Third Australian Controlled Traffic Farming Conference

University of Queensland, Gatton, July 20 -- 22

Introduction

Welcome to this CTF05 conference, organised jointly by the University of Queensland and CTF Solutions, with major sponsorship assistance from John Deere and GRDC. We hope you enjoy and value the experience of a grower-focus conference, concerned with the implementation of innovative systems and practices that work in the paddock.

The conference brings together growers from different regions in grain, sugarcane, cotton and vegetable industries. Our speakers are growers operating successful CTF systems, describing their current systems, the changes required to get there, and plans for the future.

Most industries have similar issues with innovative systems, but with different approaches to their solution. There is a good chance that someone at this conference has already worked through your issues and solved the problem you're wrestling with.

The University of Queensland Gatton location has been chosen to provide a relaxed atmosphere and maximum opportunity for participants to talk to each other, to presenters and to suppliers. All the presentations are brief, to ensure plenty of time for discussion -- formal and informal. Conference catering is in the centre of the trade display, which focuses on guidance and high technology.

Conference sessions will highlight the application of controlled traffic farming in different systems, precision agriculture, zero tillage, GPS and GIS systems, satellite imagery: all the latest new techniques and technologies for Australian agriculture. This conference aims to bring out the most effective ways to use new technology for a better, more profitable and enjoyable future.

Controlled traffic farming aims to exploit the system's full potential when soil and crop performance are not limited by wheel effects, and tractor performance is not limited by soft soil. Productivity improvements in CTF come from healthier soil with more available water, more timely field operations, and more cropping opportunities. Cost reductions come from less tillage, less spraying, and reduced machinery operation.

Our previous CTF conferences (Rockhampton 1995, Gatton 1998) had a big impact on people and industries. We hope this conference will do the same, and be the precursor of annual conferences moving around the states, organised by a national committee. It will also initiate a national group for communication and interaction among young growers from around Australia and overseas.

We hope you enjoy discussion of these issues with other growers, technology suppliers, consultants and scientists attending this conference.

Jeff Tullberg
University of Queensland

Don Yule
CTF Solutions

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Raised bed farming in WA, an application to saline land.

Derk Bakker[1], Greg Hamilton[2], Rob Hetherington[1] and Cliff Span[3]
Department of Agriculture of Western Australia
1: Albany, 2: Perth and 3: Mt Barker

INTRODUCTION

Significant areas of the Western Australian Wheat Belt experience elevated levels of soil salinity and are prone to waterlogging particularly in lower lying areas. The increase in soil salinity caused by rising ground water tables, has severely altered the farming options in those areas. Historically they produced good cereal yields but are now reduced to marginally yielding areas or are excluded from cropping altogether. They are now used exclusively for grazing with little scope for improved pastures except perhaps for the utilisation of saltbush.

Transient waterlogging has also been recognised as a factor severely limiting the potential yield in many years, depending on the annual rainfall received. For several years research into the application of raised beds to alleviate waterlogging has clearly shown that significant yield increases can be obtained with that farming system. The impact of raised beds on waterlogged and saline land has not been clear and has been the subject of a research project funded by the Department of Agriculture of Western Australia (DAWA), the Grains Research of Development Corporation (GRDC) and the CRC for Plant Based Management of Dryland Salinity.

Aspects associated with raised beds thought to be beneficial in the cultivation of saline land are:

- The ability of raised beds to leach salts from the root zone
- The increased soil cultivation limits the capillary rise in spring and reduces the re-salinisation of the root zone
- An increase in the runoff from the beds reduces the accession of the ground water, which will have a positive long-term effect on the water table.
- The ability of raised beds to increase the productivity from waterlogged land increases the evapotranspiration from the beds and reduce the salinisation of the root zone.

METHOD

Three large (about 60 ha) experimental areas located in the South Western part of WA and were selected on the basis of the range of salinities, the susceptibility to waterlogging, the willingness of the landholder to collaborate and their representation of significant portions of the landscape. The initial salinity across the areas was established through an EM38 survey and the topography assessed with a Beeline® DGPS system. Based on this information the experimental layout was determined, shallow surface drains and the treatments installed in 2002. The treatments consisted of a cropping and a pasture area with raised beds which are beds made following a deep soil cultivation and an annual soil loosening, no-till beds which are beds made without any prior soil cultivation or annual soil loosening and a control. The choice of crop and pasture composition varied from site to site and was determined by the growers.

OBSERVATIONS

Changes in the soil salinity of the top 15 cm was determined on fixed points across the experimental area through repeated soil sampling. After 2 years the depth was increase to 60 cm at a smaller number of points but with more reps per point. Piezometers to measure the fluctuation of the ground water were installed in several plots and monitored regularly. Changes in the salinity across the area were determined from EM38 surveys done during the winter and the summer. Biomass estimates of the pasture and the crop were derived from digital multi-spectral images, obtained in September. "Ground-truthing" of the images occurred at the same time by actually cutting pasture and crop samples. The reflectance of the 4 bandwidths (Red, Blue, Green and Near-Infra-Red) gave different correlations with the biomass. The image producing the best correlation was used to estimate the spatial distribution of the biomass. Pasture composition was determined during the EM38 surveys using a series (7) of potentiometers each representing a species including bare ground. During the survey done using an ATV the position of the potentiometer was changed to reflect the composition, i.e. a pure rye grass (RG) stand would result in the RG potentiometer fully open and the rest closed. The same logger logging the EM38 logged the position of the potentiometers. At harvest time the spatial distribution of the yield was recorded with a yield monitor and a DGPS. Gross plot yields were obtained by weighing the header empty and full using large roll-on/roll-off weighing platforms.

RESULTS AND DISCUSSION

The results presented are limited to one site (Woodanilling) only because the sites did not vary greatly in the way they performed and the type of relevant issues.

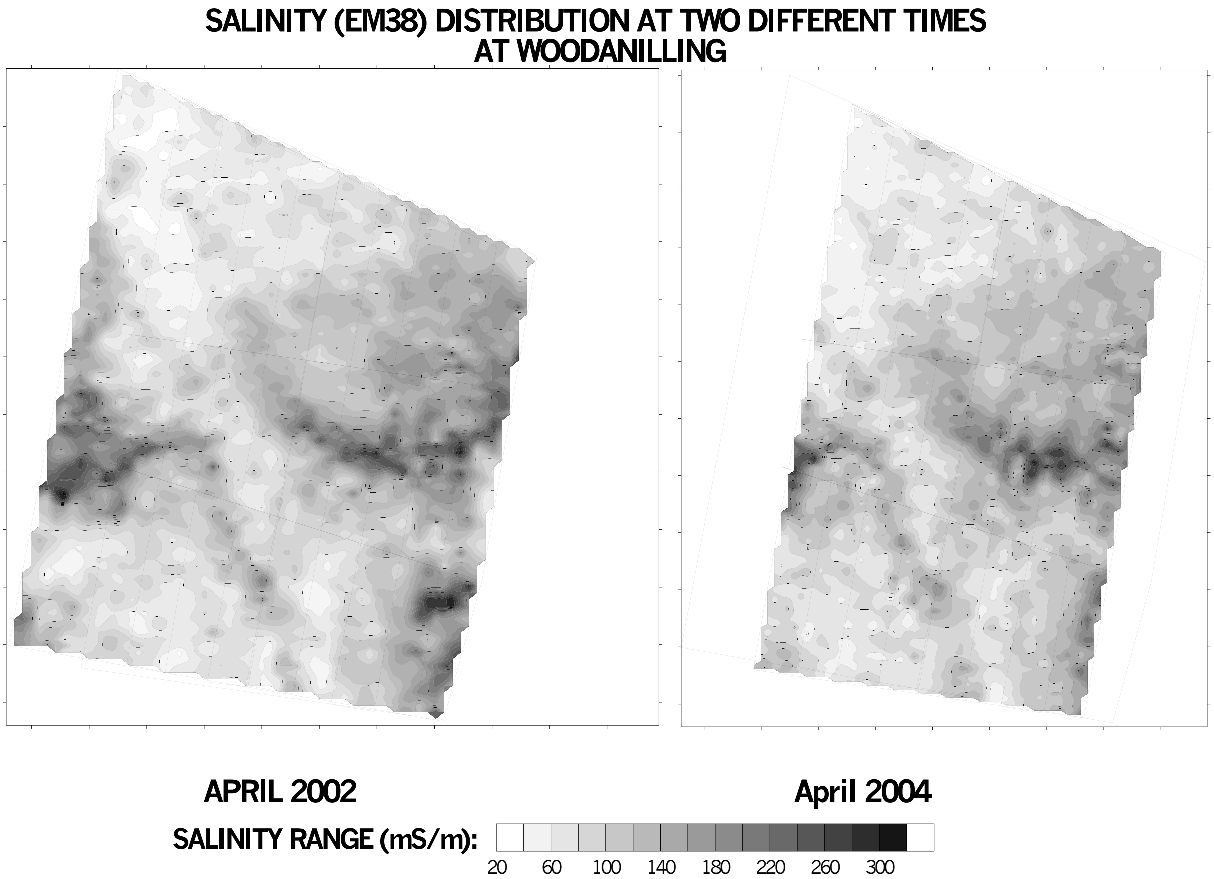

Figure 1 Salinity distribution (EM38) at Woodanilling in April 2002 and 2004

A salinity level of >300 mS/m severely affects crop/pasture growth. From the figure it is clear that several areas are affected but some of the 'hot-spots' had reduced in size by April 2004.

The soil salinity and moisture with depth at two locations is portrayed in Figure 2.

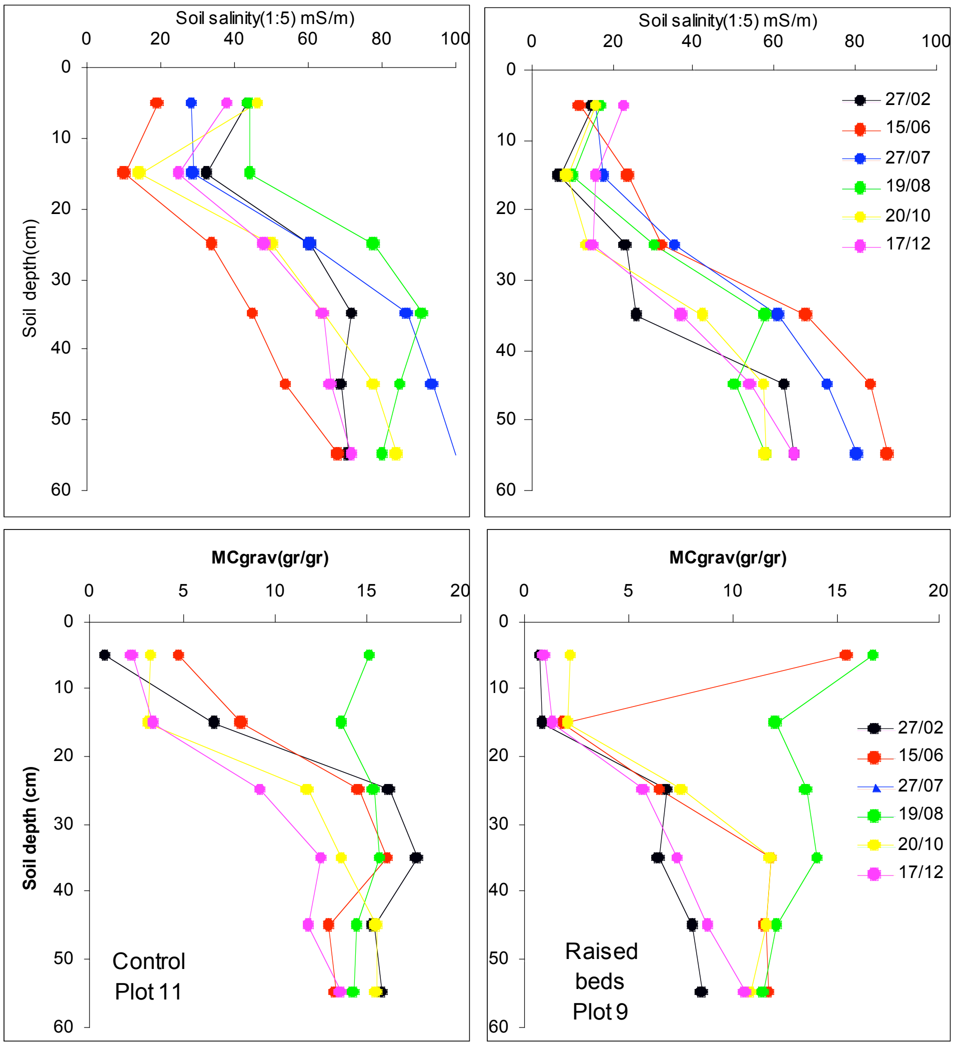

Figure 2 Salinity (top) and soil moisture profiles (bottom) in Plot 11 (Control) and Plot 9 (Raised beds) *Moisture content results from 27/07 were lost.*

It was generally found that the bulk soil salinity levels increased during the winter months and decreased during the summer months, particularly at the lower depths. It was expected that the salinity levels would decrease during the winter and increase during the summer, however in many of these areas, the influence of shallow ground water is significant. There was little difference other than some sampling variation in the way the control and the raised beds affected the movement of salt.

In Figure 3 some trends in the ground water table are shown.

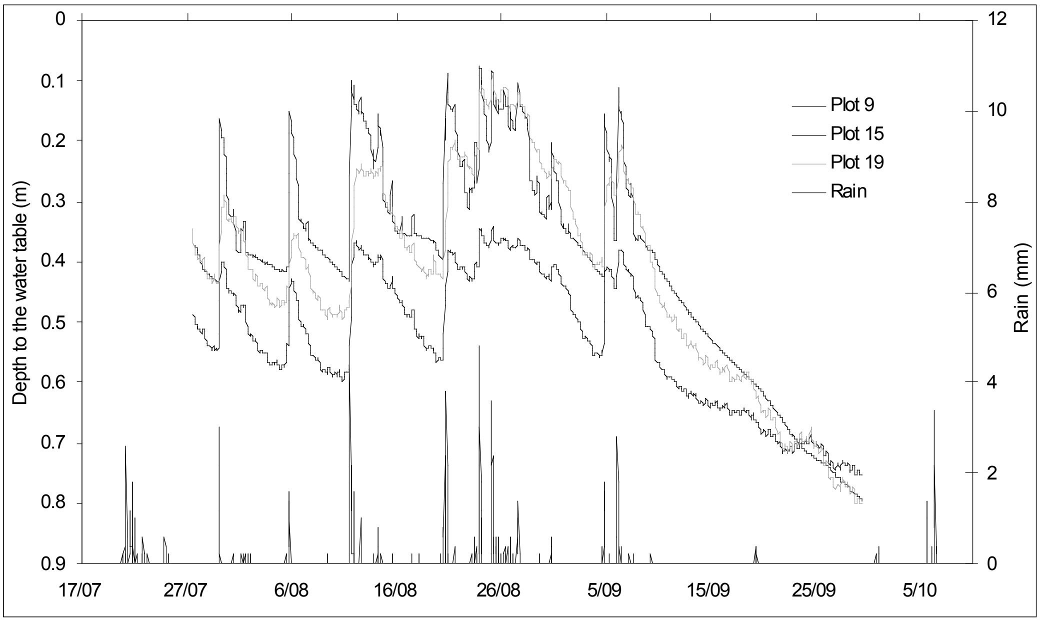

Figure 3. Movement of ground water in relation to rain fall in 2004 (a dry year).

From the figure it is clear that the water table responds very quickly to any amount of rain. The system reacts like a one-dimensional system with some water draining away over time and through evapotranspiration later in the season with no quantifiable difference between the raised beds and the control.

The quality of the ground water varies but is usually close to seawater quality (i.e. 5500 mS/m). When the water table rises and introduces saline water in the subsoil, the soil salinity increases correspondingly. At the same time the rain will leach salt away and down into the profile diluting the soil solution. The result is a rather complex movement of salt, particularly during the winter months. During the summer months, with at least the rainfall absent, the movement of salt becomes simpler even though a falling water table and the throttling effect of the dry topsoil add to the complexity of the process.

The barley yield of 2004 is presented in the following table.

Table 1 Plot barley grain yields in 2004 from the Woodanilling site.

Rep	No-Till beds (T/ha)	Raised beds (T/ha)	Control (T/ha)
1	3.38	3.15*	
2	2.64	2.05	1.53
3	0.98	0.71	0.97
4	2.11		0.79
Mean	2.28	1.97	1.09

There was a large difference between the productivity of the beds and the control. Even though dry conditions were experienced during the latter part of the growing season, during the winter months waterlogging did occur on many occasions severely affecting the productivity of the control plots. However poor soil fertility and weed control on certain areas affected the yield from the beds.

The yield was greatly affected by waterlogging as well as salinity which is presented in Figure 4

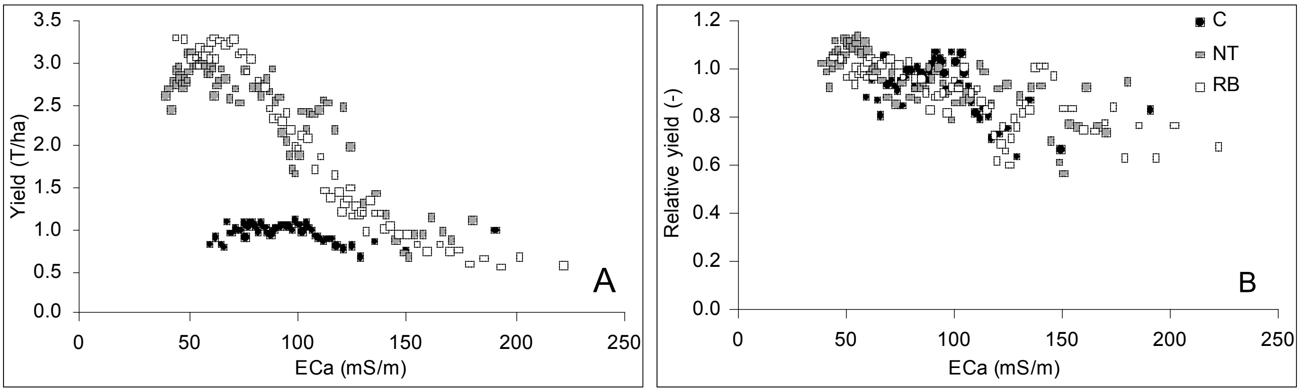

Figure 4 Yield as a function of salinity for the control, raised beds and the no-till beds (A) and the relative yield (B).

The yield in the beds remained constant until a level of about 80 mS/m after which the yield declines rapidly with only a slight hump in the NT treatment at about 120 mS/m. Because the waterlogging affected the control severely the yield results have also been presented in terms of relative yield, i.e. the ratio of the yield in each point in a plot and the yield in that plot at the lowest level of salinity (Fig. 4B). No obvious difference is present between the treatments in the salinity effect on relative yield (Fig. 4B). What appears to be a salinity effect in Figure 4A is somewhat confounded by other factors as presented in the next section.

There was a great difference between the yield in the various plots for a given salinity as presented in Figure 5.

