Farming systems trial, 2006

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Take Home Messages

- Crop yields in 2006 were driven by fallow (no difference between mechanical/conventional).
- Early sowing set an upper limit to yield but did not compensate for not being sown on fallow.
- Crop emergence was very sensitive to sowing conditions, with later sowing and sowing into 2005 cereal crop stubbles leading to much later crop emergence.
- The difference in soil available water driving the fallow response was difficult to measure with soil sampling on these soils; soil available nitrogen was a better predictor of yield in 2006.
- There were no yield penalties to adopting no-till in the Hungry Sheep and Fuel Burner systems.
- Cultivation in No Till and Reduced Till paddocks produced inconsistent effects on yield.

Introduction

The difficult growing season of 2006 raised many questions, to which existing and new treatments in the BCG farming systems trial provide some answers. This article examines (in 2006):

- Whether sowing date was the main influence on yield in no-till and other systems
- Whether there was a yield penalty from adopting no-till in a dry year in the Fuel Burner and Hungry Sheep systems
- Whether a single cultivation had a detrimental effect on yield in no-till systems

Methods

The BCG farming systems trial compares the systems of four local champions: “Fuel Burner” Paul Barclay (regular incorporation of mechanical fallow), “Hungry Sheep” Ian and Warrick McClelland (intensive sheep plus intensive cropping), “Reduced Till” Brad Martin (flexible approach), and “No Till” Allan and Neale Postlethwaite (minimum soil disturbance). Each system has five paddocks approximately one hectare in size which are sown and managed according to predetermined philosophies. There is also a control (“Standard”) system, a four year rotation of pea-canola-fallow-wheat replicated three times and intended to measure error caused by spatial variation and management across the site. The trial had a ‘set up’ year in 1999 and has been managed by the champions since the 2000 cropping season. Operations are performed by the BCG trials team.

In 2006 new split-plot no-till adoption treatments were added to the Fuel Burner and Hungry Sheep systems, and some of the no-till and reduced-till plots were cultivated for the first time (besides sowing) in years.

Plots in different systems were sown over a range of dates, but otherwise the champions all chose low rates of fertiliser (40 kg/ha of MAP or 50 kg/ha MAP + 1% Zn) and sowing rates consistent with district practice (60 kg/ha for barley, 80-90 kg/ha for wheat, except 110 kg/ha for Silverstar). Weed control was a pre-sowing knockdown where necessary and trifluralin

incorporated by harrowing or sowing in the case of direct-drill/no-till crops (most crops). There was little need for in-crop weed control. Soil samples were taken on April 7, 4 cores to 100 cm per half plot, 6 0-10 cm samples taken around each deep core.

This year we took both hand and machine harvests, and noticed that the yield of plots sown with the Avon seeder (knife points and press-wheels, 22.5 cm spacing), as measured by our Kingaroy plot harvester, seems to be poor compared to plots sown with the Concord. The differences are quite large, relative to 2006 yields (0.1 to 0.2 t/ha on yields from 0.2 to 0.6 t/ha), and as a result we have presented the hand-harvest yields. These were 10 x 0.5 m lengths of row per half-paddock, and have been quite consistent throughout the season.

Summary of systems in 2006

Fuel Burner system was allowed to own sheep in 2006, rather than the previous practice of only having sheep on agistment. One of the paddocks was sown to vetch, soon after the break (not before as intended), but poor pasture growth overall led to ewes being fed and finally sold in August. One of the fuel-burner fallows (10) was also later sown.

Hungry Sheep system put in a paddock of oats for sheep feed early but apart from that had an optimistic approach to sowing, with two paddocks being sown later in the sowing window. The hungry sheep were mostly fed throughout the year and crops are being grazed rather than harvested. Two paddocks have been cultivated for erosion control.

Reduced Till system sowed most paddocks early. A paddock of short-season Silverstar wheat sown late still produced some yield. There were two wheat crops sown, one following pea and one following canola.

No-till system paddocks were also sown early apart from a paddock of Wyalkatchem.

Results

Rainfall

Growing season rainfall in 2006 was 93.8 mm, making it the third-worst in the last 100 years beaten only by 1914 (80.6 mm) and 1982 (62 mm). The annual rainfall was 184 mm (39.8 mm before April, 50.4 mm after October), equal to 1929, fourth-worst in the last 100 years.

