

The strategic use of tillage within conservation farming

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Take home messages:

- Current advice on soil tillage management contains apparent contradictions. More flexibility is required in the application of conservation farming practices.
- We will evaluate the impact of a single tillage on soil chemical, physical and biological properties. We will assess the time required for the soil to recover from any detrimental impacts of a single, strategically applied tillage.

The issue

Conservation farming involves reduced tillage, stubble retention and good rotations. This underpins sustainable grain production systems worldwide. Problems arise when complete zero tillage is made the centre of the farming system.

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- On one hand we are encouraging the adoption by farmers of zero tillage. On the other hand we are advising farmers that limestone has to be incorporated into the soil or else it does little to ameliorate acidity.
- A lack of tillage causes nutrients such as phosphorus and organic nitrogen to accumulate on the soil surface where they can be less accessible to plants due to extremes of temperature (sub zero to >50°C) and because of soil drying.
- Zero tillage can favour diseases such as *Rhizoctonia* and *Pseudomonads* around the roots of some species and cultivars. Additionally, conventional tillage has been found to suppress plant parasitic nematode populations compared with direct drilling.
- Tillage can be used to lower numbers of snails and slugs prior to canola crops, and to lower mice numbers in affected fields.
- Integrated weed management might require the use of strategic tillage to manage herbicide resistance. In mixed farming systems, grazing of the pasture phase can be used to minimise weed burdens. However, but for continuous croppers, or within the cropping phase of mixed farming, some tillage might be needed for integrated weed management.
- Finally, zero tillage maintains soil structure and conserves soil moisture but in a mixed farming system, infiltration of rain can be poor following compaction by livestock. Tillage might be necessary to improve infiltration of rain.

Therefore, from an overall systems perspective, limited and strategically timed tillage could form part of a productive, sustainable system.

The central question emerges, ~~therefore~~:

How much damage is done to soil by occasional tillage, strategically applied, in an otherwise no-till system? ~~and~~;

If damage is done, how long does it take the soil to recover?

Objective

To resolve the contradiction[#] in current advice to farmers and provide practical ~~B~~best ~~M~~management ~~P~~practice guidelines for tillage.

[#]Farmers are encouraged to adopt direct drilling BUT are told to incorporate lime, bury herbicide-resistant weed seeds, deep rip to remove hardpans, cultivate to overcome

~~R~~rhizoctonia, etc.

What we will do

We will investigate this problem based on the hypothesis:

-That the agronomic and economic benefits of a strategic tillage operation exceed any agronomic costs due to damage to soil structure. The net benefits will accrue from such factors as lime incorporation, the homogeniz~~z~~ation of stratified nutrients, disease and pest control, and weed management.

The outcome will potentially be more flexibility in the implementation of conservation farming practices, i.e. a 'horses for courses' approach to tillage management dependent upon circumstances (paddock, season, resources).

Basic design

Main plots:

No-till (ongoing), non-inversion tillage (scarifier), inversion tillage (offset discs/rotary)

Split plots:

± NPS nutrients onto retained stubble for C sequestration

Site or year dependent split plots:

± Stubble, or year of tillage

Reps: n=4

Basic ~~M~~measurements

Agronomic:

Grain yield (plus oil, protein), anthesis DM, establishment counts.

Meteorological:

Rainfall, air and soil (10cm) temperatures, etc.

Chemical:

Soil C, total N, Colwell P, pH (plus site characterisation- ECEC, EC)

Plant N (anthesis DM and grain).

Physical:

Soil bulk density, hydraulic conductivity (saturated and -4 cm), aggregate stability (plus site characterisation- pF, psa profiles).

Biological:

Disease organisms e.g. rhizoctonia.

Team members

Farmers: Geoff and John Byrne, Chris Holland, Andrew Simpson

Consultants: Peter McInerney, Greg Hunt, Sandy Biddulph

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CSIRO–Plant Industry: John Kirkegaard, Clive Kirkby, Andrew Bissett, John Graham

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Sites

Harden CSIRO Long Term Trial

The plots having long term stubble retention and stubble burnt have been split for ongoing no-till vs ~~the~~ rotary hoeing of the previously no-till soil.

The split plot has been further split for \pm NPS supplementary nutrients for increasing the store of SOC; in 4 reps = 32 plots.

Berthong (~~North~~ of Cootamundra) - Geoff and John Byrne

~~The beauty of what we can do here is that we have t~~Two paddocks side by side with the same history but one came out of lucerne pasture into crop in 2012 and the other will come into crop in 2013.

2012: no tillage, scarifier, off sets \pm NPS; in 4 reps = 24 plots; then

2013: no tillage, scarifier, off sets \pm NPS; in 4 reps = 24 plots.

This way we capture the effect of the year of tillage at the site, both following lucerne pasture. Crop in 2012 was ~~C~~canola, with wheat in 2013.

Thuddungra (Young-Grenfell) - Chris Holland

Here we can capture the impact of cultivation during a cropping phase, post wheat and prior to liming of canola in 2012.

2012: no tillage, scarifier, off sets by stubble retained or burnt \pm NPS; in 4 reps = total 48 plots.

Daysdale (NNW of Corowa) - Andrew Simpson

This 'continuous cropping' site had a vetch brown manure in 2011, and it is occasionally grazed by sheep, causing compaction. The site grew canola in 2012.

2012: no tillage, scarifier, off sets \pm NPS; in 4 reps; then
2013: no tillage, scarifier, off sets \pm NPS; in 4 reps = 48 plots

As at Berthong, we are able to capture the effect of the year of cultivation.

Conclusion

Results will become available over the next few seasons, with an estimated completion and reporting date of September 2016. As this is a long term issue, we are not offering short term advice based on results to date.

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