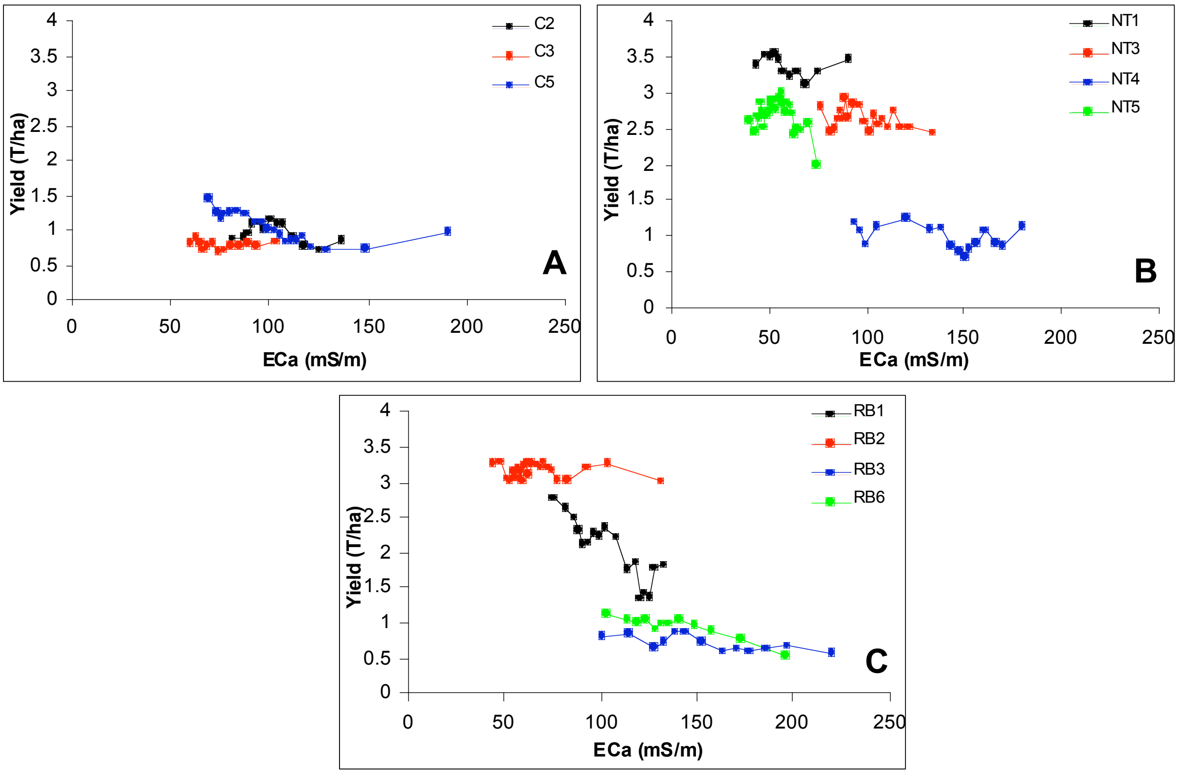

Figure 5. Yield as a function of salinity separated in the plots for the control (A), the no-till beds (B) and the raised beds (C).

Little difference was found between the plots in the control (Fig. 5a). All plots were affected by waterlogging and weeds to a point that salinity did not affect the productivity. In the no-till beds NT1 was the most productive plot, followed by NT5 and NT3. Plot NT1 has the largest depth to the ground water, the best nutrition, the least exposed to waterlogging and very few weeds. The salinity levels in NT3 go up 140 mS/m but the productivity is only marginally affected by the salinity. This indicates the yield potential even under elevated salinity levels. The productivity of the raised beds varies greatly. Good yields were achieved in RB2 adjacent to NT1, well drained, a good fertiliser history, few weeds despite some moderate salinities i.e. up to 130 mS/m, again illustrating the yield potential for such salinities. RB1 is poorly drained despite the presence of beds, a poor fertiliser history and not very productive. RB3 is also poorly drained as well as poor weed control, fertiliser history and very high salinities resulting in an overall poor productivity. RB6 is very well drained but has high levels of salinity, a poor fertiliser history and has a big weed problem which upsets the yield potential. Using 120 mS/m as an indicator the yield ranged from 3 to 0.9 t/ha for RB2 and RB3 respectively.

Assuming that at 120 mS/m the yield is not yet affected the potential to improve yields by better drainage, fertiliser application and weed management is considerable (i.e. 2 t/ha). From this approach it is clear that large gains in the yield here at Woodanilling can be expected to be made when salinity is the only limiting factor and when weed control, fertiliser and surface water management are improved.

Pasture Productivity and Composition
The pasture productivity was derived from the reflectance of blue light using the equation presented in Figure 6.

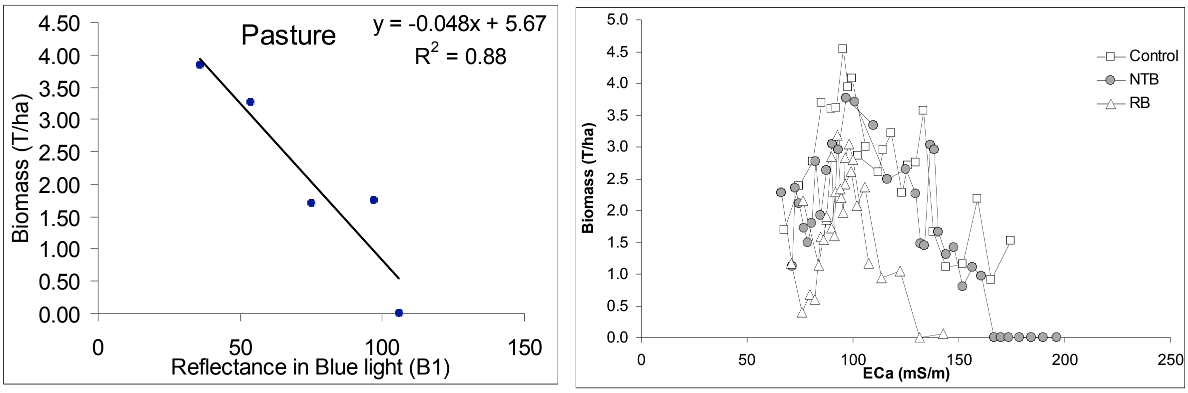

Figure 6 Blue light reflectance (left) and the pasture productivity at the end of September (Right).

There was no strong correlation between the salinity and the productivity with a peak around 100 mS/m. The raised beds did not do well due to the presence of bare furrows, following the soil loosening and furrow cleaning process.

The pasture composition was expressed as a presence of rye grass and cape weed, the first a sign of a healthy pasture and the latter evidence of a poorer pasture. The composition was determined in September 2003 and again in July 2005 and is presented in Figure 7.

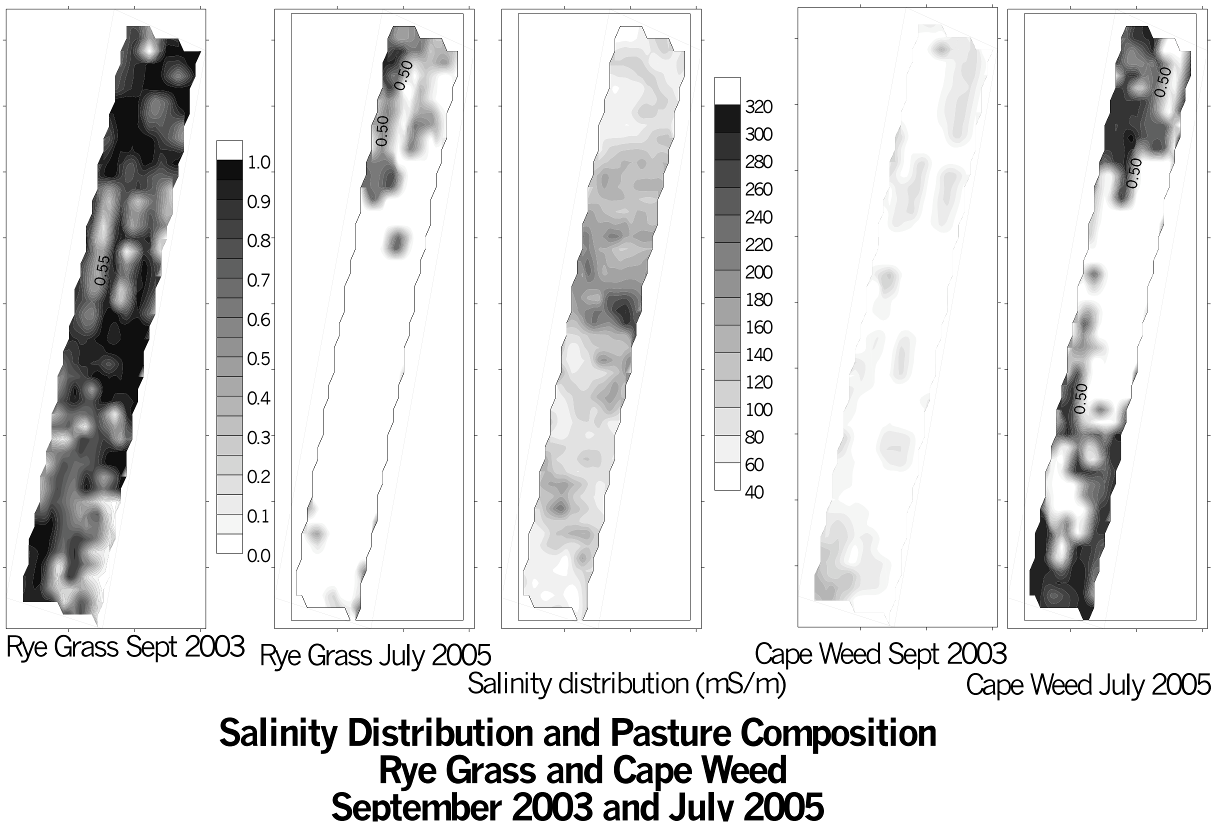

Figure 7. Salinity distribution and pasture composition changes over two years at Woodanilling. 1 = Solid stand and 0 = nothing present.

A severe degradation of the pasture occurred over the two years the surveys were conducted. In September 2003 the pasture had not yet been grazed and the rye grass grew prolifically. This almost entirely disappeared after two years of intermittent grazing while the cape weed showed the reverse. While the rye grass seems to survive in the areas with a low salinity there was no obvious treatment effect. The raised beds while providing very good surface drainage did not halt the decline of the pasture. Salinity had an effect on the composition as did soil type. At times waterlogging did seem to have a positive effect on the pasture with pockets of clover established in the wettest areas.

CONCLUSIONS

The introduction of raised beds to waterlogged saline increased the farming systems options available for this type of landscape. The alleviation of waterlogging greatly improved the yield, but pockets of high salinity limited the yield in those areas. Other factors however such as soil fertility and weed burden limited the actual yield also. The dynamics of the salt balance is governed by proximity of a sometimes very saline ground water table, which in conjunction with the 'right'-soil type expresses itself as "hot-spots" of salinity. Increasing the depth to the ground water would reduce the threat to salinity but is, at the same time, difficult to achieve in this flat landscape and the one-dimensional nature of the water movement during the winter months. The implementation of raised beds did not improve the pasture growth neither improved nor maintained the pasture composition. If surface drainage is warranted in pasture production other means to improve intensive surface drainage need to be considered.

ACKNOWLEDGEMENT

The cooperation of Russel and Margaret Thomson, Michael and Mary White and the Cunderdin Agricultural College is greatly acknowledged as well as the financial assistance of the GRDC and the CRC for Plant Based Management of Dryland Salinity.

Innovative use of Tramlines in WA; consequences for better soil management and more profit on shallow soils in low rainfall.

Paul Blackwell[1], Harold Millington[2], Rohan Ford[3], and Mike Kerkmans[4]
1: Department of Agriculture WA, 2: Burradowns, Merredin, 3: Nookanderri farm, Northampton, 4: Marlingu farm, Mullewa

INTRODUCTION

In Western Australia numerous broadacre wheat growers have adopted the QLD/NSW CTF formula of parallel working and bare tramlines on each run, but some have carefully considered the design principles and arrived at different recipes; sometimes integrating Nth European ideas. These innovators are often involved in developing useful spin-offs from their tramline system to improve the profitability and operational convenience of their enterprise; especially in low rainfall areas. This paper explains three such farms and three spin-offs which have begun to develop and may be useful to other growers.

METHODS

The Burradowns satellite-free racetrack system with and 18m wide self steering shield sprayer.
The Millingtons keep no livestock and crop about 1800 ha with wheat, barley, lupins and peas in about 300mm annual rainfall just east of Merredin on mainly heavy valley floor soils. Harold works the farm with his son Glen and it supports two families. The Millingtons love saving money, so modified all their own gear in 2001 to fit all the equipment on 2.6m tramlines. They simplified the guidance and reduced the cost by using one 2nd hand marker arm on the seeder. Harold invented a nice ute-based marker arm system to mark out the guideline for the first lap of every paddock to provide an initial mark for the seeder; they just follow the established tramlines in subsequent years. Experimentation with fuzzy and disc sown tramlines have led to only needing bare tramlines in this low rainfall area, after the tramlines have hardened. Their seeder is 18m wide sowing on 375mm (15") with twin rows; (700mm for lupins and some barley). The sprayer is 36m wide; thus they use a 'wing tramline' for the sprayer, one tramline for each wing of the bar to fit the boom nicely to the edge of the paddock. The Millington's 'piece de resistance' is an 18m (60') wide self steering shielded sprayer; this uses a skid on the back of the hoods to get guidance from the furrow with no crop in it when lupins or barley are sown on wide rows, but all the 375mm tines are in the ground. The home-made shields are made from 200L blue plastic herbicide drums. They are now in their 3rd season of successful shield spraying; about 500ha or more per season and all steered round and round! I often recommend small scale growers to visit Burradowns and see what can be done for a small enterprise at low cost and minimal change of paddock layout by applying CT principles with an open mind. They are a hospitable mob, fond of a good bottle of red!

The Marlingu spray-only tramline system integrated with oil mallee trees
Mike Kerkmans grazes some livestock and crops about 4000 ha mainly to wheat in a 2-300mm annual rainfall at Pindar, east of Mullewa with broad valleys and soils over shallow granite and laterite. Mike employs 2-3 hired drivers at seeding and harvest; autosteer on the seeder and header have been a great help to efficiency and profitability. Almost the whole farm is worked in parallel running and eventually all paddocks will have double rows of oil mallee trees on 110 m spacing integrated within the crop. The seeder is 15m wide and the sprayer is 45m wide; Nth European-type spray-only tramlines are used on the farm. The tramlines are established in the first seeding operation of the paddock; autosteer on the seeder is set to spraying width and each tramline is formed by blocking 2 seed outlets for each tramline on the 300mm row spacing DBS seeder. The tramline track is 2.5 m to fit the sprayer, spraying tractor and air seeder box. When all the tramline runs have been seeded, the guidance width is set to the seeder width and the rows are unblocked so that the seeder moves back

across the paddock to ‘fill in’ the spaces between the tramline runs. The only guidance for spraying is the visual bare tramlines; weeds in the bare tramlines have been a minor problem in this low rainfall area. They are often controlled by triflurilin; which is well incorporated because all the tines are kept in the ground. Mike is developing a system of 600mm row spaced wheat and shielded spraying to reduce costs. He is an excellent host for much of our current research into wider row spacing to reduce drought stress on cereals with shallow rooting depth and tramline farming downhill with modification of earthworks.

Nookanderri narrow bare tramlines for cereals

The Ford family keep some cattle on dedicated pasture and tagasaste. They crop about 3000 ha Nth east of Northampton on mainly sandplain country. Annual rainfall is nominally 300mm but drought and frost are common. Rohan employs one or two workmen at seeding and harvest and has observed large improvements of efficiency and convenience since purchasing high precision autosteer for the seeder. Grass weeds and double gees are a challenge in his wheat/lupin rotation and he uses 175 mm row spacing on single disc openers to reduce grass seed burial and encourage competition from the crop. Bare tramlines on each pass as wide as 500mm were a challenge to weed control. A compromise was adopted by removing only one row on the seeder and having a 350mm gap. This provided good competition for the weeds, but was visible from the spraying tractor. The edge rows are stunted by the tyre traffic of the first post emergent spraying, but this becomes an advantage when looking for the correct tramline for subsequent spray operations. Rohan’s header matches the seeder at 9m and all heavy wheels are on a ~3m track. Rohan’s wife Carol bakes excellent scones and Rohan was inspired enough by his ideas of inter-row deep ripping, to design and build an ‘off tramline’ inter-row ripper.

Deep ripping between wide rows of lupins

This idea may have benefits in the whole cropping system because:-

It can be done after the busy time of seeding and spraying when the seeding tractor is available to run on permanent tramlines between the crop rows.

Deep ripping before seeding can delay seeding and compromise yield.

Deep working by the seeder can be slow and often is not deep enough. Maximum compaction is often between 200 and 400 mm depth.

In dryer years the soil is often not moist below 500mm until June or July.

A deep ripper was modified to fit onto the 3m tramline and rip between 500mm rows of lupins (with a 900mm row space for the tramline). It was also fitted with a trailed disc seeder unit to allow sowing and ripping for some treatments. A trial was designed to test some of these ideas. Plots were designed around Rohan’s seeder, sprayer and harvester; the treatments were;

1. Unripped;
2. Deep ripped to 300mm between 500mm spaced lupins in 2003
3. Deep ripped to 300mm before wheat sown in 2004,
4. Deep ripped to 450 mm before wheat sown in 2004

Soil and tissue samples were taken to help explain some growth effects; a weigh trailer was used to measure yield of wheat in 2004 with the farm header. Further details are explained in Blackwell, Ford and Webb (2005). About 175 mm of rain fell during the growing season; drought and frost occurred.

Pre-furrowing pasture dry

The surface soil after pasture can be compacted and early rains penetrate poorly. Better guidance from autosteer and tramlines offers the opportunity to sow back into a pre-made furrow. The pre-furrowing done dry can help rainfall penetrate below the surface and reduce moisture loss from evaporation. We tested this idea in 2003 at Marlingu with Mike Kerkmans; a sandy loam and a sand with surface compaction from sheep grazing was dry furrowed, in early May, with a DBS seeder on 300mm row spacing with ‘2cm’ autosteer guidance. After suitable rain and weed germination, the treatments were both sown with the same machine, following the prepared furrows, or directly sowing into the compact pasture. Yield was measured with the farm yield monitor. Full technical details are in Blackwell and Kerkmans (2004). About 200mm of rain fell during the growing season. 5mm fell after pre-furrowing and penetrated to about 180mm, compared to poor penetration without pre-furrowing and evaporation.

Very wide row wheat on shallow soils in low rainfall
Observations of extended maturity of longer season wheats in edge rows of bare tramlines (Blackwell et al., 2003) encouraged testing of 'inter-row fallow' between very wide rows of wheat (600-900mm) to help reduced crop drought stress during warm periods of low rainfall in the NE wheat belt of WA. Trials were set up at paddock scale with the farm equipment of Mike Kerkmans at Marlingu. Wheat (variety Arrino) was sown on 300, 600 or 300/900 mm row spacing at the same seed rate/ha (60 kg/ha) in May of 2003. The soil is shallow, about 800-500 mm to colluvial gravel over weathering granite. Yield grain size and quality were measured from hand cut samples from subsections of the whole trial. About 200mm of rain fell during the growing season mainly in July and August.