Crop yields

Crop yields from 2006 are shown in Table 1 below. These yields were driven primarily by the rotation (whether fallow or on a 2005 cereal or other crop) and sowing date. Yields for wheat sown on fallow were highest (Figure 1a), apart from the later-sown fuel burner fallow. Among the fallow paddocks, the performance of crops on chemical and mechanical fallows were similar. Early sowing did not, however, compensate for crop not being sown on fallow. Yields of crops early-sown into the stubble of 2005 barley crops were low and similar to late-sown crops. Yields of early-sown crops on wheat, pea and canola stubble were higher but still less than fallow crop yields. Instead, sowing date placed an upper limit on potential yield (Figure 1a).

Table 1. Summary of crops sown in the systems trial in 2006, treatments, sowing dates and yields. The first yield given is hand harvest in t/ha. Kingaroy plot harvest yield is given in brackets.

Fuel Burner	Hungry Sheep	No Till	Reduced Till	Standard
Plot 8 NoTill Barley (Vic Sloop) Sown 11/05/2006 Yield 0.00 (0.02)	**Plot 2** NoTill Wheat (Yitpi) Sown 11/05/2006 Yield 0.04 (0.03)	**Plot 6** NoTill Wheat (Wyalkatchem) Sown 9/05/2006 Yield 0.07 (0.03)	**Plot 3** NoTill Wheat (Yitpi) Sown 9/05/2006 Yield 0.12 (0.09)	**Plot 1, 15, 20** Fallow
Plot 8 Till Barley (Vic Sloop) Sown 11/05/2006 Yield 0.04 (0.00)	**Plot 2** Till Wheat (Yitpi) Sown 11/05/2006 Yield 0.02 (0.03)	**Plot 11** NoTill Wheat (Yitpi) Sown 9/05/2006 Yield 0.53 (0.34)	**Plot 3** Till Wheat (Yitpi) Sown 9/05/2006 Yield 0.18 (0.07)	**Plot 4, 25, 31** Pea (Kaspa) Sown 14/06/2006
Plot 10 NoTill Wheat (Yitpi) Sown 16/05/2006 Yield 0.35 (0.18)	**Plot 5** NoTill Wheat (Yitpi) Sown 16/05/2006 Yield 0.01 (0.01)	**Plot 11** Till Wheat (Yitpi) Sown 9/05/2006 Yield 0.55 (0.34)	**Plot 14** NoTill Wheat (Silverstar) Sown 18/05/2006 Yield 0.16 (0.07)	**Plot 7** Wheat (Yitpi) Sown 9/05/2006 Yield 0.53 (0.58)
Plot 10 Till Wheat (Yitpi) Sown 16/05/2006 Yield 0.19 (0.18)	**Plot 5** Till Wheat (Yitpi) Sown 16/05/2006 Yield 0.01 (0.00)	**Plot 16** NoTill Wheat (Wyalkatchem) Sown 16/05/2006 Yield 0.01 (0.01)	**Plot 14** Till Wheat (Silverstar) Sown 18/05/2006 Yield 0.07 (0.04)	**Plot 17** Wheat (Yitpi) Sown 9/05/2006 Yield 0.51 (0.46)
Plot 18 Fallow	**Plot 13** Oats Sown 3/05/2006	Plot 22 Fallow	**Plot 19** NoTill Barley (Vic Sloop) Sown 11/05/2006 Yield 0.17 (0.09)	**Plot 28** Wheat (Yitpi) Sown 9/05/2006 Yield 0.59 (0.61)
Plot 21 NoTill Wheat (Yitpi) Sown 11/05/2006 Yield 0.60 (0.42)	**Plot 26** Barley (Vic Sloop) Sown 18/05/2006	**Plot 27** NoTill Barley (Vic Sloop) Sown 11/05/2006 Yield 0.27 (0.03)	**Plot 24** NoTill Barley (Vic Sloop) Sown 11/05/2006 Yield 0.05 (0.06)	**Plot 9, 12, 23** Canola (44 C 73) Sown 5/05/2006
Plot 21 Till Wheat (Yitpi) Sown 11/05/2006 Yield 0.52 (0.39)	**Plot 32** NoTill Barley (Vic Sloop) Sown 16/05/2006 Yield 0.01 (0.01)		**Plot 30** Fallow	
Plot 29 Vetch (Blanche Fleur) Sown 4/05/2006	**Plot 32** Till Barley (Vic Sloop) Sown 16/05/2006 Yield 0.03 (0.01)			

