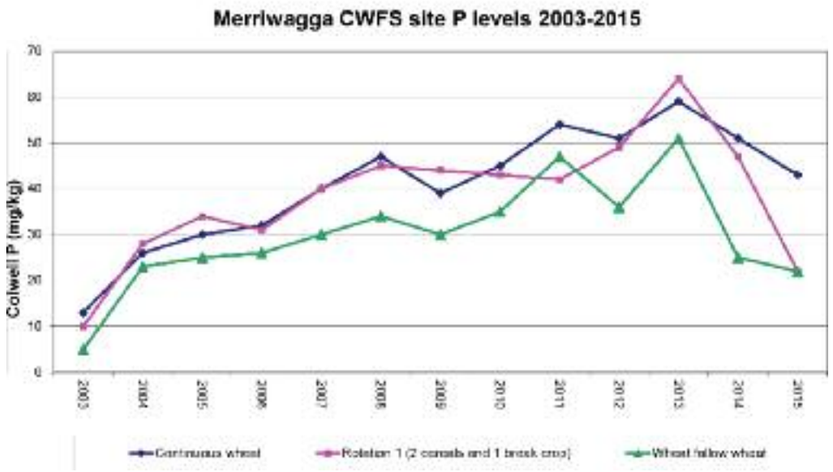
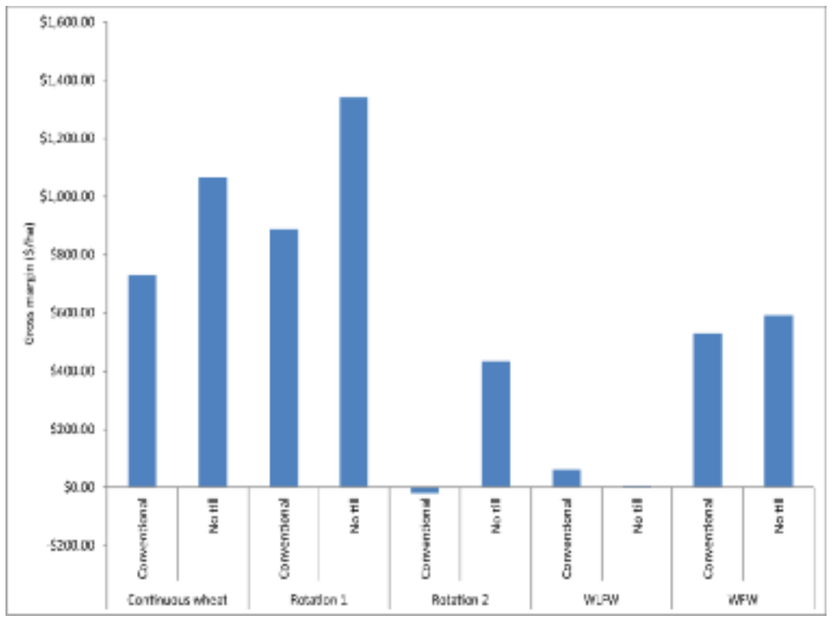


TABLE 3 Costs and profit for each treatment in 2015. Note WFW was in fallow, hence no yield recorded.

Treatment	Tillage	Costs 2014	Costs 2015	Total Costs	Income	Profit
wheat/ley /fallow /wheat	conventional	77.56	302.24	379.8	576.4	196.6
	no till	77.56	267.24	344.8	585.2	240.4
rotation 1	conventional		302.24	302.24	400.4	98.16
	no till		267.24	267.24	481.8	214.56
rotation 2	conventional		277.7	277.7	68	-209.7
	no till		242.7	242.7	68	-174.7
wheat/fallow/wheat	conventional		118.41	118.41	0	-118.41
	no till		83.41	83.41	0	-83.41
continuous wheat	no till		267.24	267.24	393.8	126.56
	conventional		302.24	302.24	365.2	62.96

FIGURE 4 Long Term Gross margins for each treatment 1999 to 2015.



Protein was higher for all the conventional tillage treatments, with an average of 10.8%, compared to 9.7% for the no till treatments.

The average grain protein overall was 10.21%.

Nutrition

The trend in soil P levels at the trial site for the past 13 years is shown in figure 3.

Unlike the drought years, where we saw an increase in soil P levels as a result of adding more phosphorous than what was being taken out, the last few years has seen a decrease in soil P levels at the site. The only treatment that remains above 25 mg/kg in 2015 and would be considered adequate is the continuous wheat rotation.

Economic Comparisons

The costs, income and profit of each treatment in 2015 is shown in table 3.

In 2015 the no till treatments all had a higher income and profit compared to the conventional treatments. Profit and income for 2015 was highest in the no till wheat/ley/fallow/wheat rotation, with an income of $585.20 and a profit of $240.40.

Rotation 2, although not having the lowest income had the lowest profit of all the treatments with a loss of $209.70 for the conventional treatment and a loss of $174.70 for the no till treatment.

The only other treatment to have a negative profit in 2015 was the wheat/fallow/wheat treatment, which was in fallow in 2015.

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.

The standout treatment for both conventional and no till for the past 17 years has been rotation 1, two cereals followed by a break crop.

This was closely followed by a continuous wheat system.