RESULTS

Deep ripping between wide rows of lupins
Deep ripping reduced yield in 2004, due to the low rainfall and optimistic use of nitrogen top-dressing. However the yield loss from inter-row ripping in 2003 was 240kg/ha less than ripping in 2004 pre-seeding. This is worth about $50/ha if the grain is $200/t at the farm gate. The lower yield in the 2004 ripped treatments maybe attributed to greater crop biomass production and higher N uptake in July, than the other treatments, hence with the dry finish the crop ran out of water and 'burned off' resulting in lower yields. Excess N supply is a common risk in dry years. The burning off was least with the 2003 inter-row ripping treatment, suggesting a slower availability of extra N from the residual ripping compared to ripping in 2004. This was confirmed by tissue tests of the growing crop before anthesis.

Table 1: Yield response of wheat to deep ripping at the Ford property in 2004. * indicates deep ripped between wide rows of lupins in 2003 with the modified ripper working from 3m tramlines.

Treatment		Yield t/ha	Response kg/ha	% change in yield
1	Unripped	1.1		
2	Ripped to 300mm '03*	0.9	-130	-12
3	Ripped to 300mm '04	0.7	-370	-35
4	Ripped to 450mm '04	0.6	-460	-44

Pre-furrowing pasture dry
Dry pre-furrowing of sandy loam pasture at Pindar in 2003 resulted in a yield benefit estimated at $26.5/ha, but no benefit for the sand. Grain quality and size was similar.

Table 2. Wheat yield, t/ha; for with or without pre-furrowing, with calculated value of grain.

Soil	nil, direct sown	prefurrowed	difference	LSD 0.05	$/ha for $200/t grain
sandy loam	1.12	1.258	0.132	0.078	26.5
sand	1.106	1.113	ns(0.030)	0.103	(5)

Very wide row wheat on shallow soils in low rainfall
In periods of warm dry weather during the winter more drought stress was observed in the canopy of the crop sown on 300 mm rows than the crop on wider row spacing. Inter-row excavation showed moist soil was retained below 100mm depth in the wide inter-rows, but the soil between the 300mm rows was dry during these periods of dry warm weather. Table 3 shows that yield for different spacings on either soil were similar, but smaller grain tended to occur for the narrower spacing; this was a more significant effect for the soil with larger clay content.

Table 3. Grain yield, size and quality for two soil types within the row spacing trial at Marlingu 2003.

Soil	property	300mm	600mm	300/900mm	LSD 0.05
sandy loam	Yield t/ha	1.621	1.687	1.597	0.169 ns
sandy loam	Kg/hl	78.45	79.15	81.3	0.974 *

sandy loam	Protein	13.75	13.55	12.85	1.31 ns
sandy loam	Small gr#	7.6	5.9	5.4	1.67 *
sandy loam	Screenings1	0.93	0.72	0.56	0.19 *
sandy loam	Screenings2	0.73	0.51	0.47	0.185 *
sand	Yield t/ha	1.489	1.578	1.519	0.198 ns
sand	Kg/hl	77.68	80.0	79.45	1.68 *
sand	Protein	13.75	13.3	13.72	0.42 ns
sand	Small gr#	13.3	8.7	9.1	4.23 ns
sand	Screenings1	1.93	1.25	1.43	0.72 ns
sand	Screenings2	1.51	1.09	1.12	0.71 ns

small grain 2.4-2.0 mm; 1= screenings from mechanical sieving; 2= Co-operative Bulk Handling screenings.

DISCUSSION

Deep ripping between wide rows of lupins
A less negative effect is hardly the best way to support a new technique!, however it is still a reduced loss of income for deep ripping the previous year between wide rows of lupins, compared to ripping just before the wheat is sown in a dry year.

Pre-furrowing pasture dry
If the operation cost $10/ha it can be a profitable technique. The effects could have been greater if the pre-furrowing had been done earlier, in April; as was an early test plot which showed a better response.

Very wide row wheat on shallow soils in low rainfall
This effect was repeated in 2004, but the rainfall was poorer (50mm of summer rain and 150mm of poorly distributed winter rain). Yields were only about 700 kg/ha and again better grain size occurred on the wider rows; more details are shown in Blackwell (2005). The ‘best bet’ use of very wide rows for wheat suggested so far for the NE wheat belt of WA is:-
Shallow rooting depths from 300-900mm.
About 600mm row spacing; better than even wider spacing.
Keep a tine in the inter-row; to incorporate Trifluralin and retain a furrow to harvest water; for heavy stubble levels add stubble tubes.
Deep band the fertiliser on all tines; to retain some fertiliser on the inter-row.
Be careful to avoid salting by fertiliser if you do not have a split system
Keep the same seed and fertiliser rates as normal row spacing (if possible)
Be wary of back pressure when blocking or diverting rows
Experiment with varieties and seed and fertiliser rates

CONCLUSIONS

Deep ripping between wide rows of growing crop offers many potential system benefits. There is only minor evidence to quantify any productivity effects; more research is needed.
Dry pre-furrowing pasture to improve water supply to the following crop looks profitable on some soils in low rainfall areas; more testing and demonstration is required.
Very wide rows of cereals with shallow rooting depth may insure against poor grain quality in dry seasons. This is now the subject of an NLP funded program and is attracting much grower interest. When incorporated with downhill layouts for water disposal we are interested in the possibility of reduced frost risk by the wider rows reducing resistance to cold air flow.

Growers can be very innovative when they apply the PRINCIPLES of controlled traffic to their farm, rather than a set FORMULA or RECIPE. Manufacturers have still to catch up and provide GPS driven tramline controllers for those who need bare tramlines only for spraying.
Self-steering shields have some potential to reduce risks and costs of shielded spraying.

AKNOWLEDGEMENTS

Bindi Webb, Glen Riethmuller, Jeremy Lemon, Simon Teakle, Peter Walsh, Wayne Chapman.

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High Resolution Images - The Key to Sustainable Property Layouts

Russell Stewart Cannon, Rural Property Design

INTRODUCTION:

Over the last 10 to 15 years significant changes in resource assessment, management and monitoring tools allow us to make much better decisions on practices to improve Natural Resource Management in the grain cropping areas of Australia – sustainable property layouts.

Originally Controlled Traffic was trialled to overcome the degradation issues of soil compaction and soil erosion in sub-tropical grain growing areas. These areas experience high intensity rainfall on soils which have low infiltration rates and low rainfall to soil water retention percentages.

At the same time a form of Controlled Traffic, raised beds, was being revisited to overcome the waterlogging effects of low intensity in-crop rainfall in the cropping areas of south-east and Western Australia.

Early systems were implemented on very much a "seat of the pants" or "a wing and a prayer" basis. Considerable follow-up by groups pushing the concept led to change.

Now high resolution and rectified satellite images, which may be in the hands of growers within 7 to 10 days of capture belong, together with intensive topographic images, now allow Advisors and crop managers to make strategic, short term and long term decisions.

METHODS:

A number of publications have detailed methods used in adoption of Controlled Traffic. These are not a significant part of this presentation. Sufficient to say that only four elements were pushed, those being:

- A long a run as possible
- Down-slope
- Keeping all wheels on the one track
- The significant reductions in cost

An example of this is the 30 foot system which has 3 meter wheel spacings and includes modified harvesters.

In the early stages of adoption the header did not appear to have a big place. I was told that 'dry soils don't compact' and it is nearly always 'a dry harvest'. I was also told "we only plant, we don't harvest anything. Get on with it Stew!"

RESULTS:

It sounds a bit ridiculous that only 10 years ago there were no high resolution topographic images and few, if any, high resolution satellite images. The only tools were out of date aerial photos and low resolution satellite images which appeared to have little, or no apparent, agricultural application.

There were no precision steering systems and variable rate technology was looking for a place in agriculture.

To now tell growers that a start was made using 1980's photo mosaics with contour banks as a guide for direction, that three pegs in a line, or any 80' length of bore casing with three long chains was used as a marking system, but even then good operators, using marker arms could achieve better than 1% accuracy over a two kilometre width seems incredible.

This humble beginning has encouraged growers to establish systems that are not always the best. It is a bit like "get bigger or get out", "we need more horsepower", "we need four-wheel drive articulated tractors for efficiency" and "we need systems which are as long as possible"

To focus on those outcomes does not look at runoff management or steering systems. It seems to me, steering systems are being purchased more as an 'ego trip' rather than a system that can be used for innovation, a system to increase yields and decrease costs. A system that, in the future, will provide the basis for crop management and monitoring and allow development of proof that chemical applications are environmentally sensitive and that other environmental impacts are being managed.

High resolution images are now being used to develop strategic management options, but they continue to clearly demonstrate that we are not on top of the basic resource management issues which are costing you, as growers, large amounts of cash.

As a clear example, waterlogging is not only a problem in the south-east Australian grain belt. These images prove that growers in the Liverpool Plains are losing up to 23% yield, and total crop loss, in some years.

For Central Queenslanders waterlogging has cost one grower more than $60,000.00 in one paddock alone.

The cost of timeliness has not been discussed.

DISCUSSION:

Being a member of a team with a project funded by GRDC not only allows you to focus on the applicability of technology, it also enables you to come into contact with a large cross-section of growers. A cross-section of growers who have made the change to Controlled Traffic and growers who have just started to change by implement parts of Controlled Traffic Farming, e.g. tramlines, zero-till or raised beds.

To continue to 'front-up' to growers on a one-to-one basis, small groups or large groups, doing presentations, not only allows you to give people support to make change but also to enter their production environment to try to understand their climate, soils, cropping practices and their general resource management issues. It allows the focus on what is the Controlled Traffic Farming elements, which allows growers to fund any planned change.

While you are in such a privileged position it also allows you to learn from the vast experience of these growers, to distil the information and form a stronger picture each time.

Don't get me wrong, a number of meetings usually one-on-one, have not always gone well. The issues of wheel-track erosion, of deep wheel tracks and un-even planting depths from variable depth of wheeling still remain as issues which require investigation and positive outcomes.

The general outcomes from a diverse participatory group is the willingness of landholders to share knowledge and for us to continue to be a catalyst.

One of the positive initiatives from this conference which will allow Controlled Traffic Farming not only to be sustainable but to move forward is Andrew Whitlock's young Controlled Traffic Farming Group in Victoria.

One of the issues which continues to arise, with continued technology developments, is the need for people with younger and more technology based skills. The need for back-up with better computing skills, the need for back-up when technology breaks down, e.g. yield monitors, and the need to review satellite images from internet access, is critical to advancement.

BASIC COMPONENTS:

What has been gained from the introduction of the basic two technology changes? Those changes being high resolution topographic and satellite images on a GIS basis.

One is the understanding of what soil saturation, or what water-logging, is costing on individual farms.

The Victorian group, centred on Geelong (Southern Farming Systems) arrived at a figure of improvement in yield of 300% if water-logging was removed by the implementation of raised beds.

In the northern production areas of New South Wales and Queensland heresay and group discussions across the grain and cotton industries suggests that water-logging for more than 48 hours stresses crops and reduces potential yield. The lack of germination, the lack of crop vigour all cost the grower grain yield and losses of up to $300,000.00 in a year have been published.

While these may be extreme, a review of high resolution images captured over the last 12 months has clearly defined areas which have clearly been a total loss or experienced a lack of yield. These crop losses can be seen from a header, but are not easily measured. They are not seen from the side of the paddock.

Combining the topographic and satellite images allows remedial work to take place. This would allow growers to manage row-by-row establishment, to establish optimum plant population and to maximize yield. Each plant is doing its job without the problems of saturated or waterlogged soils.

WHY IS THIS DIFFERENT TO WHERE WE STARTED:

Example: Longest run,
Down slope
All wheels on the same track

Optimising time and managing cost is not easy where there is a conflict between planting and spraying efficiency and management of run-off and harvesting efficiency.

Very good images, which allow analysis of soil association, waterlogging issues, to accurately measure area , run length, etc; to enable you to make better decisions.

While I may continue to use hardcopy and clear plastic film I am also sure that better skilled, and people with computer literacy, will come up with a more sophisticated system which delivers parallel systems which incorporate GPS co-ordinates to implement Controlled Traffic Layouts and which prioritise natural resource management issues.

Just a word of caution – one of our GRDC co-operators has a paddock which should clearly demonstrate the differences between natural resource elements. The addition of permanent beds and liberal application of chook shed waste appears to mask these effects.

ANOTHER ISSUE:

People on the Darling Downs in Queensland have raised the issue of changes to relative elevation due to soil/water content. Until accurate topographic maps were available and computer aided sun aspects became available there was no plausible explanation to what was being observed as surface ponding. This can now be explained by the following images and should be cause for concern and a potential catalyst for planned change.

Two examples clearly identify the issues; originally I assumed that there was a problem with the survey on Rob Taylor's property however with the other image we were told about the soil/water height difference and asked "would it cause a problem with the survey". The difference in height was not clear until changes in aspect of the sun clearly showed the old strips.

CONCLUSIONS:

For someone contemplating getting into Controlled Traffic Farming my "take home message" has three elements:-

Have a go with your own equipment. Select a direction, preferably down-slope. Complete workings 'up and back', PLANT.

Have your Advisor order a whole property high resolution satellite image, one acquired during crop growth.

Invest in a high resolution topographic image which give better than 20cm contours, Geo referenced preferably to the Australian Standard Datum.

For an estimated cost of about $15.00 per hectare these will give the best planting tool to cover the resource management elements for sustainable Controlled Traffic Farming.

Controlled Traffic at Chappel's

Lindsay Chappel, Perenjori, WA

Controlled traffic started at Chappel's in the spring of 2001. I was lucky enough to be invited on a tour through NSW and Queensland in August 2001 with a group of farmers from WA looking at controlled traffic. This was a watershed in my farming life probably in the same way as 16 years before when I discovered no till.

As I mentioned I had been no tilling for 16 years and felt there should be a bit more.
The tramline tour was a real eye opener as I wasn't expecting too much from it.
I came back from this tour convinced that controlled traffic was the way to go and immediately set about implementing it on my place.

Firstly, off went all the stock. That was pretty easy and not too bad on the pocket either. I removed most of the internal fencing and most of the contour lines (drains and banks). This made a huge difference in the ease of working and the amount of wastage. In one case I made one paddock of 617 acres from five separate paddocks. Previously there were 28 headlands, which together with the overlap required an extra 25% in workings/costs. One paddock was 1500 acres; after modifications we cropped 1670 acres. The average size of my paddocks now would be approx 500 acres 200 hectares. With some care in operations we can get our wastage well under 1% using the controlled traffic.
I made do with all the gear I had previously and only had to modify a few things.
The modifications to the machinery are outlined in the power point presentation and although not extensive added up to approx $2,000.

I purchased a Beeline navigator auto steer for the tractor (approx $52,000) and financed it over four years at $16,000 per year. I was pretty excited about this radical new innovation and told my father (81 years old) that I had bought this wonderful tool whereby one did not have to steer around the paddock. Dad replied "funny that, you never had to steer horses either.

I used the same seeding bar (60 feet) but removed the tynes following behind the tractor wheels. The Spraying rig was 125 feet so that was trimmed down a little and the wheel centres were the same as the inside duals of the tractor.

The spreader, towed behind the tractor, was nearly the same wheel centres as the tractor and sprayer so that was left the as is. There is only about 100 ml difference.

I can only stress that as with all things in life, if you really want to do something nothing is that much of a hurdle.

Making the most of CTF

Jamie Grant, Dalby, Qld

Started zero-til in the early 90's, but could not set planters because of tracks all over the place.
Went to controlled traffic on 60 inch centers. Sprayed with Toyota's, tractors & air seeders in to 60inch, harvesters on 120-180 inch duals & chaser bin on 120 inch.
This set-up worked very well and was a revolutionary step forward, however it meant that there were 6 tracks in a 30ft swath. We started noticing less growth and yield around the wheeled area compared to outside the wheel tracks.
We got the DPI to harvest single row sorghum trials to determine the difference between rows with a track on both sides, one side or no track and then by shifting row yields to different track configurations it demonstrated the economics to change to 120 inc or 3 m centers.
The decision was made to go to 3m, so tractors were spooled out, air seeders and boom sprays axles extended, the chaser bin was already built on 18 or 20 inch tyres.
In time bearing and kingpin failures made us give the spools away on the tractors and extend axle housings so kingpins and final drives were back to standard.
In 2000 economics and gene technology tempted us to grow dryland cotton.
To fit in with the 3m tracks, 15 and 30 inch rows it was decided to grow cotton on 60 inch solid rows.
The cotton picker and boll buggies were put on 3m. The first year the picker picked 4 rows out of the 6 planted (30ft), which meant it ran off the tramlines and put an extra track up the guess row. The damage that one pass on uncompacted ground did was frightening. This spurred me on to extending the picker out to 30 ft (9.14m) and picking the 6 rows that we plant.
Once we got into cotton we found that our guess rows were too wild for band spraying. The next step was to purchase a Beeline, which gave us accurate multiple width band spraying, shielded spraying, band spraying with the mulcher and general efficiencies.

CONCLUSIONS

We have moved our tracks three times, 60 inch, 3m and then 3m Beeline.
This has been part of the evolution of Controlled Traffic but has been a very expensive exercise as each time we went backwards to go forward, so I would strongly advise to go to 3m and precision guidance as soon as possible.
Suspension on tractors and spray rigs is important as it minimises the woops in the tramlines from ridged machines a speed in moist conditions.
Use swath widths of 9.12 or 18m depending on your operation – grain, cotton or lage scale farming.
Remember, farming and economic pressures are changing rapidly so you must stay progressive and flexible.

Improving Soil Structure

<u>Dennis Hobbs</u>, Warracknabeal, Vic

HISTORY - CONVENTIONAL FARMING

- Poor infiltration of water
  - leading to high evaporation loses in summer rain events
  - water logging in root zone when not over wet
  - not using water efficiently
- Hard pan problems which led to deep ripping
- History of good gypsum applications but calcium still low and magnesium high which leads to poor soil structure
- Soil is very fine like with very little air in the profile, it looks like the working of the soil has caused compaction problems while breaking down any sort of structure
- Have been applying small rate applications of lime and gypsum on high PH soil i.e. 300 kg / ha (after 5 years have noticed an increase in calcium and a drop in sodium and magnesium)

PRESENT – CONTROLLED TRAFFIC FARMING

- Poor soil structure (hard pan) led to controlled traffic
- Have been controlled traffic farming for one season and already found improved soil conditions
- Can now push probe through hard pan after harvest when dry (have not been able to do that before)
- CTF has helped sowing between stubble rows by moving tynes around
- Noticed compaction from wheels on the bar at sowing time
- Applying trace element applications (copper zinc and iron and manganese)
- A change to narrow points and press wheels has helped with emergence

FUTURE

- Moving to 3 point linkage bar (may look at parallelogram arrangement)
- Yield Mapping leading to variable rate fertilizer applications
- Nutrient applications by foliar feeding
- GPS which will open up a huge range of options
  - Drilling - in crop fertilizer applications
  - Shielded spraying on wide row crops ie chick peas
  - Accurate sowing between stubble row

I have found that in wet years (eighties} the high magnesium red clay type soil was very hard to put a tractor and bar on, the wheels would sink leaving tracks. Although in the dryer years this type of soil has out performed the black flats.

It does not matter where I dig a hole there is a poorly structured soil with a hard pan as I have mentioned, the soil is too fine. I would like to see a more bread crumb looking type of structure with more air in the profile that does not run together every time it rains.