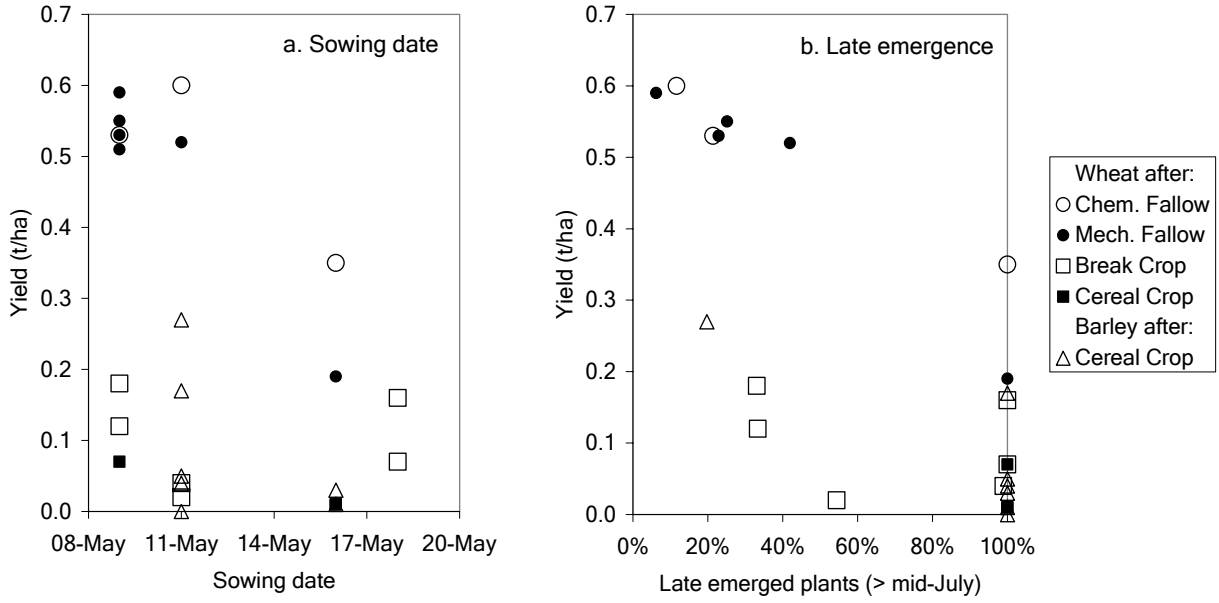

Figure 1: 2006 cereal crop yield in relation to (a) sowing date and (b) late emergence in the systems trial. Per cent late emerged plants is the difference between emergence counts made before July 13, and on August 2, expressed per cent of plants emerged on August 2.

Yield response to sowing date

The mechanism behind the sowing date response in 2006 was emergence. A few days difference in sowing date (and conditions) made a big difference to the eventual emergence date. All crops sown after 11 May did not emerge properly until after rain in mid-July (Figure 1b). Some crops sown on or before 11 May also had poor emergence. The common factor behind poor emergence of early-sown crops was being sown into 2005 cereal stubble. Wyalkatchem (sown into barley stubble) and barley (sown into cereal stubble, with the exception of one No-Till plot) failed to emerge completely until there was follow-up rain. The 2005 cereal crops would have used most spring rain and would have been quite dry at sowing, relative to the sowing rainfall (26 mm between April 28 and May 7).

We found no detectable difference between the two sowing methods used in achieving emergence.

Yield response to previous crop/fallow

It seems obvious that crops on fallows should grow better in years like 2006 because of greater stored water, but this is proving to be a difficult thing to measure with conventional soil sampling at the systems site. The soil is a ‘gilgai’ or ‘crab-hole’ soil type, which is highly spatially variable in soil texture. Among the crops where yield was not confounded by late emergence, there was little relationship between available water measured pre-sowing and yield (Figure 2a). There was, however, a relationship with available nitrogen measured pre-sowing (Figure 2b).

It is likely that nitrogen mineralisation (another product of fallow) is less spatially variable than soil available water, hence paddocks at the site with higher water content are better detected from soil nitrogen measurements. From other work (EM = Electromagnetic Induction soil conductivity survey of the site at the same time) we are reasonably confident that the fallow plots were actually wetter.

The difficulty of measuring the degree of wetness on this soil type has important implications for the concept of managing 'available soil water' on these soils using water measurements from soil cores. The results imply that it would be difficult to measure soil water on a number of paddocks with this soil type (or on the same paddock between years) and make judgements on where inputs would be best placed.

It is likely that what is varying spatially is the soil texture and 'unavailable soil water', more than the available soil water itself. When interpreting the differences between yields of long- and summer-fallow crops at the site, there is considerable scope for storing water on these soils. Until better water measurement methods come along it may be better to infer an amount stored from past experience (taking into account rainfall and quality of weed control on fallow) than to rely on measurements from soil cores.