The average gross margin for the past 17 years is $563.23, with a no till system for rotation 1 having an average gross margin of $1,342.29 and a continuous wheat no till system having an average gross margin of $1,066.60. This is also shown in figure 4.

It is important to note that agronomically the continuous wheat rotation has higher risks of crop failure. This is due to the possibilities of higher weed numbers, lower nutrition and subsoil moisture reserves and higher presence of root diseases. This trial however, has proven over the past 17 years that in this environment this rotation has still performed exceptionally well.

The only negative gross margin over the past 17 years has been the conventional system for rotation 2, also two cereals followed by a break crop but not in synchronisation with rotation 1, with a gross margin of -$20.99.

Acknowledgements

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TABLE 4 Shows the individual gross margins for each year the trial has been running as well as the long term gross margins for the past 17 years.

Table 4: Long Term Gross Margin 1999 to 2015

		1999-2015	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	
		$731.16	$62.96	$300.31	$114.97	$40.97	$66.64	$300.64	-$116.19	-$60.52	-$182.70	-$121.40	$31.48	-$74.41	$260.16	-$129.78	$61.93	$330.78	$33.40	$24.19
Continuous wheat	Conventional	$1,066.60	$126.56	$110.10	$183.91	$64.29	$50.40	$359.69	-$66.53	$16.06	-$134.79	-$90.95	$45.14	-$64.71	$266.66	-$129.78	$69.64	$188.23	$65.68	$169.92
	No till	$687.04	$98.16	$39.50	$151.72	$25.39	$345.15	$335.64	-$91.38	-$99.95	-$224.60	-$90.95	-$2.07	-$9.88	$274.13	-$129.78	-$159.89	$343.61	$81.74	-$18.00
Rotation 1	Conventional	$1,342.29	$214.56	$50.00	$214.17	$41.01	$308.85	$438.69	-$64.68	-$100.50	-$148.99	-$46.77	$20.30	-$10.10	$305.85	-$129.78	-$156.86	$225.23	$88.69	-$21.00
	No till	-$20.99	-$209.70	-$39.03	$186.29	-$67.69	-$85.10	$342.64	-$217.53	-$25.17	-$188.80	-$153.47	$72.00	-$37.13	$83.33	-$129.78	$112.81	$48.64	$9.23	-$18.00
Rotation 2	Conventional	$435.39	-$174.70	-$155.36	-$275.85	-$59.25	$62.47	$443.69	-$126.77	-$90.02	-$132.68	-$90.96	$71.61	-$80.56	$61.61	-$129.78	$57.97	$66.71	$84.65	-$18.00
	No till	$61.62	$196.60	-$78.00	-$181.48	-$159.42	$110.72	-$126.77	-$33.24	-$119.88	-$61.70	-$121.06	$217.91	$73.04	-$57.00	$0.00	-$17.72	$77.93	$21.00	-$18.00
WLFW	Conventional	$6.08	$240.40	-$78.00	$263.18	-$126.53	$106.86	-$148.04	-$30.11	-$96.10	-$74.10	-$47.56	$179.20	-$81.96	-$46.50	$0.00	-$64.91	-$54.28	-$21.00	-$18.00
	No till	$529.90	-$118.41	-$348.33	-$79.72	$43.10	-$113.55	$285.06	-$77.78	$36.63	-$112.72	$178.31	$0.00	$86.50	-$57.00	-$129.78	-$64.91	$351.00	$58.76	-$23.76
WFW	Conventional	$593.24	-$83.41	-$410.82	-$47.73	$123.80	-$109.25	$297.80	-$56.81	$26.06	-$88.22	$213.23	$90.00	-$80.72	-$46.50	-$129.78	-$54.28	$201.91	$23.76	$24.19
	No till	$563.23	$35.30	$114.65	$144.41	-$7.43	$94.74	$250.79	-$92.39	-$39.22	-$132.60	-$26.02	$63.58	-$24.99	$100.48	-$103.82	-$8.34	$169.92	$24.19	
			Low soil moisture at sowing. Sowing 2nd May, moisture marginal. Wet winter and very dry spring.	Moderate soil moisture. Sowing 3rd May. Low spring rainfall and very dry and hot from July onwards.	Moderate soil moisture. Sowing 29th May. Low spring rainfall but timely.	Very wet summer. Soil profiile full. Sown 3rd May. Very dry spring.	Moderate soil moisture. Early break, sown 3rd May. Mice an issue. Average spring.	Moderate soil moisture. ealy break. Sown 30th April. Locusts an issue. Very wet spring and harvest.	Moderate soil moisture. Late break, sowing 11th June. Dry spring.	Moderate soil moisture. 7th May sowing. Dry spring.	Very dry summer, 23rd May sowing, but no spring rain. Crop virtually died.	Late break, no stored moisture. Sown 16th June. Dry spring.	Late break, no stored moisture. Sowing 18th June. Wet spring but too late for this trial.	Late break, no stored moisture. Sowing June 6th. Dry spring.	Wet summer, early April sowing. Good rain in spring.	Didn't sow. No fallow rain or rain incrop. Driest year on record.	1st June sowing. Dry spring and low yields	Mid May sowing. Wet spring and wet harvest.	6th June sowing. Average year, but underperformed due to dry spring.	
		Average																		