My soil has very low carbon levels which have not increased over a number of years with the move to stubble retention. So I am hoping that the idea of leaving the old root systems untouched for the next cropping cycle will leave a food source for the fungi and bacteria and help with the decaying of the old root systems leaving channels for water infiltration.

During the summer of 2004/2005 I did not have any wind erosion due to leaving the stubble standing, which dropped the wind speed greatly near the ground surface. I would like to think that I retained more water in what summer rain we did receive with the stubble acting as mulch.

Where my soil has a Calcium Magnesium ratio of around 5.5 - 6 to 1 the crops seem to do better and I have noticed I need less extra nitrogen while producing high protein wheat but on the high magnesium soils I have to apply more nitrogen with protein down in the 7 and 8 range.

At this stage I am very pleased with how quickly the soil has responded to controlling the traffic on my paddocks and to see the calcium increase, magnesium and sodium drop due, I think, to light rates of gypsum and lime. This is very rewarding and I look forward to more improvements in the not too distant future.

Farming on the Queensland Central Highlands

Ross Ingram, Emerald, Qld

Seventeen years ago I had the opportunity to establish an agricultural based business anywhere along the eastern side of Australia for overseas investors. The investment had to be secure, on freehold land, have growth potential and keep the tax man comfortable.

That investment started with a 20,000 acre underdeveloped freehold property running 43 steers and dryland farming 5,500 acres. We have since added 9000 acres to this property and purchased an equally underdeveloped 50,000 acre freehold breeder property all located in the Springsure - Bauhinia Shire.

We have since cleared an additional 14,000 acres for farming, established silos, sheds, a significant self contained irrigation system, built housing to accommodate 12 permanent staff plus casuals. We have built a 4000 head Droughtmaster herd using Limousin terminal sires. Weaners come to the farming property to grow out and finish on buffel grass and grain.

Our company policy is to put all profits into development, don't borrow, integrate the properties, stay one jump ahead of the process of change being imposed on our industry and above all to maximise our return based on some very difficult seasons and commodity prices.

Some of the key issues we have had to deal with over the past 17 years are:

Seasons & Prices: Without the heavy cracking clay soils on the central highlands, that allow us to accumulate soil moisture there would be few prepared to dryland crop this area. We average 650 mm but it varies from 400 mm in 8 hours on 5-2-2002 to 396 mm for the year 1993. Seasons are unreliable, summer cropping is our best option with only three good winter cropping years in our 17 years here.

We now store up to 6000 tonne of grain on farm. Very little crop is delivered to Graincorp depots. I try to establish contracts for half our crop before harvest. Recent feedmill developments north of us have opened up key new markets. World commodity pricing is corrupt, we try to avoid futures trading and currency deals.

Crop Options: Opportunistic planting is the key to dryland farming. This involves taking some risks with only a small range of crops, and on marginal moisture. Our best option has been sorghum sown after Christmas and chickpeas for winter. Our sunflower plantings have dropped from an average of 8000 acres per year to barely 1000 acres. Dryland cotton has become a risky gamble. Dry seasons, low prices, escalating costs, white fly etc, limit our options.

Irrigation: In 1995 after waiting for a proposed Comet River dam to come to nothing, we started our first off stream storage and haven't stopped developing since. We contain all runoff water on farm and operate under cotton BMP.

Three main ring tanks, one surge area, three temporary storages provide 14,000 ML capacity.
Seven flood harvest pumps including 2 x 800 mm, 4 x 650 mm, 1 x 500mm.

582 acres of subsurface trickle fed by two pump and filter systems.
Trickle irrigation delivers savings in some years over furrow (1.48 ML/acre compared to 2.42 ML/acre on furrow). It can deliver efficiencies and higher yields up to 30% but has some equal down sides such as cost of maintaining and rodent damage.

1234 acres of siphon delivered furrow irrigation.

750 acres currently being developed - bank less irrigation an option.

In total 5400 megalitres is harvested from the Comet River through licensed pumps with 13 Cm/sec pump start-up restriction. The remaining 8,600 megalitres is sourced through overland flow diversions. All development just squeezed through a rapidly closing water reform process window.

Cotton: The biggest step forward for us has been Roundup Ready and Bolgard II Cotton. Managing weeds, chemicals and staff are our biggest headaches. Every year we trial and change cotton varieties to grasp a small advantage.

This year has produced our best cotton for an average of 4.2 bales per acres and turnout of 39%. The best variety was Sicot 71 BR. Sicot 71 Conventional produced 42% turnout. Every year is different and is affected by weather conditions, available water and insect pressure. Chemical spay drift is a major concern.

While Bolgard II reduces the need for grub sprays, we must watch for mirids and aphids. This year we used two Regent sprays plus one endosulphan spray. Nutrition and watering are critical, which is why we use enviroscans, soil and leaf testing and have an agronomist monitor the crop.

Minimal Till: Our dryland farming now involves two 20 metre planters, trailing Simplicity seeders, Garnelle presswheels, Primary Sales superseder points all pulled by two 9882 Versatiles. We use a Miller Nitro with 20 metre boom plus aircraft for spraying. Occasionally we use a conventional AFM planter on sensitive planting jobs.

Conserving moisture in suitable soil types and not beating the soils to death are the keys to successful sustainable farming in our region. We have attempted tramline farming with limited success and are unconvinced of its future.

Staff: We have difficulty finding suitable experienced operators. We rely on backpackers and a core of very good experienced men. The local booming mining industry attracts farm operators and many of the key agriculture service industry staff. Our cattle breeder property will eventually be consumed by a proposed mine.

Change: There seems no end to the expectation from some bureaucrats and the urban ill-informed that agriculture can and must change to their rules. To avoid unreasonable change being imposed on our business and way of life I have had to get involved in regional natural resource management planning and the water reform process.

We need to adopt new technology, embrace sound genetic engineering and be proactive, to be one jump ahead of our competitors. I get frustrated that too many think short term, haven't realised little comes easy. Farming and rural areas provide a wonderful way of life if we can withstand the pressure!

Raised Beds and No-Till

Jim Kirkwood, Mondurup Pastures, Kendenup WA

LOCATION & GENERAL OVERVIEW

Our family farm is situated 75km north of Albany WA adjoining the SW corner of the Stirling Range National Park. The farm has no livestock and individual trees have been removed along with most fences.
We crop 2800 hectares comprising of wheat, canola, barley, lupins and a few peas. Summer crops are also grown at times. There is no set crop rotation as this changes with weed situations and soil types. Our soil varies dramatically from deep sand, gravel, to almost pottery clay along with our share of rocks (soapstone, ironstone and granite). The topography is slightly undulating to flat. The soil is naturally very poor and tending acidic. This sounds pretty awful but the climate is good, mild with a mainly winter rainfall of 450-500mm.

No-Till

This started about 10 years ago direct from conventional tillage. In that time we have travelled extensively (America, Canada, South Africa, Brazil, Argentina and Paraguay) to study no-till cropping. Disc seeders are used because of rocks and also to minimise soil disturbance. All residue is retained with no burning.

RAISED BEDS

As water logging occurs to some degree most years, raised beds seemed a good option. The conventional machine, a double sided mouldboard type with marker arms and 1.80 metre spacings, was trailled but dislodged copious amounts of rock.

PREPARATION, TECHNOLOGY AND DRAINS

Forward planning is paramount and the first step is to level your ground as best that you can. Fortunately to determine where to construct our main drains D.G.P.S. Topographical survey mapping was available. This proved invaluable especially on very flat country. These drains were then constructed with a laser controlled (for depth and slope) scraper. A flat bottomed drain is best to minimise erosion and allow smoother travel for machinery. All new drains are either parallel to or at right angles to the proposed raised beds.

MACHINERY AND AUTO STEER

To reduce the amount of rock brought to the surface we convinced Gessners to manufacture a disc machine, 3 and 2 halves beds per pass, this machine can be used in tilled, non tilled and renovating beds. At present we have about 600 Hectares under raised beds and that will probably double. The learning curve has been great with a lot of trial and error. The raised beds are now at 2 metre centres, with the introduction of auto steer (beeline) all sowing and raised beds are up and back reducing overlapping. An added bonus with auto steer that we can and do stop and start our raised beds anywhere
In a paddock.

SOILS AND SLOPES

Soils adapt to climate especially rainfall. Our soil is not self mulching soil therefore renovation of beds is minimal. Compaction is also minimal. The raised beds run up and down our slopes without any undue erosion. On the flat country the problem we have is depressions that fill with water. The furrows in our beds alleviate this problem to a large degree.

INNOVATION AND SOWING

A bed leveller has been made using logs and harrows, with the use of Walker Gessner Disc seeder modules including residue managers the shape of the beds is not critical. These modules absorb most of the machines weight when working allowing us to have the wheels of the air seeder on top of the beds. This enabling us to go in and out of beds at anytime.

TRIALS AND TRIBULATIONS

Our search and research is constant, for new ideas to improve our farm with the K.I.S.S.
Principle (Keep it simple Stupid) foremost in our mind .
Unfortunately our beds and soils were not able to cope with the continuous amount of rain that we have had this year. From 30th March till 30th June 470mm including 125mm in 5 hrs on the 2nd of April.

Controlled Traffic Farming on Yorke Peninsula

Andrew Litster, Minlaton , SA

LOCATION
Minlaton, Yorke Peninsula   400mm Rainfall

SOIL
Sand over Clay/Grey Mallee/Sandy loam to loam over Limestone

ENTERPRISE
Cropping/Sheep   80%/20% with sheep run in stubbles.

BACKGROUND
No tilling for 8 years with knife points on 9" spacings using an 11.2m John Shearer Universal Bar with a 280hp FWA tractor on singles.
4 years ago implemented Controlled Traffic over all cropping ground after a bus trip to Northern NSW.
Using 2 home made marker arms
Pulled up two tynes at 2m spacings in Air Seeder bar and blocked the hoses.
Purchased new 4 wheel quad Air Seeder box with 2m wheel spacings , That was fitted with 22.4 m urea boom
11.2m Air Seeder/Flat Steel roller/22.4m Spray Unit/Urea Spreader.
2m spacings to match Truck mounted Spray Units – best match for all tractors and machinery.
Reduced the width of our boomspray from 24m to 22.4m.

ADVANTAGES

Up and Back Farming
Convinced it is a better way of farming.
Reduced inputs – no over lap, no head lands. Approximate saving of4%
Spraying, Seeding, Urea spreading and other operations following tracks – No foam markers are required, driving is done by looking ahead and not sideways.
Night spraying and urea spreading is possible, allowing us to make better use of calmer conditions in our windy location.
Use of wheel tracks for ever increasing number of in crop operations, nutrition, pesticide and fungicide applications with many late in the season.
Increased tractor efficiency from operating on compacted roadways.

Compaction
8 years of no-till and 4years of Controlled Traffic have greatly improved our soil structure water infiltration while virtually eliminating wind and water erosion.
We are compacting our soils by driving on them.
Will Deep soil compaction self repair and how long will it take i.e. is Deep ripping required on sand or is deep tillage necessary on loam soils?
We need to roll lentils/peas and rocks, will this undo CTF compaction gains?
Will our shallow soil that can not store large amounts of moisture, with mostly reliable winter rainfall and cool finishes, produce consistent yield responses from reduced soil compaction levels?

Challenges
Rocks – need to roll lentils, peas, barley. use a 11.2m x 1m flat steel roller.
Need to rock roll in summer when soil dry to reduce soil compaction.
Weeds in wheel tracks

Sheep traffic, increasing compaction and erosion risk in wheel tracks
Getting your head around a new farming system.

FUTURE
Autosteer

Improved Stubble Management – sowing and planting between stubble rows.
Wide rows crops and use of shielded sprayers for inter row weed control ?
Further reduction in inputs.

REFLECTIONS

The operational side of CTF has been a real benefit to our farming system allowing us to perform all operations in a timely manner, night or day with no guidance and stress, while reducing costs of both inputs and machinery

Weeds in the wheel tracks, mainly ryegrass, is the major problem mainly in our dirtier and sandier paddocks, with most solutions adding expense and time consuming.

The reduction of compaction side of CFT is harder to quantify with our climate of mainly winter rainfall and cool finishes and our shallow soils that can store limited amounts of moisture But I am confident that along with No-till our soils are in much better condition and the rainfall is staying where it falls and being used. This was evident last year with a long dry finish after a fairly wet winter the crops finished with a good sample and good yields.

CFT along with No-till, Rotations, Nitrogen management etc. are all contributing to a profitable and robust farming system able to better deal with variability's of our climate.

Update on CTF and gps uptake by farmers in SA

Matt McCallum and Bill Long, Ag. Consulting Co., Ardrossan, SA

SHORT HISTORY OF CTF IN SA (2001-2005)

CTF systems have rapidly developed at various levels across SA in the past 5 years, which has coincided with the adoption of no-till cropping systems (Table 1).

Table 1. % hectares under different systems (75,000 ha total)

	2001	2002	2003	2004	2005
No Till	16%	26%	29%	37%	51%
Up and Back	7%	28%	39%	48%	57%
GPS Guidance	3%	13%	20%	37%	40%
Wheel Tracks	2%	10%	10%	8%	8%
Autosteer	0%	0%	4%	15%	25%
Wheel Tracks + Autosteer	0%	0%	2%	6%	6%

note: source = Ag. Consulting Co. clients

Early adopters of CTF in SA placed permanent wheel tracks in their paddocks, although interest in this has waned due to the dramatic price drop in gps equipment in the last few years e.g. 2 cm Auto-steer has dropped from $90,000 to $45,000 in three years. Some farmers have even removed their wheel tracks due to various problems (weed control, wind erosion). Marker arms and basic light bar systems are rapidly being superseded by auto-steer technology because it is now within reach of many broadacre farmers. The current driving forces behind adopting CTF in SA are,

- Increase in the number of in-crop operations (fungicides, N top-dressing) and the later timing of these operations in relation to crop growth stage
- Ability to operate at night
- Reduction in overlap (5-8% cost savings) and underlap (weed nurseries)
- Greater overall efficiency of operations in larger paddocks
- Reduced fatigue

During the last 4 years Ag. Consulting Co. in partnership with the YP Alkaline Soils Group have conducted a range of research projects aimed at investigating the benefits of gps and CTF systems and at overcoming some of the problems. These projects include,

- Solutions to overcoming weeds in wheel tracks
- Evaluating the use of herbicides at night
- Assessing the potential of wide row cropping of pulse crops
- Agronomic benefits of 2 cm auto-steer e.g. inter-row sowing

WEEDS IN WHEEL TRACKS

Weeds in wheel tracks (especially ryegrass), is the single biggest barrier to the adoption of permanent tracks. Fuzzy tramlines provided adequate weed competition/control in the dry year of 2002, but not the more favourable season of 2003. High rates of particular soil applied herbicides (e.g. Simazine @ 2L) applied on wheel tracks provided adequate weed control in both years of the trial (2003 and 2004). These herbicides can be applied at sowing or soon after.

NIGHTSPRAYING

A range of herbicides from all major groups were tested for their suitability for use at night i.e. whether any product had reduced efficacy when sprayed at night compared to day. Key results and observations from this research were,

- Group A (Targa®, Select®): OK at night, except Targa® had reduced efficacy once under frost conditions at night at Ardossan in 2002
- Group B (Midas®, OnDuty®, Ally®, Hussar®, Oust®, Atlantis®): OK at night, except Midas® had reduced efficacy under frost conditions at night at Ardossan in 2002
- Group C (Lexone®): OK at night, although symptoms of herbicide action may be delayed
- Group G (Goal®, Affinity®): Bit of a mystery? Not recommended at night due to reduced efficacy in some cases under good spraying conditions. This has also been observed by others.
- Group F (Sniper®, Brodal®): OK at night
- Group I (2,4-D amine): OK at night
- Group L (Sprayseed®): OK at night, although symptoms of herbicide action may be delayed
- Group M (Roundup Max®): OK at night, although symptoms of herbicide action may be delayed

WIDE ROW CROPPING

CTF and auto-steer allow farmers to apply row cropping techniques to their broadacre crops. Farmers in WA are continuing to adopt wide row technology in lupins. This is primarily used as a strategy to overcome herbicide resistant wild radish, and ryegrass to a lesser extent. Shielded sprayers can be used for inter-row spraying of knockdown herbicides during the season on wide rows. We have investigated the suitability of chickpeas and faba beans as wide row cropping options for SA farmers. Conclusions to date are,

- Yield penalties can occur (but not always) when faba bean and chickpea are sown on wider row spacings (0.5 to 1.0 m)
- Yield penalties are more likely and are generally greater for chickpea compared to faba bean
- Wide rows generally increase pod height for faba bean (up to 10 cm), which may improve harvestability
- Faba beans at 0.5 m spacings appear to be the most promising wide row cropping strategy at this stage.

INTER-ROW SOWING WITH 2 CM AUTO-STEER

2 cm Auto-steer allows farmers to sow between the rows of last year's stubble. This can improve the stubble handling ability of sowing equipment and may also increase the yield of cereal on cereal crops due to less soil borne disease on the "inter-row" compared to "in the row" of the previous year's crop. Two wheat-on-wheat experiments in 2004 proved this to be the case,

Sandilands SA (Ag. Consulting Co., YP Alkaline Soils Group) a yield increase of 0.23 t/ha (3.88 vs. 4.11 t/ha) was measured for wheat-on-wheat due to less take-all on the inter-row

Tammworth NSW (NSW DPI) a yield increase of 0.2 t/ha (2.3 vs. 2.5 t/ha) was measured for wheat-on-wheat due to less crown rot on the inter-row

SOIL COMPACTION AND CTF IN SA

Reducing soil compaction is not a major driving force behind the adoption of CTF in SA. This is despite the research by Tim Ellis at Roseworthy (1989 to 1994) that showed a 2-5% yield increase of crops under controlled traffic. Furthermore, the work of David Malinda and co. in which compaction layers were progressively tilled deeper each year have produced remarkable yield increases (10-50%) at Halbury. However, Malinda could not repeat these yield increases on sites which had soils with other subsoil constraints besides compaction e.g. Minlaton (limestone subsoil) and Hart (boron and salt). This could explain why some farmers that have adopted CTF for at least 5 years can't prove yield increases due to reduced compaction.

ACKNOWLEDGEMENTS

ACC Staff: Danny LeFeuvre, Aaron Long, Nathan Rennie, Stephen Wentworth
Funding Bodies: South Australian Grains Industry Trust Fund (SAGITF), National Landcare Innovation Grant, SANTFA, gps-Ag and GRDC.

Farm Management

Scott McCalman, Warren, NSW

My wife Jo and I, and our three children, are dedicated zero-tillage farmers, operating two properties, totalling 12500 acres. We are dry land cropping 10,000 acres and irrigating a further 1500 acres on Jedburgh and Drungalear, North-West of Warren in NSW.

With a highly variable 455mm rainfall, and a commitment to long-term sustainability, we needed a business that was robust, profitable, offered long-term security, with an enterprise mix that was environmentally friendly and returned a better family life-style.

Being a fourth generation farmer, I grew up facing the reality of the hardships our conventional sheep, cattle and cropping operation faced with our highly variable climatic conditions. Over grazing and crop failures was creating major soil degradation and stress during dry times, and then an over abundance of feed during wet periods that were not being capitalized on.

