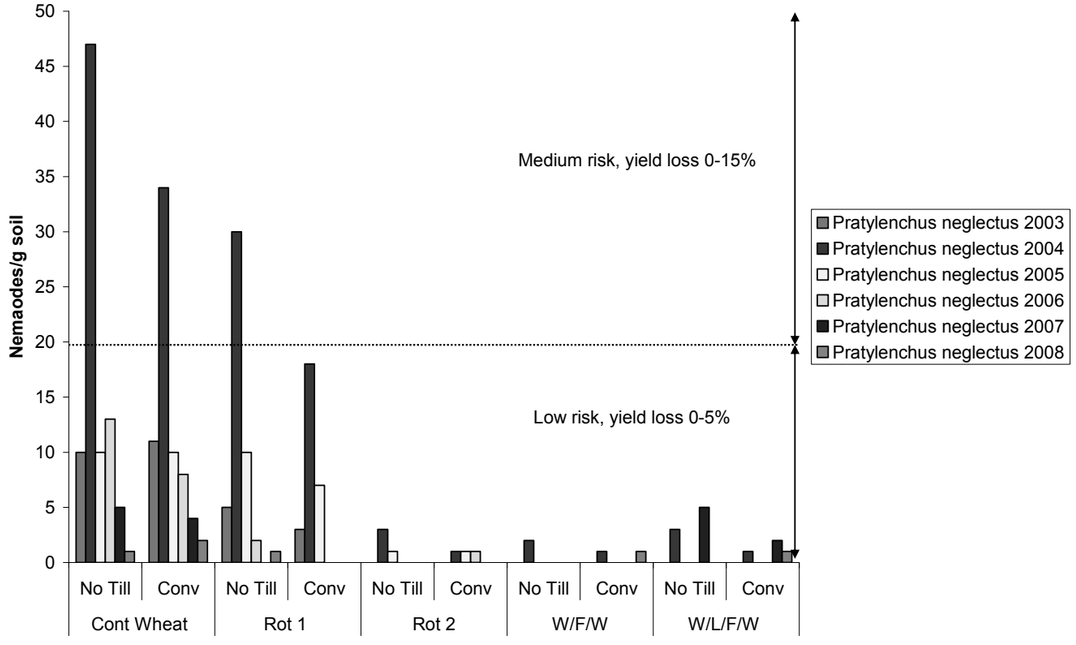
Figure 5: The trend in Pratylenchus neglectus nematodes since 2003.



Interestingly enough, whilst trends with time were not obvious, common root rot, take all and pythium inoculum have all been found at moderate levels throughout the life of the trial, highlighting that many diseases can be found 'sleeping' in the soil until suitable conditions arrive.

For further information

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MERRIWAGGA TILLAGE AND ROTATION TRIAL 1999-2010

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Key Points

- No-till has performed on average 5% higher in yield and increased profits over cultivated farming systems in continuous cropping rotations.
- Adding cultivation to the system has increased both yield and profit in the 18 month fallow rotations.
- Thirteen years of continuous wheat has produced the most grain per hectare, closely followed by a wheat–barley–field pea rotation.
- Continuous wheat rotations host the highest root disease and weed risks, whilst also showing the lowest soil and plant nutrition. Eighteen month fallow rotations show the lowest risk of root diseases and weeds, and have the highest soil and plant nutrition.

Trial aim

To compare no-till with cultivated (conventional) farming systems across 5 crop rotations, with particular interest in long term;

- yield and gross margins
- weed risks
- disease risks
- nutrition

This trial was established in 1999, and is now 13 years old.

2010 Trial details

Soil type:	Red Sandy Loam
Soil test:	0 – 10 cm: pH = 6.5, Al% = 0 CEC = 13; Colwell P = 25 mg/kg
Row spacing:	30 cm
Sow date	30 April (eaten by locusts) 4 June (re-sown)
Fertiliser:	45 kg/ha MAP + 15 kg/ha Gran-Am
Herbicide:	3 fallow sprays, 1L/ha Triflur X IBS, 670ml/ha Velocity in crop.
Fungicide:	290 ml Folicur (Sept for stripe rust)
Insecticide:	200 ml Fastac (May for locusts)
Harvest date:	23 December 2010

Treatments 2010

Variety

Crusader at a sowing rate of 35 kg/ha

Tillage treatments

No-till

- all weed control by herbicides
- sown with knife point and press wheels
- stubble always retained

Conventional

- weed control both by herbicides and cultivation
- sown with knife point and press wheels
- stubble incorporated.

