Flexible farming systems focus paddocks – a summary

Ben Jones *(BCG Consultant)*

Take home messages

- *Many of the management issues in till and no-till systems are similar.*
- *A flexible approach is beneficial in both systems.*
- *Full results can be found at www.flexiblefarming.com.au/results.*

Background

The project began in 2006, with the aim of helping southern Mallee and northern Wimmera farmers cope with whatever came their way. In 2005 farmers were already starting to recognise that the changes in the rainfall pattern were distinct from the usual yearly variation. At the same time, farmers were beginning to adopt no-till in adjacent areas, and to intensify cereal cropping. Prior to this, the uptake of these farming practices in the region had been slow.

Six pairs of focus paddocks were set up around the target region with the aim of having an extension focus while also collecting data that might help to illustrate the management differences between different systems. This article summarises monitoring on the paddocks between 2006 and sowing, 2009.

Aim

To help conventional (till) and no-till farmers appreciate the differences in management issues between the 2 establishment techniques and associated farming systems.

Method

The Flexible Farming Systems Project monitored 6 pairs of focus paddocks across the southern Mallee/northern Wimmera between 2006 and 2008. One paddock in each pair was managed no-till and the other till.

The monitoring involved soil and crop measurements, as well as collection of farmer data on crop inputs and yield. Effort was also put into characterising the region in terms of soil and rainfall variation, so that differences between the paddocks and climate specific to 2006 – 2008 could be best understood.

There are limitations to interpreting the data collected. It is easy to find a pattern amongst 6 pairs simply by random chance. Differences in paddock history, management, soil type and climate need to be taken into account. Nonetheless the data represents the type that farmers base management decisions on, and was measured with the greatest possible care and accuracy. The trends found in the paddocks often echo the experience of local agronomists, and/or world scientific literature.

Results

Rainfall

With some minor local variation, the pattern of change in April – October rainfall has been a 50mm decline between the 1996 – 2005 period and 1900 – 1995. There has been a further 50mm decline in 2006 – 2008. During this period the historic average rainfall of the northern Mallee, was experienced by the Wimmera – south of Horsham. Over the same sets of years, summer rainfall has increased in the east and decreased in the west of the Wimmera/Mallee, although the change has been small.

On a monthly basis the biggest changes have been in March – April and September – October. March – April tended to be very dry between 1996 – 2005, but similar to average in 2006 – 2008. Winter (May – June and Jul – August) rainfall has been declining slowly. Spring (September – October) rainfall was average between 1996 – 2005 but dropped dramatically in 2006 – 2008. The experiences of farmers over these years will have conditioned thinking about particular practices, although the trends may not continue into the future. 2009 thankfully broke some of these trends.

Images of rainfall patterns have been made available as free downloadable 'kmz' files for Google Earth: http://www.flexiblefarming.com.au/results/post/2009/04/Wimmera-Mallee-rainfall.aspx.

Landscape

Elevation and gamma-radiometric images of the Wimmera/Mallee demonstrate the overwhelming influence of water on the landscape over the past 3 million years. Images have been made available as free downloadable 'kmz' files for Google Earth (http://www.malleefocus.com.au/PA/post/Spatial-data-for-Google-Earth.aspx) and can be used to better understand how individual farms are placed with respect to past geomorphology.

The focus paddocks covered a range of southern Mallee/northern Wimmera landforms and soils. Although Electromagnetic Induction (EM) soil conductivity maps were used to help select similar parts of some paired paddocks, future studies would benefit from also using large-scale elevation and gamma-radiometric images.

Agronomy

All paddocks began in cereals in 2006 (except for lentils at Minyip) and then diverged. Over the period of the project, the Patchewollock till farmer adopted no-till. No-till farmers grew more pulse crops on the focus paddocks in 2007 and 2008.

Till and no-till farmers tended to sow at similar times, allowing for differences in crop type. There may have been some differences if sowing times were measured on a whole-farm basis.

Plant densities in no-till crops (generally 30cm spacing) tended to be lower on an area basis, but were similar to till crops (generally 17.5cm spacing) when calculated on a lineal (per m row) basis.

Weeds and diseases were monitored in all paddocks but tended not to be problematic (in numbers causing economic loss). Rotations and management in both no-till and till systems controlled weeds and disease as expected.

Soils

Salt (EC1:5) was measured regularly and found to change more than was previously expected from measurement to measurement. Whether a soil was considered 'hostile' on the basis of soil measurements could depend greatly on when the sample was taken. There were no regular variations with till or no-till that could not be related to soil texture (the northern till paddocks tended to be on heavier textured soils).

Soil water

Soil water was sampled at sowing and harvest to allow for estimates of water use efficiency. In some seasons till or no-till crops would tend to be drier or wetter but there was no consistent pattern of soil water use with system or crop. Long fallows in 2007 and 2008 stored water but most had been stored before harvest soil sampling. With wet harvests there were few differences between short and long fallows at sowing.

Phosphorus

Soil measurements showed that most available phosphorus (P) in southern Mallee/northern Wimmera paddocks was present in topsoil, and in most paddocks was sufficient – crop yield would not be limited by P. There were no differences related to whether the crop was in a no-till, or till paddock.

In the relatively dry years when plant P uptake was measured, P was more limiting to crops than nitrogen (N), and till crops tended to take up more N than required to match P uptake. At GS30 the excess uptake of N across both till and no-till crops was related to the P deficiency determined by the soil's Critical Cowell P (CCP) calculated using Colwell P and Phosphorus Buffering Index (PBI).