To mimic what nature had in place in our area, before white settlement i.e. open savannah grass covered clay soil plains, inter-dispersed with timber woodlands provided me with the key for change. Nature was providing permanent soil cover.

In 1990 we removed all hard hoofed animals off our property and became opportunity zero-till croppers. Permanent stubble cover with control traffic returned the land to a stable, sustainable and economic environment. A positive key indicator was the increase in native fauna and flora that permanent cover was mirroring the natural habitat.

Soil amelioration, cover cropping and moisture conservation have been paramount to the success of our operation. The system allows us vastly improved flexibility with the capacity to produce economic yields in the drier years. The most satisfying outcome whilst living through this current, worst in 100-year drought is observing that we are loosing no precious topsoil.

From a management perspective we opportunity grow both summer and winter crops. This has increased our cropping flexibility and cropping frequency and allowed a decrease and better control on our input costs. The main crops grown are wheat, canola, chickpeas, lupins, sorghum and cotton. A specific example of how we create opportunities, in the 04-05 summer we faced a 2% water allocation in the Macquarie Valley. 1500 acres that was to be planted to irrigated cotton obviously was not feasible. To generate cash-flow we established we had 80cms of stored moisture in the soil profile and we had forward sold cotton back in 2000 at profitable prices, we decided to plant the area to double-skip dry land cotton. Due to drought conditions this did not produce a record yielding crop, however we were able to produce reasonable cash flow, utilise our machinery and staff and generally keeping our business working with flow-on benefit within our community.

Jedburgh Farming operates with a team approach, employing two full-time staff working along side myself and using casual employees as the season dictates. My wife Jo manages the bookkeeping side of our business. Marketing, Financial Planning and Budgeting are an ongoing process and regularly discussed. As a husband and wife team, good communication and planning has been paramount in setting and achieving our goals.

INNOVATION & RESEARCH.

The day we stopped ploughing our soil and introduced permanent stubble cover, combined with controlled traffic, and the removal of stock, was without doubt the simplest yet most effective change ever to be implemented in our operation to date. Starting with homemade marker arms and no-till planters in the early 90's to now utilising GPS auto-steer has given our farming operations cost effective precision, and controlled soil compaction. The advantages include increased accuracy, reduced fuel, seed, fertilizer and spraying costs, by eliminating the standard 10% overlap. Less horsepower is required running the tractors on compacted tramlines. Better soil structure and stubble cover gives less evaporation, whilst ensuring higher moisture infiltration and moisture retention.

To become successful at zero till, has involved many hours of trialling numerous items manufactured and designed in our workshop. Today we operate two 12.2metre wide zero-till planters. One, a custom-built single disc opener, allowing high speed planting with extremely low disturbance. The second planter was built and designed by ourselves, a dual tool-bar configured for both summer and winter planting on a variety of row spacings. We built two self-propelled 24.4 metre boom sprays using old cotton pickers with capacity to spray 100 ha per load. A new innovation we developed from an earlier homemade planter design is a green manure, cover crop roller. Trials to date have included rolling saia oats and vetch on the soil surface to produce a very thick surface layer of mulch. The green decaying crop has found to greatly enhance soil microbial activity and retain even higher amounts of soil moisture. A positive outcome has also been the effective control of weeds by the biofumigation action of the decaying crop. Other green manure crops have involved forage sorghum and fenugreek.

On going soil research has involved many on farm trials over the years. Addressing calcium deficiencies in our heavy clay sodic soils has been an exciting challenge. These include lime, gypsum, humates, rock phosphate and carbon trials.

A major innovation in our winter pulse crop programme has involved growing these crops on wide one-metre row spacings. This has allowed for many inter-row weed control options using our home-modified shielded sprayer. The wide rows have also provided increased sunlight and air into the crop canopy, greatly reducing the incidence of leaf born diseases and ultimately increased yields.

On farm storage and grain trucks have given us flexibility to market and contract cart throughout the year.

A strategic tree-planting programme has been active and on going for the past 15 years. We try and plant 1000 to 1500 speedlings per year. The idea has been to create buffer zones and wind breaks whilst creating an aesthetic value.

Marketing both summer and winter crops is usually dictated by seasonal progress. Once our production base has been covered we generally forward sell one-third of the commodity, allowing flexibility in the sale of the remaining crop balance.

FINANCIAL & MANAGEMENT SYSYEMS.

Jedburgh Farming P/L operates on the Phoenix Financial Management Set Of Books. As our business grew, my wife Jo whose background profession was a Registered Nurse/ Midwife had to participate in numerous bookkeeping and computer TAFE courses and Phoenix workshops. Jo spends two to three full days per week in our office. We were one of the first businesses to trial RABO Internet Banking and have successfully used Electronic Funds Transfer for the past 5 years. Data entry and quarterly BAS are attended to in our farm office, with the BAS being reviewed and checked externally as required.

We have a very open and close liaison and a shared vision with our Accountant/Financial Planner, Bank Manager and Agronomist. All these people have been paramount to our business in growing and achieving our goals. Positive and optimistic thinking has been absolutely essential and is the platform for our family and our business.

On purchasing our second property in 2000, five and ten year goals and budgets were implemented. The key to this partnership has been open, honest and regular communication with ongoing forward planning and commitment.

In regard to monitoring and benchmarking, we have involved our business in comparative analysis studies, enterprise based regionally. We participated in this benchmarking programme over a five-year period from family partnership split to purchase, from 1998 to 2002.

We use the tools of Benchmarking, Comparative Analysis, Risk Management, Forward Marketing, Yield Performance, Double Cropping and Succession Planning as Key Performance Indicators in our business. This gives us a good indicator of how robust our Farming System is performing locally and regionally.

Risk Management Strategies first and foremost involve conserving as much rainfall moisture as possible, to take better advantage of our extremely variable climatic conditions. This offsets to some degree the effects of drought. Full stubble cover, and No till planters with the capacity to moisture seek allowing crops to be planted within the correct window, instead of having to wait for the season to break. Wheat yields can diminish up to 7% per week once outside the optimum-planting window. We maintain and produce up to 90% per year all our planting seed requirements, which is stored, graded and treated on farm. We carry an extensive grain variety mix, covering long, medium and short growing season, giving good insurance and flexibility to suit seasonal conditions.

Our marketing is closely tied into our tax planning, and annual financial commitments, such as interest and machinery repayments. Cash, Pool and projected forward sales at locked in commitments are used as security going forward.

Agronomically we grow crops on varying wide row spacings to target disease, weed control and resistance strategies. Soil Testing and available moisture are regularly monitored and dictate our crop inputs.

A footnote in summary: I'm passionate about soils and cropping and have chosen to remove livestock from our farming operation. It is important for others to understand soil cover is the driver for our business. A modern rotational grazing system can offer similar environmental benefits.

Australian grain farms step up… to take the next big leap Using High Resolution Satellite imagery for dryland crop production

Tim Neale & Don Yule, CTF Solutions, Dalby, QLD

Key words: Australian grain farms, high resolution remote sensing, airborne, IKONOS.

Current farming practice in Australia is gaining momentum into a new age of 'spatial information rich agriculture'. Researchers and farmers are beginning to understand and manage the spatial variability that exists across fields and farms.

Access to a range of spatial tools including proximal production sensors (grain yield monitors), electromagnetic induction (EM), RTK GPS, and multispectral imagery has paved the way to discover how management and environment interact to drive the modern farming system. Although many of these tools are not new, their wider application to Australian farms is; particularly the way in which the spatial data is interrogated.

High resolution multispectral imagery using airborne and space borne platforms have been used in a study commissioned by the Grains Research and Development Corporation (GRDC) as part of the strategic initiative on 'Precision Agriculture'. In 2003, 2m pixel airborne imagery was captured on eight paddocks throughout Australia. Various vegetation indices and band combinations were used to analyse the data. Other layers of spatial information such as topography, grain yield and EM were analysed in combination with the imagery using a GIS.

The 2003 results showed that high resolution imagery has greater potential than its coarser resolution cousins (such as Landsat) to detect and begin to understand variability within crops. The 2003 aerial imagery demonstrated that crop variation in fields was as much a result of human management as other variations such as soils and topography. This implies that better farm management alone will considerably reduce paddock variability. When coarser resolutions of spatial data such as yield monitors were used, this crop variation appeared to be less obvious.

Although the benefits of the aerial imagery were apparent, concerns of timeliness, availability and cost became evident. IKONOS satellite imagery is now being examined as a more suitable form of image capture for broad acre grain farms. This paper aims to further examine the results from imagery capture (its uses and problems), how can the information be used to make better decisions, and the use of IKONOS satellite imagery as an alternative to airborne platforms for collection of high resolution imagery.

CTF Solutions
P.O.Box 1088
DALBY Q 4405
Ph: (07)46 623 913
Mob: 0428 157 208
Email: tim@ctfsolutions.com.au

Cotton Systems – "Keytah" (Moree)

Andrew Parkes, Parkes Agricultural Consultancy Pty Ltd Moree NSW

INTRODUCTION

The brief given for this presentation is to relate what we have done within our specific cotton farming system to address issues and problems. The following list broadly covers the direction given for this presentation:

1. The original system and it's problems
2. What has been changed within this system and why
3. The outcome: costs and benefits, successes and benefits.
4. Reflections
5. Where to next?

A quick history of the farm and me. I have been associated with "Keytah" for eleven years and have been the general manager for the past eight. The property now comprises 26,300 hectares and produces a variety of winter and summer crops as well as up to 6,000 feeder cattle per year. Irrigated cotton has been grown since 1988. There is 10,500 hectares of irrigation area. The largest area of cotton grown in one season was 7,500 hectares producing 72,000 bales of cotton.

THE ORIGINAL SYSTEM AND ITS PROBLEMS

The catalyst to look into the farming system we were running was economic viability. Both the farm and the district were averaging less than 7 Bales per Ha on a long term basis. With increasing costs these yield levels were not economically sustainable. We began by identifying the poor areas of production and the causes of these production losses and then set about correcting the problems in both the short and long term. This was done on a large scale, initially, and resulted in an immediate number of changes to the farming system that yielded some very pleasing results. The critical issues that were discovered were:

1. Severe compaction and hard pans in particular areas (caused from past practices of irrigating pastures for cattle).
2. Nutritional problems identified through soil testing (extremely low zinc levels and concerns with phosphate levels)
3. Poor irrigation design in particular areas (again caused from original irrigation design criteria developed for pasture irrigation).
4. Poor irrigation scheduling and timing of irrigations became a function of the problems listed above.

CORRECTING THE PROBLEMS – SHORT TERM

A number of management decisions were made immediately to help lessen the impact of the problems discovered.

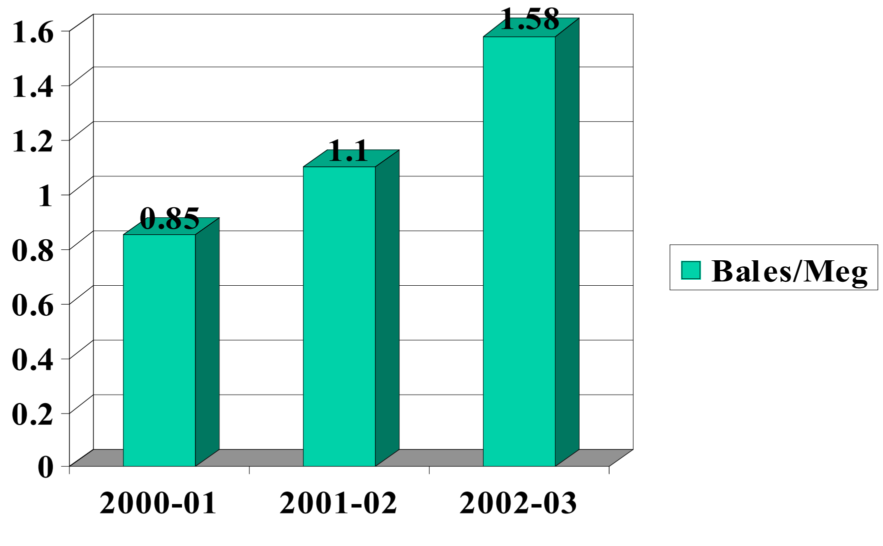
1. Indeterminate varieties were selected for the identified problem areas. These varieties were not as susceptible to stresses imposed through the poor function of the overall system.
2. Irrigation intervals were shortened and we started looking for better tools to assist us with irrigation scheduling that could become paddock specific.
3. Once the worst of the compaction zones were identified, the immediate remedy was to deep rip those areas with a dozer and apply gypsum to them.

The first year results showed a definite move in the right direction. The historically poorest yielding areas of the farm were brought up to the average of the better areas and the overall farm average was taken from below 7 Bales per Ha to 7.83 Bales per Ha in one season.

CORRECTING THE PROBLEMS – LONG TERM

Additional management decisions were made to help correct some of the problems discovered over the longer term. These included:

1. A long term nutrition plan that attempted to increase, rather than just maintain, both zinc and phosphate levels. The development of liquid zinc products allowed for this to be achieved simply and economically in the one pass.
2. A re lasering plan was organised that would, in time, allow for most fields to be re surveyed, re designed and re lasered to ensure a better and more even field was able to be irrigated with ease and efficiency.
3. Many of the older fields were designed originally for large through the bank pipes and had very little slope (1 in 2,000) and were also over a kilometre in length. All of these fields were split into two and the slope increased to an average level of 1 in 1,200.
4. Plans were also developed to rotate the fields to cereal crops (mainly wheat) on a more regular basis. This has continued over the past five years from a point of two years cotton and one year of wheat to a 'one in one out' scenario now.
5. A conscious effort was made to research new and better ways of irrigation scheduling. Through this process we ended up trialling and then purchasing a number of capacitance probes (C Probes) and went about the process of learning the intricacies of using them.
6. An additional benefit that came with the C Probes was the ability to begin to make some crude measurements of water use efficiency. Once we could measure it we were able to concentrate on developing ways of improving it. Ultimately we learnt that improving water use efficiency actually produced two massive benefits for the farm. Firstly, we used less water per hectare per season and, therefore, had more water for following crops and seasons. Secondly, and surprisingly, we found we grew **more cotton** because we used **less water**. A win win that deserves continued focus in the future.



WHERE TO NEXT?

Water: As mentioned above, water use efficiency is worth spending more time on to further enhance both productivity gains and natural resource sustainability. We are only just starting to look at ways in which we can begin to mitigate the losses from our water delivery and storage systems. The technology is available to both measure and manage these sources of water loss.

Yield: It was once mentioned to me that *"Yield is King",* and in terms of increasing the returns to the bottom line, it still is (although water is quickly catching up!). A comment extracted from The Boyce and Co & CRDC Comparative Analysis – *"Extra Yield Costs Very Little To Produce"* is very true and is fundamental to our approach. We have had many areas within fields producing in excess of 17 Bales per hectare (almost 7 Bales per acre); it should not be seen as ridiculous to assume that we can get the whole farm to these levels in the near future.

Farming Systems: New technologies are allowing greater flexibility in how we operate the farming system that we control. GMO technology, for example, could soon allow us the possibility of no till (or extremely minimum till) irrigated cotton. With the development of Roundup Ready Flex and new and improved ways of supplying nutrition to irrigated crops we have the ability to follow a wheat crop with a cotton crop and only traffic the fields to plant and harvest! In today's world of increased fuel prices and difficulties in finding labour as well as the known benefits of controlled traffic and minimum till these systems need to continue to be developed.

Technology: Is something that has become fundamental in the farming environment in order to remain economically viable. Its adoption and use has become as fundamental as applying fertiliser or monitoring crop growth! The new technological tools that are available to us in the farming environment can be mind numbing in both number and variety. Some can be simple and easily adopted and used, whilst others can be sophisticated, hard to understand and almost scary! One thing is almost guaranteed (besides death and taxes!), and that is that technology will continue to develop and advance at an astonishing rate. Consider a statement made by Ray Kurzweil – *"we won't experience 100 years of progress in the 21st century it will be more like 20,000 years of progress (at today's rate)".* The difficult thing about the continued development of technology is trying to filter out the best items to adopt to gain the greatest benefit. We need to do everything possible to stay in touch with new developments. Run trials, talk to neighbours, utilise extension staff, attend field days, come to events like this one, etc, etc, as it will become a necessity to continue to adopt new technologies to stay economically viable.

IN CONCLUSION

In his address to OUTLOOK 2004, Dan Banfield noted: *The world is increasingly becoming one market, which is receptive to innovative and differentiated products delivered through effective supply chains. It's a market also driven by the pursuit of reduced costs and competitiveness.*

This can be interpreted to indicate the need for Australian farmers to continue to be world leaders in innovation not just consumers of other people's technology. Efficiencies in our production system will be key to our competitiveness and we will need to innovate throughout the chain from production to product. Australia has a unique cropping environment which offers unique opportunities and sensitivities. We must manipulate these to our greatest advantage to build our competitiveness through production efficiencies, environmental responsibilities and differentiated products.

Use of controlled traffic systems with auto-steer to enhance inter-row cropping and opportunities for introduction of non-chemical weed control systems.

Rohan W. Rainbow, South Australian No-Till Farmers Association, Clare SA

ABSTRACT

Controlled traffic systems and the use of +/- 2 cm auto-steer technology has paved the way for new weed management systems and opportunities for inter-cropping. Canola is considered a high-risk crop in low rainfall areas of Australia and the application of triazine or imidazoline herbicides on lighter textured soils in these low rainfall areas has significant plant-back implications. In 2004 an experiment was sown at Waikerie in the South Australian Mallee with triazine tolerant canola sown on alternate 28 cm rows to barley. Simazine herbicide was applied with shrouded sprayers over the canola row. Barley was the selected crop based on seasonal conditions. The inter-row canola was sprayed out with glyphosate in early spring. Crop establishment and barley grain yield of the inter-crop system was not significantly different from conventional sowing. The inter-cropping approach has been used in experiments sown in South Australia during 2005. Opportunities for use of inter-row cover crops and knife rolling technology will allow introduction of non-chemical weed control into a no-till and controlled traffic farming system. Comparison of the inter-row knife rolling system in contrast to the cover crop and knife rolling systems widely used in South America and its effectiveness compared to inter row tillage and shrouded chemical based weed control systems is discussed.

INTRODUCTION

There have been many technological advances in broad acre farming over the last decade. Reduced tillage systems have been a key part of this change, however the adoption of these changes for many farmers has not been altogether smooth. The issues of weed management in a no-till seeding system has continued to be a major issue for increased no-till adoption, particularly issues with increased dependence on herbicides as a major management strategy.

Controlled traffic systems and the use of +/- 2 cm auto-steer technology has paved the way for new weed management systems and opportunities for inter-cropping. Canola is considered a high-risk crop in low rainfall areas of Australia and the application of triazine or imidazoline herbicides on lighter textured soils in these low rainfall areas has significant plant-back implications.

METHODS

In 2004 an experiment was sown at Waikerie in the South Australian Mallee to look at ways of improving risk management of canola establishment in low rainfall environment using controlled traffic systems.