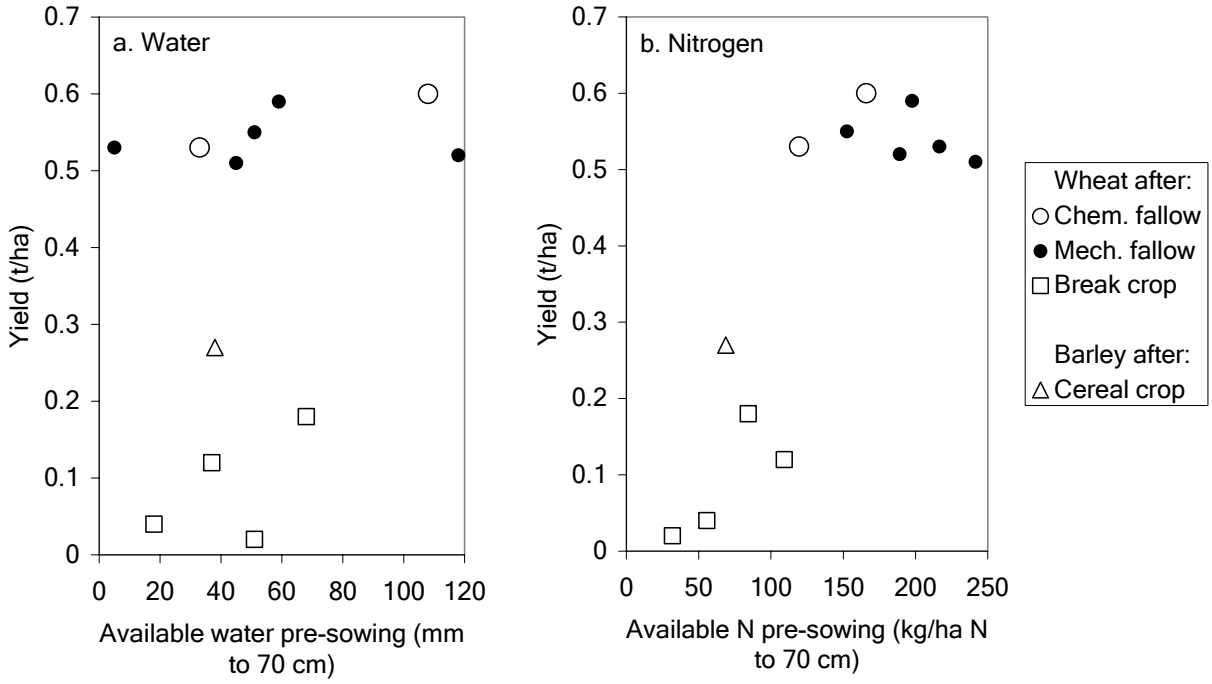

Figure 2: Relationship between available water (a) and nitrogen (b, nitrate + ammonium) measured pre-sowing, and yield of crops at the systems site with emergence measured before mid-July.

Fuel Burner and Hungry Sheep no-till adoption

The Fuel Burner and Hungry Sheep systems adopted no-till to the extent that crops were sown with narrow points/press-wheels (Avon seeder) and trifluralin incorporated by sowing (already the practice on some 'conventional' paddocks). Where paddocks had been mechanically fallowed, chemical fallow was used from the start of the year.

There was no penalty in crop yield to Fuel Burner and Hungry Sheep systems when adopting no-till in 2006. Crop yields in the 'no-till' version of the Fuel Burner fallows were slightly higher (Figure 1a, fallow crops sown May 11 and May 16), but the yield improvements seemed to be related to better emergence in the May 11 sowing (Figure 1b). There were no consistent, measurable differences between the fallows in available soil water or nitrogen. There were no other notable differences because few of the other paddocks in either system yielded anything!

Cultivation in no-till systems

Some of the No-Till and Reduced-Till half-paddocks were cultivated in 2006, with the aim being to see whether there were immediate or on-going penalties to using occasional cultivation in these systems. There were no consistent effects on yield, with a positive effect in wheat on canola (0.18 vs 0.12 t/ha), a neutral effect on a fallow (0.55 vs 0.53 t/ha), and a negative effect on wheat on pea (0.07 vs 0.16 t/ha). There were some indications during the year of increased weediness in the cultivated plots, and it will be interesting to see if this causes problems in 2007 crops.

Concluding comments

This report tackles the 2006 systems trial data from a couple of very specific angles only; there is much more yet to be learnt from 2006. The current analysis should help to explain what was driving yields on heavy soils in the region in 2006, and give confidence to those considering the adoption of no-till.

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