Rotation treatments

Table 1: Crop sequence for each rotation.

	Continuous wheat	Rotation 1	Rotation 2	Wheat fallow wheat	*Wheat ley fallow wheat
2010	Wheat	Wheat	Wheat	Wheat	Fallow
2009	Wheat	Wheat	Fieldpeas	Fallow	Wheat
2008	Wheat	Fieldpeas	Wheat	Wheat	Fallow
2007	Wheat	Barley	Wheat	Fallow	Wheat

**Note that Wheat-fallow-wheat is exactly the same as wheat-ley-fallow-wheat, but in alternate years. This is because the ley phase was seen as less important in the current farming system, so we took the ley phase out in 2005.*

Plot size

Each plot is 300 m x 33.3 m, or 1 hectare.

Replicates

Each treatment is replicated 3 times, that is, 5 rotations by 2 tillage treatments by 3 reps. This makes a total trial area of 30 ha.

Seasonal review

The season in 2010 was very wet, especially in October. A cool September and October also benefited later sown crops such as this trial.

Perhaps the biggest issue were the locusts

experienced in April and May, which forced us to re-sow this trial in early June.

Table 1: Monthly rainfall and temperature at Merriwagga.

	Rainfall (mm)	Minimum temperature (°C)	Maximum temperature (°C)
Jan	5	19.1	35.7
Feb	61.6	20.1	32.1
Mar	62.2	14.9	29.3
Apr	35	12.1	25.1
May	29.7	6.8	19.9
Jun	17.6	5.5	16.4
Jul	37.4	2.8	14.9
Aug	33.8	4.3	15.0
Sep	57.6	5.9	18.8
Oct	118.8	9.8	23.8
Nov	68.4	13.8	27.3
Dec	36.4	15.1	30.4
Total	563.4		
In-crop (Apr-Oct)	329.9		

Trial results 2010

Yield

The average yield in 2010 was 3.65 t/ha, much higher than 1999–2009 average (Figure 1).

The variation between treatments in 2010 was only 0.47 t/ha. The highest yielding treatment was Rotation 2 No-till (3.9 t/ha). The lowest yielding treatment was Continuous Wheat No-till (3.43 t/ha).

Gross margin 2010

The gross margins in 2010 were the highest in the 12 years of the trial. The treatments sown to wheat averaged $348/ha (Figure 2).

Rotation 2 No-till had the highest average gross margin at $444/ha (wheat following fieldpeas). Wheat following conventional cultivated fallow averaged the lowest at $266/ha.

Long term yield analysis

There are distinct trends in the yield of various treatments in this trial (Figure 3).

Trends include:

- No-till suits continuous cropping rotations better than 18-month fallows.
- 18-month fallow rotations favour conventional management over no till.
- No-till rotations yielded less than conventional rotations in the first 3 years of the trial. Since then the trend has reversed. Continuous cropping no-till rotations have since yielded on average 5% higher.

The first 3 years of the trial were variable, and it seemed as if it took 3 years for the no-till system to start performing. For this reason, it is important to measure the performance of no-till from this point onwards.

Continuous wheat and Rotation 1 have grown the most grain for the period of the trial. A total of 10 t/ha has been harvested since 2003. This gives an average yield of 1.3 t/ha.

The wheat–ley–fallow–wheat rotation has grown the least grain with only 3.5 t/ha harvested since 2003. This rotation obviously was not hosting wheat in the better seasons since the trial began.

Long term gross margin analysis

There are distinct trends in the gross margin analysis that follow similar trends to the yield results (Figure 4):

- No-till gross margins were higher in continuous cropping rotations.
- Conventional gross margins were higher in 18 month fallow rotations.
- No-till rotations in general are cheaper to grow than those in conventional treatments. Contract rates are used for all operations in this trial.

The highest gross margin was with Continuous wheat No-till ($531/ha) and Rotation 1 No-till ($514/ha). These treatments were not statistically different (LSD>5%) from Wheat–Fallow–Wheat Conventional ($450/ha).