The principle was to give some options for sowing canola in a low rainfall environment without the problems associated with establishment failure. If the canola establishes properly and the season looks promising for a canola crop, then the barley would be sprayed out with glyphosate using a shrouded sprayer, retaining the canola for harvest. The canola has also been protected from wind erosion during establishment. If the canola establishment is poor due to dry conditions and the season looks poor, then the canola is sprayed out and the barley is kept and harvested. In this scenario, simazine has been sprayed over the TT canola rows only, so the barley can continue to grow during the current season with excellent inter-row weed control, and also plant-back issues due to herbicide residues can be managed. The following years crop if sensitive to residual herbicide such as simazine, can be sown very close to the cereal barley stubble row using the same autosteer system.

This research used shrouded sprayers and +/- 2 cm autosteer mounted on a tractor to sow both canola and barley at the same time. The experiment was sown to barley or canola/barley on alternate 280 mm (11 inch) rows on the 30th July 2004. Simazine was sprayed at 1.18 kg/ha a.i. simazine over canola rows only on the 7 days later with a shrouded sprayer. Following very poor winter rains, the canola was sprayed out on the 21st September 2004 with Glyphosate at 1L/ha Roundup Powermax (540 g/l a.i. glyphosate) usine the same shrouded sprayer. This resulted with a barley row spacing of 563 mm (22 inches) on these plots. Harvest took place on the 25th November 2004

RESULTS

The resulting establishment and grain yield results for both systems were identical (Table 1). The grain yields were both very low due to the poor seasonal rainfall. Summer weeds were also suppressed in the plots sprayed with simazine post harvest.

Table 1. Alternate row cropping effects on barley establishment and grain production at Waikerie SA 2004.

	Plants/m^2	Yield (kg/ha)	Screenings (%)	Protein (%)
Barley 280 mm row spacing (11”)	134.7	295	8.5	19.2
Barley sown with canola on alternate 563 mm row spacing (22”)	135.9	308	8.0	18.5
LSD (P<0.05)	ns	ns	ns	0.2

RECENT WEED MANAGEMENT RESEARCH USING CONTROLLED TRAFFIC SYSTEMS

Following the successful autosteer research described above, SANTFA initiated further innovative weed management research using controlled traffic systems and autosteer. This research has been funded by the Australian Government Department of Agriculture Forestry & Fisheries, National Landcare Program through a Natural Resource Innovation Grant. The project ‘Holistic use of chemical and non-chemical weed control methods in no-till farming systems’ will demonstrate new ways of managing weeds in no-till farming, including non-chemical methods.

This project seeks to expand the methods of weed control to a more holistic approach to weed management which includes strategies of new and emerging IBS (incorporated by sowing) herbicides, more competitive crop varieties, cover cropping and the use of knife rolling technology which has been successfully adopted in Brazil in South America. Knife rolling is widely used in Brazil as a cost effective, non-chemical, non soil disturbing method of controlling weeds, often in combination with a cover crop (Derpsch, 2005). The US Department of Agriculture has published reports suggesting that this is a viable alternative method of weed control (Anon, 2002).

Recent developments in autosteer technology in Australia has meant that it is now feasible for farmers to use a combination of shrouded sprayers and/or non chemical knife rolling between the rows of the established crop. The use of cover cropping, non-chemical knife rolling and competitive crop technology in combination with more traditional chemical methods has created significant interest for established no-till farmers because of the advantages of better managing herbicide resistance. The knife rolling trials of this project have been sown and managed using DGPS guidance and +/- 2cm auto steer systems and potentially other visual non-GPS row guidance systems. The trials incorporate treatments which have a cover crop sown every second row between the cereal row, including an indian mustard and saia oats.

These inter-row cover crops will be knife rolled down in late winter early spring before too much soil water is used and also provide effective non-chemical weed control on the inter-row. The following seasons crop will be sown with a disc seeder through the cover crop residue. Trials have been sown in 2005 on Yorke Peninsula, the Mid-North and Mallee regions of SA.

CONCLUSIONS

This research has demonstrated some very useful applications from the use of controlled traffic with +/-2 cm autosteer systems and the use of shrouded sprayers. The impact of wider plant row spacings and soil water competition from inter-row cover cropping is yet to be determined. Controlled traffic systems and the use of +/- 2 cm accuracy autosteer systems have given farmers the ability to significantly change their farming system to incorporate new weed management systems that will enable them to use pesticides in new ways with a higher degree of accuracy. This will enable farmers to potentially reduce the amount their dependence on pesticides or at the very least reduce pesticide costs. There will be significant issues for pesticide registration and label changes in the future as farmers and scientists begin to test the boundaries of what is possible with these systems.

ACKNOWLEDGEMENTS

Special thanks to SANTFA, Nufarm and gps-Ag who have sponsored this research. Special thanks to the Department of Agriculture Forestry & Fisheries National Landcare Program Natural Resource Innovation Fund who have funded this ongoing research in 2005. Special thanks to Jack Desbiolles, Murray Crane and Dean Thiele from the University of SA Agricultural Machinery Research & Design Centre who have collaborated in sowing these research sites. Special thanks to the research site collaborators, Allen Buckley (Mallee), Graham Mattschoss (Yorke Peninsula) and the Hart Fieldsite Group (Mid-North).

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South Australian No-Till Farmers Association
PO Box 923 Clare SA 5453 Ph (08) 8842 4278 Email admin@santfa.com.au

Controlled Traffic Lucerne Hay Production

Joe Reddy[1], Tim Neale[2]
[1]Farmer, Wowan; [2]CTF Solutions, Dalby
(07)49 371 351; (0428) 157 208

INTRODUCTION

Separate cutting, raking and baling operations in lucerne hay typically involve 3-5 tractor based operations in each cut. A large proportion of the cropped area (approximately 50-70%) is wheeled each harvest, if traffic is random. Research has demonstrated direct (plant growth/water use) and indirect (soil/disease) damage by wheels in lucerne production.

Controlled Traffic (CTF) lucerne has been shown to improve lucerne yields by up to 25%, and double stand life (from four to eight years). However to date, there have only been a handful of lucerne hay producers who have adopted a CTF system.

This paper shows how CTF lucerne is actually being achieved on a farm in Central Queensland's key lucerne growing area – the Callide Valley near Wowan.

A CTF SYSTEM FOR LUCERNE

The system is set up on a 2m wheel track system, but is not bedded. A 12' flail mower conditioner, which has the capacity to swing and cut both sides of the tractor, has been purchased to allow 36' to be cut on each set of wheel tracks (3 swaths).

A series of combined rakes that turn the lucerne each day to assist with drying, are still being developed. A final raking brings the 3 swaths together immediately prior to baling. Baling involves a tow-behind, large round baler with wheels that match the tractor.

A 3 bale JD accumulator was purchased to minimise the distance travelled during hay removal operations. The hay retrieval will be assisted with the CTF system, as the driver can drive up and reverse down each wheel track in the paddock to remove the hay to the headlands on awaiting trucks.

EXPECTED CHANGES

Using this system, the area trafficked by heavy machinery tires will be reduced from near 100% to around 10%. Stand life is expected to increase significantly, thereby reducing establishment costs. Yields are conservatively expected to increase by 10%.

On a spreadsheet analysis, an extra 50% on the gross margin is expected, assuming yield and stand life changes occur.

A View of the ISIS Future

Peter Russo, Canegrowers ISIS

I will be talking about my personal position in regards to control traffic farming and some of the benefits I believe the sugar industry can gain from a change to a system such as this. I must firstly begin by saying I am by no means an authority on control traffic, so this presentation represents my thoughts on this system only, and is not an attempt to convince people to employ control traffic to their own business, but merely an endeavour to give a growers perspective of this system.

WHERE HAVE WE HAVE COME FROM?

My three brothers and I farm about 750 hectares of cane in the Isis mill area which is in the Childers district. Childers is 320kms north of Brisbane, boasting a population of 5000 people within the shire. The Isis Central Sugar Mill has been crushing cane for over 100 years. From February first, 2005, the sugar industry was again deregulated to a point where a grower could choose to send his cane to a mill of his choice providing he had a contract with said mill. Since then, Isis has been actively seeking more cane supply and the mill has contracted over 115 new growers to supply cane, giving Isis an estimate of 1.2 million tonnes to crush this year. The Russo family grows about 60 thousand tonnes of cane per year. We also have a harvesting contract with other growers, cutting a total of 95 thousand tonnes per year.

Our farming system has seen on-going change over the years, from traditional burning of cane and full working of the ground in the ratoon cycle, originally, to a burning and minimum till operation. From there we progressed to cutting green while still employing ground engaging equipment, and presently our practice is simply to cut green and drop fertiliser directly on top of the stool. Weed control is maintained by chemical sprays.

Our traditional way of fallowing and preparing ground to plant started with raking the thrash and burning it, followed by several discing operations and at least 3 ripping operations with an 11 tyne grubber on a 240 horse power tractor. We then used a 3 ½ metre rotary hoe on a 210 hp tractor, lining out and planting at 1.68m, or 5 foot 6 centres with a conventional billet planter single row. Over the last 2 years we have grown soybeans in rotation as a fallow crop and recently have grown our first 20 hectares of peanuts. We have looked at water efficiency issues on our farming operations. Presently, we have a surface water allocation plus 4 dams & 2 turkey nests. About 5 years ago we purchased 2 low pressure booms, since that time we have now purchased 1 towable and 1 fixed centre-pivot irrigator. These pivots cover over 130 hectares in total.

Over the last few years we have looked to a large neighbouring grower with the view of establishing more economical solutions to daily practices by working together. Three years ago we looked at purchasing bulk fertiliser. The first year the fertiliser was stored quite crudely on a concrete pad and covered by a tarp. This venture proved quite successful, so the following year we built a proper facility consisting of a retractable roof and two separate bays holding forty tonne each. We are each saving around thirty dollars a tonne using this method.

As farmers involved in primary production and especially the sugar industry, I don't need to inform you of the problems we face at the moment. Poor prices, a high Aussie dollar, the lack of good recent seasons and sky-rocketing oil prices means our industry is heading for certain failure if we cannot stop the slide and try to turn the industry around. Personally I think that the sugar industry is in the doldrums and is in great need of a new outlook and way forward. We need to be able to grow sugar cane at 250 dollars a ton of sugar to be viable. We can not rely on governments to bail us out any longer.

WHERE DO WE GO FROM HERE?

About 4 months ago I was getting out of bed every morning wondering if there was ever going be a future for the sugar industry & more importantly our own mill area. I am also a director on the board of Isis mill, and therefore notably concerned about the massive investment we as a mill are making into the future. I always reiterate to others that without critical mass of cane the mill has no future. We cannot have this critical mass unless the growers can grow cane for a profit even at low world prices. So what I am saying is that we have to change how we do things now, so that we will still be here into the future. This will require a whole systems approach. My belief is we need to have a system that can deliver better outcomes for the sugar industry. This system has to be robust enough to give the industry a leg up and move forward, and I envision that way forward through control traffic.

I have been attending B.S.E.S field days and various other workshops as well as sugar yield decline meetings, and the one take home message from all these discussions focuses on compaction and permanent beds Until such time as we can match our equipment to our row spacing we will never get away from compaction. I believe the issue of row spacing in the sugar industry is the biggest hurdle we have to overcome. My own experience within our family partnership shows me that an entire day can be wasted sitting in the shed with my brothers, arguing about correct row spacing, and if we surveyed the entire sugar industry I am sure we would be unable to reach a consensus on what the best row width should be. Whereas, the focus should actually be on matching our row spacing with our existing equipment.

For example, if a farmer who is using 1.57 m or 5 feet 2 inches row spacings and producing 100 tonnes per hectare, was compared with another farmer using 1.68m or 5 feet 6 inches, who was also producing 100 tonnes per hectare, you would have to say that the grower on the wider rows would have to be more profitable, because he is producing the same amount of cane while utilising less rows and therefore decreasing compaction to his farm.

A NEW FARMING SYSTEM

I would now like to discuss the new farming system as I would like to see it implemented firstly on our property, then flowing through to the wider group of growers in our mill area once it proves successful at our farming level. This system would be a full control traffic system on 1.8 m permanent rows or beds.

In the first stage we would have two tractors set up to take a GPS 2cm accuracy system. These tractors will share the one screen, with the ability to be easily shifted from one tractor to the other.

Following either a soybean or peanut break crop, ground preparation for returning to a cane cycle would consist of a single spray of Round-up to clear any residual weeds then a running through with our modified stool worker-come-lining out implement. This would be succeeded by a billet planter on 1.8 m single row with a 14 inch wide drill to plant into. Any weed issues in the early stages of the plant crop will be treated with products like gramoxone. Cultivation and filling-in can be done by a simple modification to existing equipment. In around 2 years I am hoping to have GPS units fitted to our harvester and haul-out equipment.

In subsequent ratoon crops the only passes a tractor would make over the ground would be to run fertiliser on top of the stool. To my way of thinking, weed control would be easily accomplished using round-up through a hooded sprayer. This practice would continue through our entire farming area. At the end of the crop cycle grown under the control traffic programme, when considering break cropping, we would spray out the stool with round-up again, then plant soybeans straight into the trash on either side of the stool, using a JD Maxi merge double disc opener seed planter. This operation would also be done with a GPS fitted tractor. Returning to the cane cycle after the break crop would be a simple case of going back over our permanent beds with the stool worker implement.

I feel this system is readily available for growers to adapt into there own farms. I think the role of contractors will become increasingly more important in this system, by the fact that if a contractor has GPS fitted to his machinery it would render a lot of unwanted capital tied up in farmers sheds wasting away.

Our GPS supplier has only this year fitted a GPS system to our cane harvester as a trial for us, so we could see the guidance system in action, and although we have narrow rows and no cane planted to our new system, we are already able to see the advantages of using this system, making us very excited about the prospects of our business once the control traffic system is fully implemented. This year we have a lot of sprawled cane on our farms, making it extremely difficult to judge whether or not the harvester is in the correct position. By using the GPS, the harvester driver can now take a lot of the guess work out of the tangled mess and therefore reducing problems.

I mentioned earlier that we harvest about 35,000 tonne of cane from 5 other growers. If we as contractors could duplicate the same system to these growers the cost savings could have a multiplier effect, and a far quicker adoption of this farming practice would take place.

Contracting could also provide a fantastic way for smaller growers to be able to adopt control traffic on their own farms without incurring the major capital expense that would otherwise need to be undertaken to experience the same benefits of a large grower, hence increasing the profits while lowering the cost to implement the system, and allowing the smaller farmers to stay in the industry.

I read with interest the July issue of the Australian Canegrower magazine, who ran a story about Mr. Ken Blyth. Mr. Blyth was awarded an OAM in the Queen's birthday list for his service to the sugar industry. His job was to promote the adoption of mechanical cane harvesting into the industry.

I believe we are once again at a place where we need to take another great step forward just as our fore-fathers did before us, and control traffic is the road that I personally believe we should follow.

I would just like to finish by acknowledging the help of Paul Nicol in providing me with the photos for this presentation, and to thank C.T.F. for giving me the opportunity to share my thoughts with you all today.

The sugar industry has seen a lot of change over the years: some good, others not so good. I believe this new system of farming will be the catalyst to take the sugar industry to a higher level of productivity, therefore ensuring the sustainability and profitability of this important industry into the future. Thank You.

The Cotton Industry Perspective

Ben Stephens, Manager, Auscott

Adoption of new technologies and advances in production systems has played a key part in the innovation of the Australian Cotton Industry. Through strong industry Research, Development and Extension new methods of farming are continually developed and implemented within farming systems. The Cotton Industries development of the Best Management Program (BMP) has been an integral tool in the advancement of the modern day cotton production system, both on and off farm.

Following are examples of work conducted within the cotton industry, both on farm and at the research level, which are related to the themes of this conference.

GEOGRAPHIC INFORMATION SYSTEMS (GIS)
Environmental management on a catchment scale
Groundwater management and resource allocation
Irrigation supply system assessment and monitoring
Yield Mapping
Elevation Mapping
Soil Typing
Drainage Mapping
Variable rate applications of amendments and nutrients

GEOGRAPHIC POSITIONING SYSTEM (GPS)
Accurate farm mapping for correct pesticide application
Requirement of licensing for the use of transgenic varieties
Tractor Guidance
Precision soil sampling/tissue sampling
Precision positioning of soil moisture monitoring equipment
Irrigation Engineering survey, design and construction

CONTROLLED TRAFFIC
Permanent beds
Long fallows for moisture accumulation
Decreased cost of production
Decrease in compaction

PRECISION IRRIGATION
Advances in farm and field design
More formalised laser levelling
Siphon flow rates matching set times
Lateral move/Centre Pivot irrigation

SATELLITE IMAGERY
Accurate resource maps
Land use/catchment management
Floodplain management

ROLE BY INDUSTRY
Strong research, development and extension effort
Knowledge management
Industry Best Management Practices Program
Vision for a more sustainable, profitable and competitive cotton industry, providing increased environmental, economic and social benefits to regional communities and the nation

CTF: What's Known, What's Next.

J.N. Tullberg, University of Queensland, Gatton

INTRODUCTION

"Wheels work better on hard soil, plants grow better in soft soil". This is obviously true for the great majority of soils and crops, but with few exceptions it has been totally ignored until 20 years ago by farmers in the developed world. Bright ideas have been discussed for 100 years, and serious research done for 50 years, but practical farm-scale controlled traffic did not happen until the early 1980s. Adoption increased rapidly across Australia from the mid-1990s, and different varieties of controlled traffic are now in place on 1-2Mha.

The object of this paper is to summarise what we know to be important in terms of the science and practice of controlled traffic farming, and suggest future directions. It is important to note that most of the hard evidence to date has been concerned only to demonstrate what we know already: uncontrolled wheel traffic causes major soil damage.

Controlling field traffic transforms random damage into a concentrate benefit, but this is only the starting point controlled traffic farming -- achieving the system changes and multiple benefits which are possible when farming healthier soil. These system advantages of CTF are the important outcome, and we hope to learn more information about these, and the process of getting there, from the grower papers at this conference.

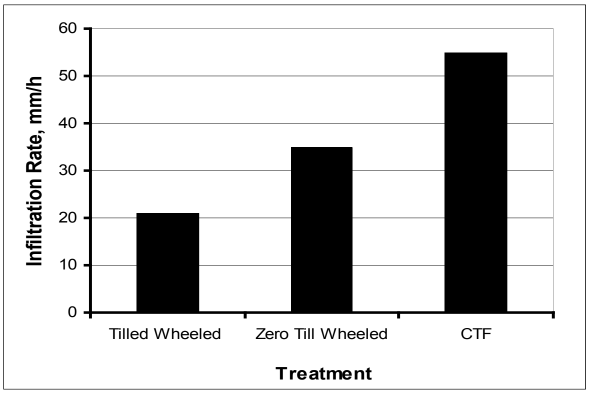
WHAT'S KNOWN

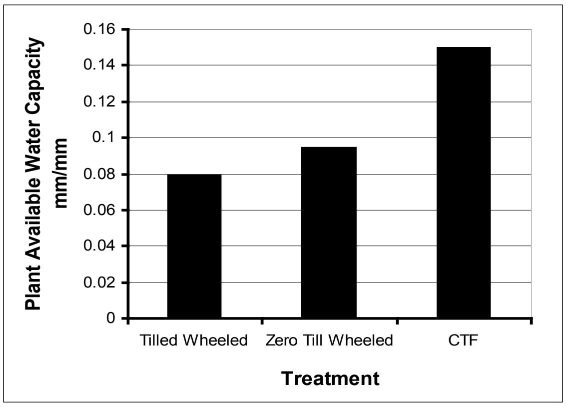
Soil in optimum condition for plant growth is relatively weak and permeable. When a wheel or track rolls over that soil, it compacts until it is strong enough to carry the applied load. The processes of transmitting surface loads to lower layers of the soil are not straightforward, but it is generally accepted that tyre pressure is the most important factor in surface damage, but total axle load is a more important influence on subsurface damage, and the depth to which it penetrates.