Plant P uptake up to GS30 was relatively small compared to fertiliser and soil P supply.

In all paddocks the P balance was positive, with till farmers tending to apply more P fertiliser and removing less in grain or hay. There was no relation between P balance and change in Colwell P during the period of the project. Till paddocks tended to have a decrease in Colwell P despite having a positive P balance. It was highlighted that both P budgets and Colwell P have limitations as tools for planning fertiliser strategies, but are still the best tools available.

Large changes between harvest and pre-sowing Colwell P measurements were related to nitrate N measurements, and may have been caused by mineralisation/immobilisation, or be an artefact of the soil sampling process. Whatever the cause, crop management needs to consider the possibility of large summer/autumn changes in soil measurements. Early soil tests may not correspond to soil nutrient status at sowing.

Nitrogen

Soil mineral N measurements in most paddocks fell (as expected) between sowing and harvest, but rose by a similar amount between harvest and sowing of the next crop. Most N in the years of the project was between 0 and 40cm, except in paddocks that were fallowed, or had a history of high N application in some years. In most cases 0 – 40cm N measurements were an adequate predictor of 0 – 70 and 0 – 100cm. Changes in sampling depth would have to consider whether water measurements at these depths would still be useful.

N was not limiting in any of the crops between 2006 and 2008 despite a generally negative N balance. There were no patterns associated with till or no-till.

The amount of N released in mineralisation (assumed) between sowing and harvest was not well related to rainfall or organic carbon, but appeared to be intrinsic to particular paddocks. The amount of mineral N already in the soil at harvest was a predictive factor, and a reasonable predictive model could be made using rainfall, topsoil organic carbon measured at harvest, and the mineral N already in the profile.

Organic carbon

Organic carbon levels fell during the project period, especially in paddocks where crop production was low. The rate of decline may have been related to P balance. Differences between paddocks in a pair tended to relate more to soil texture than till/no-till.

Trace element levels varied more between paddock pairs than with till or no-till. No patterns were observed.

Crop growth, ground cover, water use efficiency and yield

Ground cover was measured in-crop through 2007 and 2008. Straw was a greater proportion of ground cover in no-till paddocks than till paddocks, but soil made up a large proportion of ground cover in both systems. Soil throw at sowing tends to cover retained straw in no-till systems. Straw in no-till systems substitutes for crop ground cover in till systems; this is mainly related to row spacing. Otherwise ground cover of crops in the 2 systems was quite similar.

Despite the dry seasons, several crops achieved reasonable biomass growth up to anthesis (4 – 8t/ha). There was usually little growth after that. Yield was related to harvest index (the ratio of grain to dry matter) over the years of the project. Till crops often had higher GS30 and GS65 biomass, but lower harvest index and often yield. Making hay would have been a useful strategy for till (and some no-till) farmers in dry years.

Water-determined yield potential was often much higher than crops were able to achieve, which reflects dry springs. Crops sown in 2008 came closest. In general, where till and no-till paddocks were both sown to cereal crops (mostly 2006), no-till paddocks were closer to potential yield. This reflected a higher harvest index.

Data from the paddocks also demonstrated the potential to calculate unrealistically high 'water use efficiency' figures for both till and no-till crops if soil evaporation and stored water were not properly accounted for. All crops achieved realistic 'water use efficiency' when data was available to make the adjustments.

Inputs

Herbicide use was greater on no-till paddocks, but till farmers also used chemical fallow. In general there was little tillage over the 3 years of the project, with till farmers adopting many of the chemical fallow approaches used by no-till farmers. Till farmers applied more fertiliser P, but this was not reflected in Colwell P, which declined more in till paddocks over the 3 years.

Economics

Cost to put a crop in tended to reduce between 2006 and 2008 as till and no-till farmers reduced spending on fertiliser. No-till farmers spent more on herbicides, which was generally balanced by till farmers spending more on fertiliser. Allowing for differences in crop type, there were no clear trends in overall cost with either system.

Most paddocks had a positive average gross margin despite the years. A few were quite profitable, reflecting decisions appropriate for the year and system (till or no-till) and good cost control. 2 pairs of paddocks included a long fallow in the till system. One was more profitable than the continuous crop in the no-till paddock (Sea Lake), the other less profitable (Donald).

Hay crops were often more profitable than cereal crops. Legume crops were expensive when they failed (2006), but could be quite profitable with modest yields (chickpeas) or when made into hay (vetch). In some areas it was difficult to make a profit regardless of crop (Culgoa).

Till and no-till systems were less different than expected in terms of time required in the paddock, because on many till farms the time-consuming task of tilling summer fallows has been replaced with herbicide. Making hay was often the biggest difference between systems.

Interpretation

The results from focus paddock monitoring reinforce the need for 'flexible' farming systems. Farmers operating till, no-till or even both systems need to be ready to take ideas from each other and elsewhere to make the best of what nature and world grain markets provide. In the case of till farmers, this may be replacing summer tillage with herbicides (while retaining full-cut sowing, if desire), and being prepared to make hay if high biomass crops are unlikely to convert into grain. No-till farmers need to remain alert to possible changes in nutrient requirement in their system (less P) as signalled by soil tests and consider hay if appropriate. Agronomic basics in each system (weeds, diseases, establishment, nutrition) have been managed well and neither system is likely to fail in the short to medium term.

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