Trends in weeds

The weed spectrums that have been measured in the trial show some very interesting trends. In general, no-till promotes:

- fewer weeds than conventional
- more annual ryegrass
- fewer broadleaf weeds except fumitory

Trends in root diseases

The disease spectrums in the trial have also changed dramatically. These have been measured each year since 2003 by DNA Predicta-B soil tests.

The major root disease risk is from *rhizoctonia*, however, *pythium*, *common root rot* and *take all* are all present in these soils. *Pratylenchus neglectus* root lesion nematodes are also common in these soils, and have been found in some rotations in high numbers.

In general, no-till increases the:

- risk of Rhizoctonia
- risk of *Pratylenchus neglectus*

Rotations have a big impact on root disease risks because;

- fallows significantly reduce the risks from all root diseases and nematodes, to the point where they are too low to measure. This is likely because when there are no weeds or crop living in the paddock, there are no hosts for the diseases.
- continuous wheat promotes the highest risk of root disease, as the diseases continually build up and multiply in numbers.
- field peas reduce the risk of root diseases compared to continuous wheat. This is because field peas are not as good at hosting many soil diseases as wheat, however the risk is not eliminated and is not nearly as low as following a fallow.

Trends in nutrition

There seems to be very little difference in nutrition between the no-till and conventionally sown crops. However, the crops following a long-fallow or field peas are usually the healthiest, exhibiting the highest nutrition and vigour of all rotations. Continuous wheat crops are often deficient in nitrogen and sulphur. Leaf tissue tests also indicate deficiencies in micronutrients such as copper, molybdenum and zinc. Foliar applications of those nutrients have not yet resulted in significant yield increases.

Soil phosphorous levels have increased in all continuous cropping rotations as fertiliser applications have been higher than grain-phosphorus removal.

Discussion

The trial is now 13 years old and showing some clear trends. The main trend being that no-till performs better under continuous cropping rotations rather than 18-month fallows.

The main reason is an increase in competition from weeds such as windmill grass, corkscrew, hairy panic, fleabane and other perennial grass weeds. They build up in the 18-month fallows and are difficult to control with herbicides, particularly in the second summer. They rob the soil of nutrients and moisture and subsequently lower potential yield.

Stubble levels have also been very low due to the dry seasons. High stubble levels are essential to ensure moisture infiltration and reduce evaporation in 18-month no-till fallows. The trial data indicates that in years with little or no stubble you are better off cultivating.

Three rotations were equally financially successful – continuous wheat (no-till), and rotation 1 (no-till) closely followed by wheat–long fallow–wheat (conventional).

The continuous wheat, however, has a high risk of failure due to root disease, lower nutrition and increased weed pressure. While this has not yet occurred in the trial, regular monitoring suggests Rotation 1 to be quite sustainable and is probably the preferred rotation.

If the seasons stay dry, then the 18-month fallow rotations may begin to overtake. However, if the seasons return to average or wetter, then continuous cropping rotations will remain in front.

Acknowledgement

The contributions of Ian Barber “Sylvanham”, and the local Merriwagga growers group are gratefully acknowledged in the running of the trial. In addition, support from local agribusiness agronomists, banks and chemical companies are greatly acknowledged.

File reference: Merriwagga CWFS 2010

Variety Specific AGRONOMY Packages

GRDC-supported research project in south/central NSW to develop agronomic information for new varieties of wheat, lupins and winter oilseeds.

GRDC Grains Research & Development Corporation

NSW GOVERNMENT Industry & Investment

Figure 1: Yield results for each rotation in 2010.