In most soils, natural processes can repair that damage, slowly, from the surface downwards. This occurs at a time scale in years at 20cm depth, even on "self-ameliorating" soils. Natural processes, or tillage can hide the surface damage quickly, but with heavy wheels driving over 50% of paddock area per crop, causing damage at 30cm depth and below, root zone damage is almost universal in cropped soils.

Soil damage occurs instantly, on the first wheel pass. Second and subsequent wheel passes do little further damage if they are on the same track. Fixing this damage takes years. Damage is less severe on dry soil, but extreme wheel loads imposed by the largest grain harvesters penetrates a long way down the profile, and certainly below the maximum depth of traditional deep tillage.

The impact of this soil damage on infiltration rate, plant available water capacity and soil life is illustrated in figure 1. This is data from Queensland's black vertisols, but broadly similar outcomes have been found in totally different soils in Victoria , Western Australia, and many other parts of the world. For all practical purposes, wheeled soil produces more runoff and absorbs less rainfall, stores less moisture in plant-available form, and is less able to cycle nutrients.





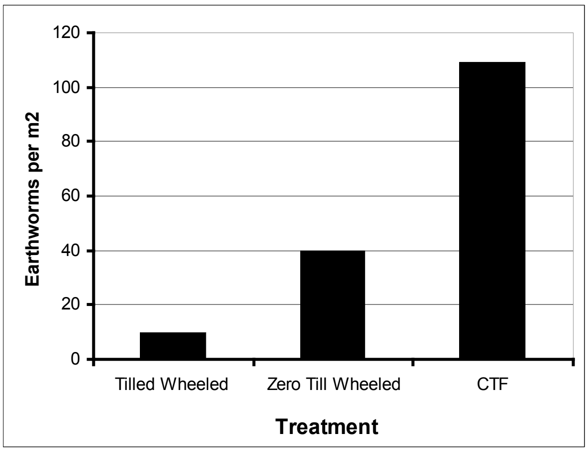


Figure 1 The Impact of Traffic and Tillage on:

a) Rainfall infiltration in and 80 mm/hour storm .

b) Plant available water capacity (0 -- 30 cm after two years CTF.

c) Earthworm numbers (0 -- 15 cm, average over two years)

The soil damage process also absorbs a loss of power. At least 25% of a tractor's power will be lost in the soil under the wheels when operating on normal field surfaces. This power is dissipated in rolling resistance and slip, in the process of compacting and increasing the strength of surface soil. The tractor needs to supply even more power to the implement to plant or till this stronger compacted soil behind the wheels.

Restricting field traffic to permanent laneways significantly reduces the power wasted in the traction process. The reduction in implement power requirements for planting or tillage is even greater. Importantly, eliminating the surface ruts and damage of random wheel traffic also gets rid of another of the major reasons for tillage.

When traffic is controlled we will have a healthier soil making a greater proportion of rainfall available to our crops. Soil disturbance will be required only where there is an identified need, and then it will require a lot less energy than current tillage.

WHAT'S NEXT

We know a lot about the problems caused by wheel traffic, and some of the direct benefits which occur when these problems are eliminated. We know very little about the broader system effects, simply because nearly all of our knowledge -- whether derived from research or practice -- is based on the issues of cropping damaged soil.

We are learning more about the immediate challenges of controlled traffic, and the solutions. Australian farmers and their suppliers have been the major innovators in developing and adopting accurate guidance systems, moving to a common track width, and achieving modular working widths. These are the immediate requirements of lining up all heavy wheels on permanent laneways.

We are also learning more about the immediate benefits: more rapid access to paddocks after rain, more efficient, timely operations with less power, less unnecessary soil disturbance, more moisture, more planting opportunities and better crops. We are starting to see more possibilities of using yield maps and satellite images to improve systems, that are no longer confused by random traffic effects.

We know amazingly little about the integration of this set of opportunities and benefits, or the new challenges that might arise. The whole topic has not yet registered on the institutional research radar: my hearing is not good, but I hear no discussion of the new opportunities that might come from -- for instance -- breeding crops, managing fertiliser inputs, or improving herbicide application in this improved soil environment.

Perhaps this is unavoidable in an environment that generally prefers to ignore machinery effects. Funding bodies obviously regard tractors and machinery as overheads to be provided by the research provider, while the provider institutions simply don't have the resources for equipment investment. This is a shame, because machinery is usually the major limitation. Farming would easier and cheaper, for instance if:

- Depth control was independent of load-bearing wheels, without parallelograms on everything.
- Accurate implement guidance could be achieved with drawbar equipment.
- Harvesters transferred products into multiple, towed bins, to allow quality differentiation.
- This integrated "commodity cart" approach could be applied to all field materials handling.

Controlled traffic farming is the integration of all the challenges and benefits of permanent traffic lanes and uncompromised soil, to achieve a more productive, profitable and sustainable agriculture. The objective is to optimise cropping systems in the absence of the constraints of random wheel traffic. This is a matter of taking advantage of the opportunities of improved timeliness and greater precision. For instance, planting immediately after harvest when soil moisture is available; capitalising on the ability to access growing crops without causing crop damage; using greater precision to better target the application of fertiliser and herbicide.

The research institutions might address some components of this challenge, but the system issues will have to be sorted out by farmers, individually and in groups, working with input from scientists and consultants. This conference is an important step along this pathway, and I am sure we will hear more innovative developments which are already underway in the paddock, using the best available technology.

ISO 11783: CAN CANBus deliver what we hope it CAN?

Ben White, Kondinin Group

INTRODUCTION

During 2004 Kondinin Group surveyed 200 farmers and found many were frustrated with the lack of compatibility between the different components used in precision agriculture. Having a standard platform for precision farming hardware and software was equally ranked as the second most prominent issue in providing potential benefit to growers. The survey found standards for precision agriculture hardware and software was second only to targeted chemical applications technology in an estimated potential benefit matrix.

ISO 11783 FOR FARMERS

ISO 11783 is a voluntary standard to which companies can manufacture electronic components. The standard specifies the use of the Controller Area Network (CAN) bus communication system.
Companies supplying ISO 11783-compliant components, allows customers the option to buy different devices that communicate using a standard system.
ISO 11783 is designed to improve the compatibility of electrical components just like the three-point linkage system standardised implement attachment. The voluntary standard has 13 parts specifying how data should be transferred between sensors, actuators, control elements, mounted or integrated tractor information storage and display units and implements.
The standard goes a long way toward helping to standardise the platform for precision farming technology. Manufacturers who embrace the standard will improve the compatibility of devices including virtual terminals, tractors, steering controllers, application rate devices and yield sensors. The standard describes this communication via a 250 kilobytes per second twisted non-shielded quad layer cable.
Manufacturers selling ISO 11783-compliant products will use common hardware including plugs, cables and software data exchange. As a result, the standard should mean improved efficiencies for farmers in terms of implement combinations and automation. The virtual terminal is one of the most important components of any precision farming system as it provides the user with an interface and control centre. The terminal is described as 'dumb' because the information it displays is generally governed by an electronic control unit. Data entered is supplied to the electronic control unit via the virtual terminal (VT). ISO 11783 standardises operator prompts and data entry on the VT.

POTENTIAL BENEFITS

According to Kondinin Group's 2004 Machinery Survey, simplified integration of precision farming technology would increase farmers' annual returns by up to $23 per hectare.

Manufacturers might take some time to release CAN bus technology to a plug-and-play stage but this will increase as companies embrace ISO 11783. Widespread uptake of the standard will give farmers more freedom to choose the most appropriate precision agricultural components for their operations. This might include differing makes and models of tractor, spray controller, guidance system or yield monitor with the ability for equipment transfer between units.

LIMITATIONS

According to some manufacturers, one of the limitations of ISO 11783 is the specification of only the lowest common denominator expected from each component. While a solid platform to start with, the capabilities of standard compliant ISO 11783 systems are relatively basic in comparison to some of the graphically rich colour moving maps some operators are now familiar with.

ISO 11783 delivers a maximum bandwidth of 250kbits/second but manufacturers report that some graphically rich colour moving maps can consume between two and three times this bandwidth.

CAN bus as a system, is designed not to fail but it may suffer degradation as a result of overloading. For example, the bus could become overloaded with graphically rich data transferred to the virtual terminal. The results of an overloaded bus may include unresponsive steering.

Until all manufacturers switch to CAN bus technology, farmers will continue to experience data transfer compatibility problems. For example, late model CAN bus-wired harvesters will be unable to use National Maritime Electronics Association (NMEA) positional strings via an RS232 input from an inexpensive handheld global positioning system (GPS). Manufacturers could provide gap solutions for these problems in the form of CAN bus adapters to cater to market demand.

SOLUTIONS

Some manufacturers include a second CAN to maintain prompt control signals for commands with time-sensitive operations such as automated steering.

The second CAN uses the same virtual terminal as the original. While still receiving raw data input from a remote electronic control unit, a dedicated graphics engine in the virtual terminal renders graphics for the display, preventing the bus from becoming clogged with bandwidth-heavy graphics information. This would alleviate data response delays. While 250kbits/second should provide ample bandwidth for most operations, farmers using combinations of time sensitive applications such as automated steering and moving map graphics may need to consider supplementary CAN networks or VT-based data processing.

COMPLIANCE TESTING

During August 2004, the Association of Equipment Manufacturers (AEM) represented by its North American ISOBUS Implementation Task Force (NAIITF) and the Federation of Engineering Industry (VDMA) represented by its Implementation Group ISOBUS (IGI) agreed on common procedures for the release of the ISOBUS Compliance Specification and revisions; ISOBUS Compliance Test Protocol and revisions; ISOBUS labels; and relevant test information. In the future, electrical components that are ISO 11783 ready will be indicated by ISOBUS conformity label.

On track to an improved Future – Dryland Cropping

Andrew Whitlock, Precision Agriculture Agronomist, DPI, Geelong, VIC

REVIEW OF CURRENT STATUS

- Slight decline in world economic growth with Australia's economic growth to remain robust for 2005/06 (ABARE Outlook 2005)
- Stable interest rates for next 12 months (ABARE Outlook 2005)
- ABARE assumes the Australian dollar will fall to US 72c (ABARE Outlook 2005)
- Farm exports forecast to increase by 3% (ABARE Outlook 2005)
- Grain prices expected to slightly increase, as world production levels fall (ABARE Outlook 2005)
- Fuel prices are expected to rise
- Widespread drought effects
- Isolation of crop improvement groups throughout Australia
- Land prices increase – more rapidly where land is more amenable and accessible to urban
- New technology being developed before we understand it, leading to more snake oil merchants
- Various dryland cropping systems – conventional, biological, CTF, zero-till, biodynamic, organic, low input, high input, composting, raised beds etc…

DRIVERS FOR CHANGE

- Lifestyle
- Declining terms of agricultural trade / cost-price squeeze
- Meeting demands of consumer/exporters
- Traceability
- Environmental Management Systems (EMS)
- Availability of technology
- Climatic uncertainty
- Unsustainable systems

WITHIN PADDOCK LEVEL

- Continual addressing the limiting factor
- Get the basics right – sound agronomy
- Fine tuning - assessing, trialing, and reassessing (strip trials)
- Satellite imagery to measure management systems and spatial variability
- Managing water – layout, raised beds, knife points & press wheels, grassed waterways
- Chemical resistance – rotating chemicals and crops, inter row operations, shielded sprayers, weed detectors, enhance natural predators, hay production, burning windrows
- Soil structure – CTF, minimum tillage, soil cover, organic matter, balanced soil chemistry, primer plants
- Increasing organic matter - stubble retention, composting, green/brown manure
- Crop rotations – new varieties (N-fixing cereals), short season legumes
- Improving soil biology – CTF, mechanical weeding, more organic matter, microbial applications
- Effective soil sampling – EM38 surveys, testing physical, nutritional, chemical and biological status
- Addressing the sub soil – slotting organic matter, is it too difficult?
- Variable rate – understanding soil potential, yield potential map, maintenance/replacement rates
- Micro-sensors – measure soil water, weather stations, predict disease risk
- Biotechnology – plant genetics (GMO's), value added products (specialist crops)

WHOLE FARM LEVEL

- Mix of enterprise – livestock vs cropping
- Land use suitability – what areas should be cropped?
- Mapping – grain yield and quality, soil parameters
- Satellite imagery – assess management system, improve farm layout and paddock design.
- Remote sensing for in-crop applications
- Precision Agriculture – should start with CTF then evolve to address other limiting factors
- 2cm Autosteer provides key to many advantages – CTF, inter row sowing spraying and mechanical weeding, no over-lap or under-lap, focus on operation, makes life easy, stubble management, less weed establishment, avoid root diseases etc
- Environment – shelter belts (trees), weed management, healthy waterways
- Farm efficiencies – assess points, laneways, paddock shapes
- Managing spatial data (electronic data management system with GIS capabilities) – paddock history, satellite and aerial imagery, yield maps, soil maps, variable rate maps
- Environmental Management System – price premiums, recording all operations, manage off-paddock impacts
- Nutrient management – slow release fertiliser, accurate feeding of crops, precision placement
- Risk identification and management
- Seek advice from consultants – succession planning, business structure, agronomy, new technology, data management, EMS
- Marketing and business management – seek advice, network ideas, identify opportunities

REGIONAL LEVEL

- Farmer support groups – CTF Young Farmer groups
- Localised concept farms to test and demonstrate best management practices
- Satellite imagery – cheaper by the dozen
- Shared base stations – 'GPSnet'
- Improved infrastructure - grain handling and storage
- Marketing local products – determining own markets
- Healthy catchments – water flows, erosion, salinity
- Develop regional plant breeding centres
- Leasing/share farming an option for young players
- Need to skill our labour force – apprenticeships, trainees, diplomas

NATIONAL LEVEL

- Capture new markets (domestic and international)
- Improved transparency between research and extension
- Greater sharing of information between crop development programs
- National CTF Young Farmer Association
- Telephone conferences for growers – international experts
- Improved communication between Australian farmers
- Implementing a single vision for Australian Grains Industry
- Education of youth – mentor programs, travel
- Standardised approach to the development of technology – electronic communication for machinery, GPS solutions, wheel centres
- Embrace and support innovative ideas, thinking and adoption
- Agribusiness lending linked to sustainable farming systems such as zero till/CTF

CONCLUSIONS

- Get the basics right and demonstrate this on concepts farms spread throughout Australian cropping regions.
- Improve soil structure, balance soil chemistry and develop soil biota
- Grow the farm business with decisions based on sound economics. Identify cost of production, determine return on capital, consider opportunity cost

- Innovative farmers should be supported and encouraged to explore ideas. Begin by developing a national CTF Young Farmer Association.
- Domestic communication networks within Australian Agriculture need to be improved at all levels.

ACKNOWLEDGMENTS

Australian Bureau of Agricultural and Resource Economics (ABARE) http://www.abc.net.au/rural/outlook2005/stories.html

Andrew Whitlock ph: 0419 551 201
Email: andrew.whitlock@dpi.vic.gov.au

Bed Farming – realising the profiles potential

Andrew Whitlock, Precision Agriculture Agronomist, DPI, Geelong, VIC

TAKE HOME MESSAGES

As we move into an era of unpredictable climatic conditions farmers are encouraged to improve their soil conditions to store more plant available water to facilitate greater water and nutrient use efficiency. Soil compaction and other hostile subsoil issues are limiting crop production throughout the country. The expansion of raised beds in broad acre now exceeds 40,000ha in south west Victoria alone, which has led to significant improvements in soil structure through the control of waterlogging. Controlled traffic and improved biological activity in the subsoil appear to be closely associated with the soil processes. The confinement of wheeled compaction through controlled traffic is delivering significant farm management and financial benefits.

Farmers cannot afford to not implement a Bed Farming System, either a raised bed or flat bed or combination of the two. There is now a great deal of evidence that says your farming system cannot evolve to its potential until you have adopted these simple yet advanced management systems.

Flat beds (CTF):

- Even with direct drilling, approx. 80% of a paddock will be covered by wheel tracks every season
- 80% of the damage to soil structure is created by just one wheel pass
- CTF limits wheeled compaction to 15-20% of a paddock
- One wheel pass at sowing reduced yield by 30%, while numerous passes reduced yield by 80%
- One wheel pass increased soil bulk density by and average of 10% in the 0-10cm zone, compared to a 20% increase with numerous passes
- Other benefits of CTF include improved trafficability, less input costs (fertiliser and chemical savings), reduced fuel bill, night operations, improved agronomy options, less driver fatigue and a simplified system
- CTF adoption exceeds 1,000,000ha across Australia – it is here and it is the future

Raised Beds:

- Raised beds in broad acre offer an excellent opportunity for controlled traffic cropping thus minimising the effects of compaction.
- Soil structure under raised beds has been measured to be different compared to flat paddocks and it appears that with time the differences become even greater
- The absence of compaction and the frequent wetting and drying of soils on beds would appear to be the main contributory factors to the improvement in soil structure
- Such soil structure differences have also been measured below the depth of initial tillage in the installation of beds
- The above changes have contributed to enhanced plant available water capacity on raised beds
- Such improvements should result in yield stability across years under changing weather conditions

INTRODUCTION

CTF is a smart, healthy cropping system, which delivers production and efficiency in an environmentally sustainable way to those who implement it. It literally means to control where you drive during cropping operations by driving along clearly defined, permanent wheel tracks, with the aim of minimising the area affected by wheeled compaction. By doing this we separate our paddocks into sections, one which provides a healthy well structured medium for supporting crop growth, and one which provides the roadways for supporting vehicles and machinery. Raised bed farmers do all those things as part of their bed and furrow system. In fact we could refer to these systems as Bed Farming, some beds are flat others are raised!

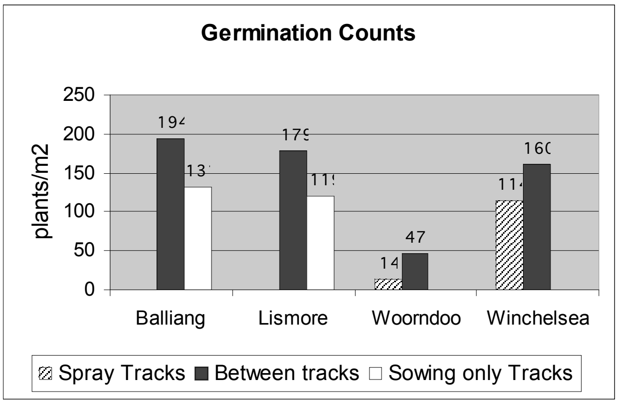
Work conducted by the southern grains team of the Victorian Department of Primary Industries has brought to light a number of benefits of bed farming systems. We have focussed on both flat beds and raised beds.