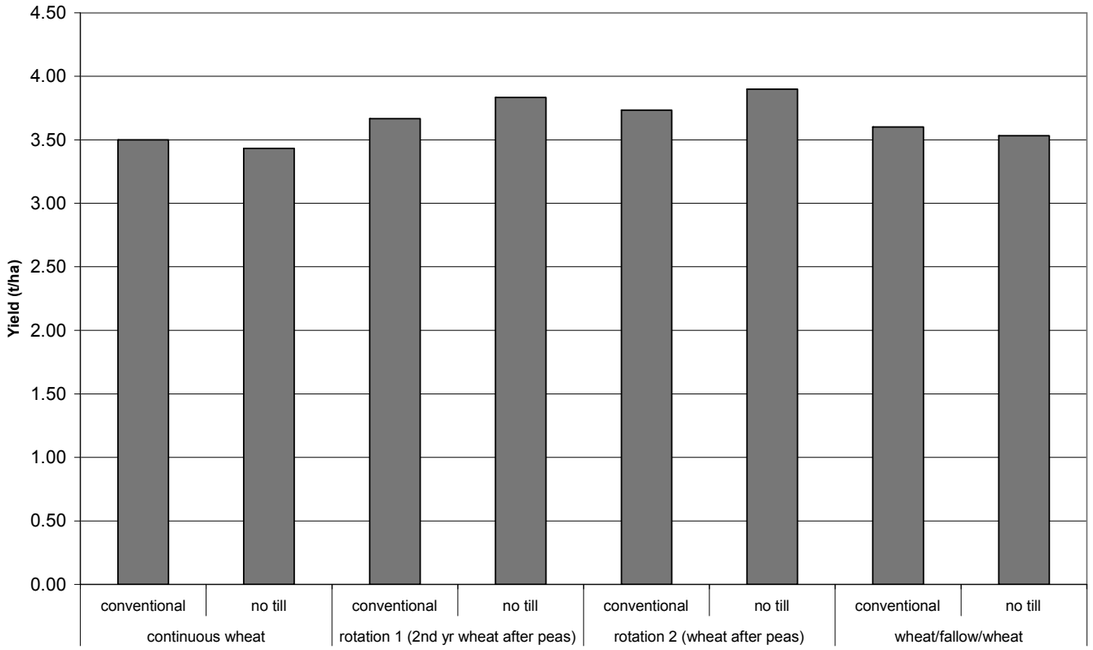


Figure 2: Gross margin results for each rotation in 2010 (Note W-L-F-W rotation was in fallow).

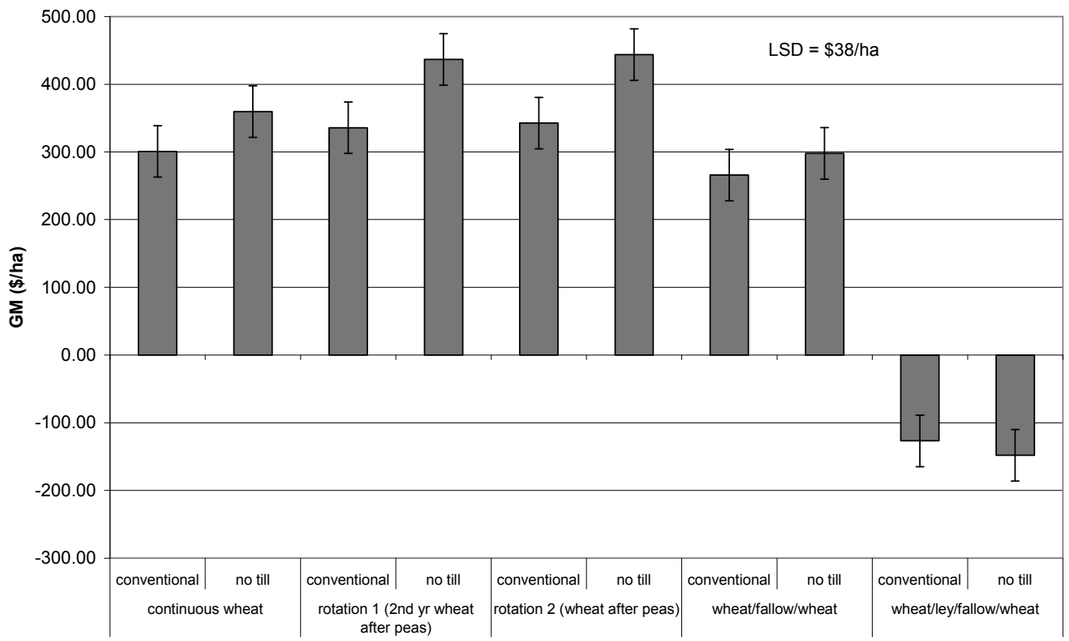
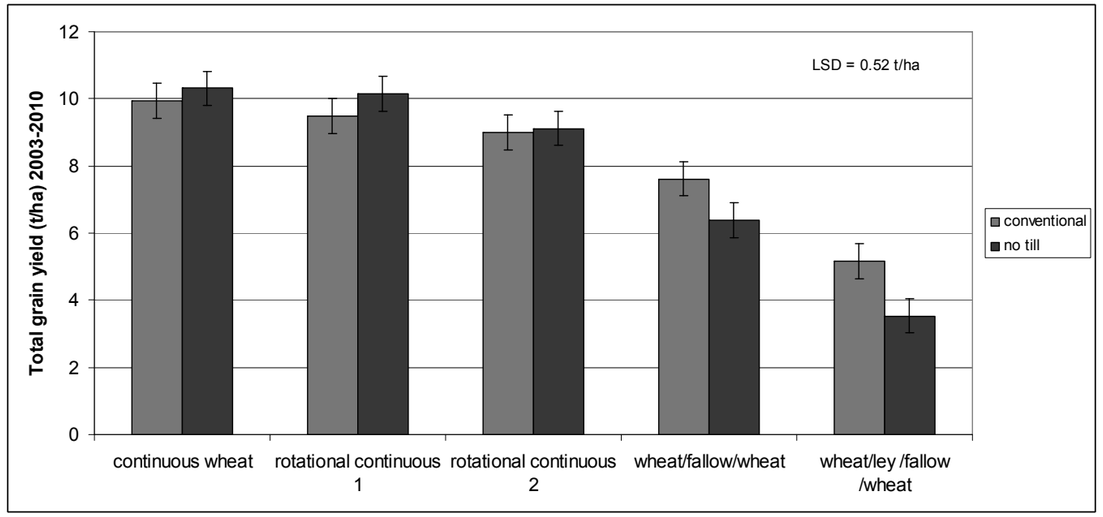
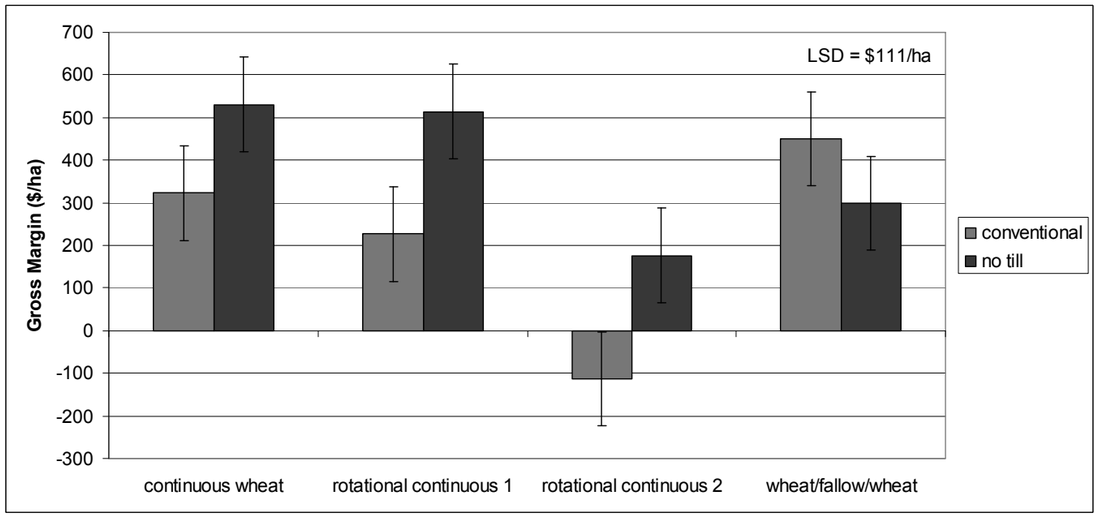


Figure 3: Total grain yield 2003-2010 for each rotation.



Note that Rotation 1 and 2 include some field peas into this total, which are typically higher value than wheat. This graph shows how No-till performs best in continuous cropping rotations and conventional rotations perform best in 18 month fallow rotations.

Figure 4: Long term gross margin analysis of treatments within the trial.



Note that the two wheat–fallow–wheat rotations were combined and averaged. The LSD is high due to varying performance between seasons.