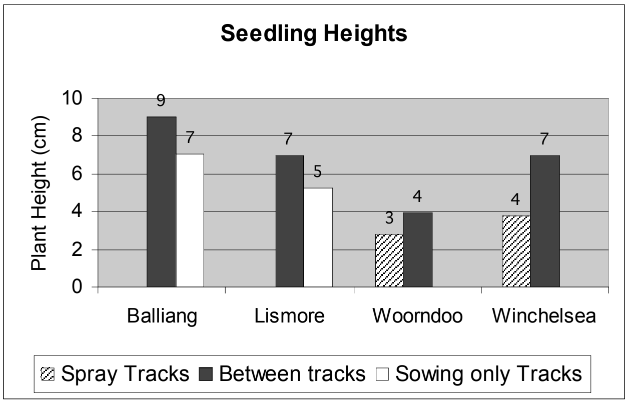
INVESTIGATING SOIL COMPACTION ON FLAT BEDS

Soil compaction costs agriculture up to $850 million every year in lost production. However, there are many farmers who are unaware of its presence. Managing compaction makes sense, and there is a lack of understanding, particularly in Victoria, about the effect it has on crop growth. In season 2004/05 DPI Precision Agriculture Agronomist Andrew Whitlock conducted a pilot study investigating the importance of CTF in Victoria through measuring the effect soil compaction on crop growth. The project consisted of four key case studies of CTF systems throughout south west Victoria.

The research component of this project aimed to quantify the effect of wheel compaction on crop growth. Measurements were conducted on four farms at different locations, lupins at Woorndoo and barley at Lismore, Winchelsea and Balliang.

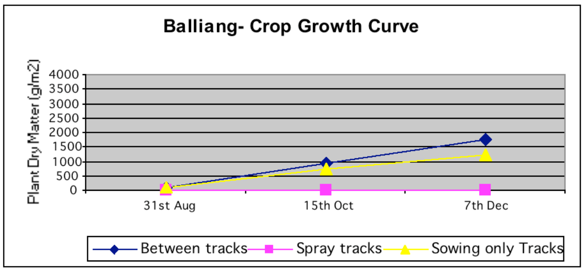
Crop Establishment:

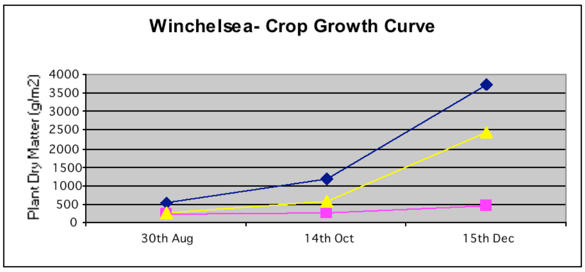


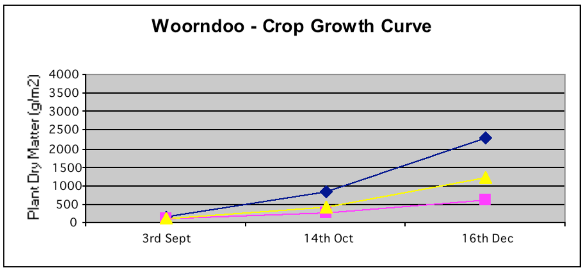


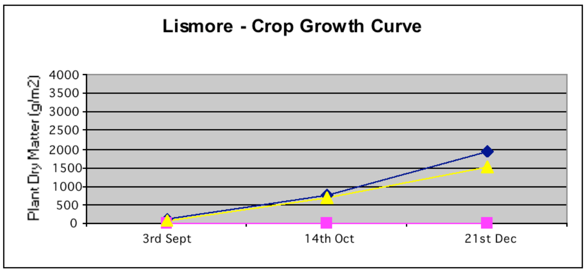
The average reduction in germination rates along wheel tracks was 30% for barley and closer to 70% for lupins. The seedling heights along the wheel tracks were also reduced at all four locations. The seeds not only struggled to penetrate the compacted surface, but eventual emergence was delayed and seedling vigour was reduced.

Crop Development:







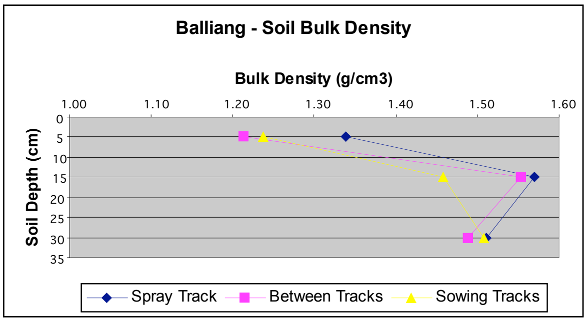


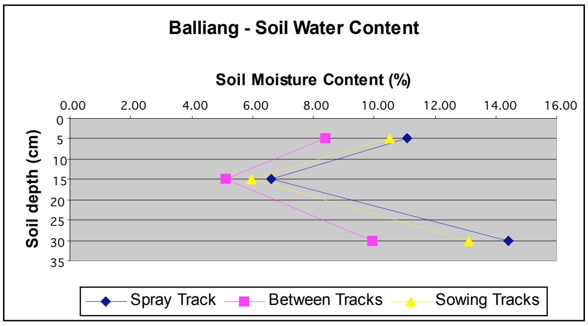
Crop growth measurements at three different times throughout the season (September, October and December). The crop growth rate along sowing only tracks was clearly lower than the corresponding growth of between tracks at all four sites and for each date of sampling. The differences varied between locations but were in the order of a 50-20% reduction of biomass along sowing only tracks. At Woorndoo and Winchelsea, the spray tracks were sown but this was not the case at the Balliang and Lismore locations, hence the incomplete data sets. The biomass measurements along the spray tracks were considerably lower than the corresponding measurements for both between tracks and sowing only tracks. This effect is apparently caused by the combination of compaction and physical traffic damage.

Tiller density was also reduced along sowing only and spray tracks, to a far greater degree than on the spray tracks. The data sets from all four locations confirm the theory that just one wheel pass can have a major effect on crop performance.

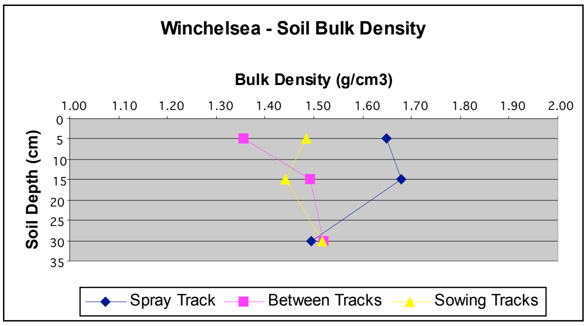
Soil Observations:

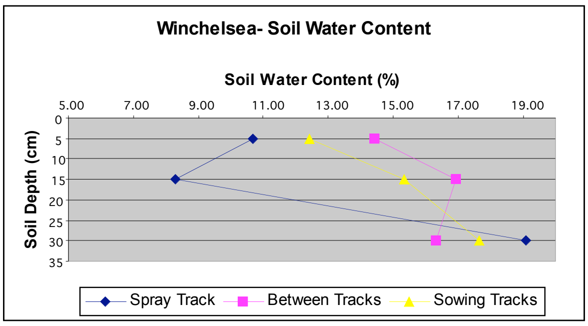
Balliang – The topsoil is a sandy clay loam with high levels of organic matter, overlying a light medium to medium clay subsoil. The subsoil wasn't found to be dispersive, however red and orange mottles were present throughout suggesting the prevalence of long-term, sub surface waterlogging.



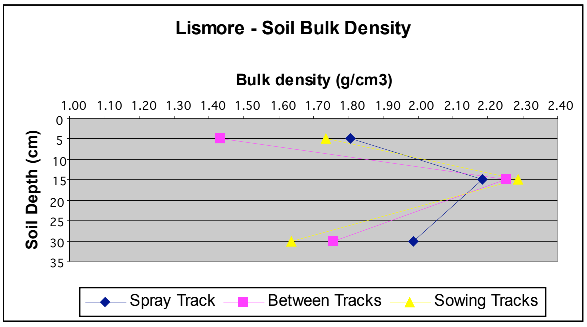


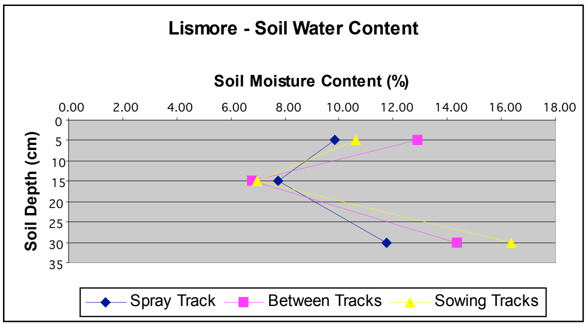
Winchelsea – duplex soil profile with A-horizon (0-25cm) consisting of a sandy clay loam and light sandy clay overlying a B-horizon with medium to heavy clays.



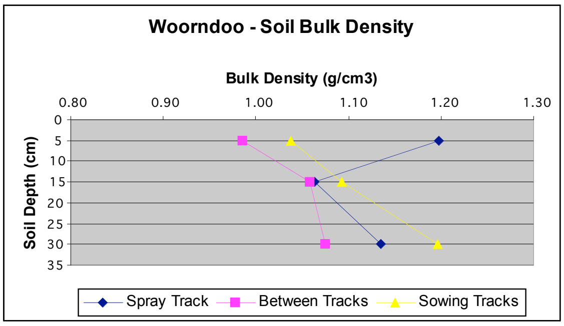


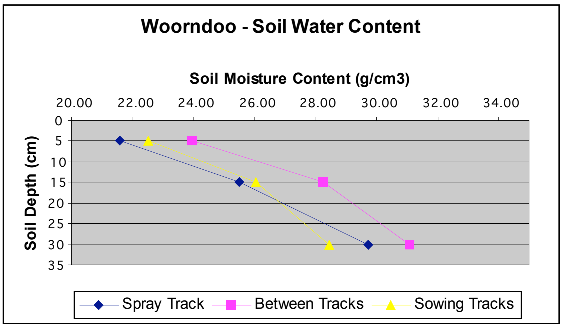
Lismore – Sandy clay loam with slight buckshot (0-5cm) over clay loam, sandy with increasing buckshot (5-30cm) over a sandy (30-50cm) and then medium clay (50cm+) subsoil. Significant buckshot levels (approx 50%) between 15-50cm.





Woorndoo – A unique soil type on lunette banks, a deep non-dispersive black cracking clay with light clay (0-30cm) over a medium clay (30-100+cm).



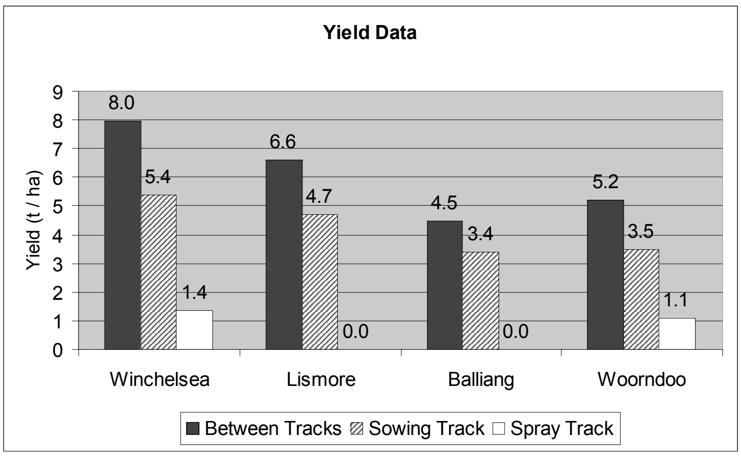


Average bulk density measurements (g/cm^3) from all four sites

Depth (cm)	Spray Tracks	Between Tracks	Sowing Only Track
5	1.5	1.25	1.38
15	1.62	1.56	1.57
30	1.53	1.46	1.47

The level of compaction caused by machinery was determined through the measurement of soil bulk density and soil moisture. These basic measurements highlighted the fact that random wheel traffic can compact the soil to a point where root penetration and soil water storage is severely limited. The measurements along the spray tracks (numerous passes throughout the year) showed bulk density readings exceeding the upper limit for root penetration of 1.6g/cm^3 at two of the four sites. The greatest impact was measured in the top 15cm. The one wheel pass at sowing also increased bulk density, thus limiting plant available water, at all four sites.

Final Yield:



This study of four different paddocks with different climate and soil types has found that one wheel pass at sowing will reduce crop yield by ~ 30% and numerous passes can reduce yield by ~ 80%. The yield reduction of spray tracks is a result of both compaction and physical traffic. The data highlights the damage that can be caused by just one wheel pass and the need to manage wheel compaction.

CONTROLLED TRAFFIC ON RAISED BEDS:

In southern Victoria, soil structure continues to be monitored for over eight years since the development of the raised beds. On the shrink-swell clays of the basalt plains, the absence of compaction (with controlled traffic) and minimum tillage are delivering a range of soil benefits to farmers that has resulted in the rapid uptake of raised beds in areas prone to winter waterlogging. The beds also offer an excellent opportunity for wetting and rapid drying of soil, which favours the rapid development of aggregates in certain soils. While we are not able yet to partition the effects of effective drainage, controlled traffic and minimum tillage, it is certainly a combination of these factors that are responsible for the enhanced crop yield on raised beds that is experienced in southern Victoria. These changes have, over the years contributed to yield stability in the region despite erratic weather patterns (Bruce Wightman and Renick Peries).

CONCLUSIONS

Cropping systems across different landscapes and soil types are suffering from soil compaction. Compaction is a continuous process ultimately resulting in a loss of soil macro-porosity, leading to low storage/supply of water and oxygen, and increased soil strength. This investigation of the effect of wheel compaction on crop growth supports the need to actively manage soil compaction. Wheel compaction reduced crop establishment leading to poor crop growth and reduced crop yields at all four sites. A single wheel pass at sowing increased the bulk density of the topsoil at all four sites, limiting root penetration and plant available water.

Controlled Traffic Farming, with or without raised beds, is generating a lot of interest and is being widely adopted across Australia. The benefits are delivered through a range of areas of crop management such as time efficiencies, making life easier, improved soil health, better crop growth and higher yields, increased accuracy of operations and reduction of inputs.

ACKNOWLEDGMENTS

Thanks for the cooperation of the four farming families involved with the soil compaction project. Particular thanks go to David Jamieson, Tom and Sam Dennis, James Bufton and David Langley. Thanks must also go to DPI-Victoria colleagues Renick Peries, Bruce Wightman and Chris Bluett for supporting the research.

Andrew Whitlock ph: 0419 551 201
Email: andrew.whitlock@dpi.vic.gov.au

Permanent Beds In Horticulture

Lionel Williams, Bowen, Qld

SUMMARY:

Euri-Gold Farms is a family owned horticulture farming business, situated about 20km's north west of Bowen.
We commenced farming here in March 1976, growing tomatoes, cucumbers and rockmelons.
Standard farming methods were used: furrow irrigation with inter-row cultivation for weed control.
Tomatoes and mangoes are the main crops grown now, around 50 – 60 hectares of tomatoes and 56 hectares of mangoes.
Tomatoes are grown on trellis, plastic mulch and trickle irrigation.

The large volumes of used plastic mulch generated by the almost total adoption of this product by the districts farmers created major problems for the Bowen Shire Council to dispose off.
Resulting in the refusal to accept plastic mulch waste at the Council's tip.

Council promoted trials using mulch made from chopped green garbage in an attempt to find and alternative to the use of plastic mulch. Other trials where done using paper, straw mulch and biodegradable plastic. While the crops grew successfully it was obvious it was not possible to obtain or transport the huge volume of material required.

A simple solution seemed to be to grow the mulch on site.
This lead to the development of a system of permanent beds. A number of different cover crops where trailed, including; sorghum, oats, legumes and several varieties of grasses.

The main difficulties where with weed control the high use of herbicides and the lack of consistent summer rain. Work is continuing to develop a cost effective sustainable system that will improve soil health and control erosion caused by cultivation.

Controlled Traffic as a Consequence of Raised Beds

Brian Wilson, **Lismore Victoria**

BACKGROUND

In spring of 1990, we installed 40 ha of under ground drains into old long term phalaris pasture. By the time the subsequent workings to prepare a seedbed were complete, the soil was too dry to seed. However 90mm of rain one Friday in early January, and the effective drainage of the fallow, allowed us to sow sunflowers the next Monday. Normally this would have remained wet for a few weeks. We trialed the new red winter wheats in 1992 and in a very wet spring and summer, where other crops rotted in the ground, our Lawson wheat yielded 7t/ha Having shown that high yielding crops could be grown by eliminating water logging with underground drainage, when the raised bed cropping system became available, and the establishment cost of about $200 / ha was only 20% of the underground drainage system, we could then factor the cost into our annual gross margin.

SOUTHERN FARMING SYSTEMS

The trial set up in 1996 of 2 ha each of underground drains, wide raised beds, and narrow raised beds, with each yielding around 3.5t/ha of canola in a very wet winter reinforced the value of drainage. The narrow raised beds were favoured because of the lower cost compared to underground drains, and the more uniform crop compared to wide raised beds. In 1997 satellite sites established a further 300 ha of narrow beds. Despite the dry year there appeared to be little or no yield penalty on beds.

ESTABLISHING NARROW RAISED BEDS AT HOME

With wool prices continuing low and unprofitable, cropping a larger area seemed a logical solution to remain viable. For this to be safe the crops needed to be grown on drained country. We now had 80 ha of underground drains, increased by 40 ha in 1995. Together with 70 ha of creek bank, we only had 150 ha of safe crop. A decision was made to install 140 ha of narrow beds. A topographical map using a tracking theodolite was made, a deep ripper procured, and our 4m roterra converted to a bed former. A plan was developed and grader hired to form the main drains, and beds installed. By 2001 all our crops were planted on drained country, with 450 ha of narrow raised beds.

SEEDING EQUIPMENT

The first year we used our 21 tyne Shearer trash culti-drill to sow the crop. This sowed two 2m beds with the combine wheels running on top of the beds. Although the tractor was running in the furrows, it was interesting that the combine wheel compaction alone, was sufficient to reduce the ability to penetrate the soil next summer. A 5/8” steel rod could be pushed in the full 20cm. of uncompacted bed and only 5cm under the wheel marks. The turning land at each end was virtually impenetrable, as was any flat land. One consequence of loose soil however, was an increased area damaged by false wireworms in canola.

The following year we converted a 28 run Chamberlain combine, taking off the front and back rows of cultivating tynes, and installing three gangs of eight press wheels to follow the seeding tynes. This worked well except in wet conditions, when mud built up between the press wheels, preventing them from turning. With all vehicle wheels now running in the furrows, compaction was no longer a problem. In 2002 we purchased a Multi-planter seeding bar and Simplicity air-seeder. This allowed us to have individual depth control, deep banding and the ability to split fertilizer. By using 28 tynes on 24 heads, and splitting the tubes adjacent to the furrows, we can sow 50% seed and 10% fertilizer into the furrows, hopefully minimizing nutrient run off and still allowing some crop growth to compete with weeds. We can also block one of the two main seed tubes, so that crops like beans can be sown on 40cm spacing.

COLLECTOR DRAINS

Because the collector drains are designed with the lower grades, many of our slopes were .1% or less, and shallow pooling occurring. In conjunction with DPI, we established laser graded, gravel covered slotted pipes, in the bottom of the collector drains. These very effectively dry the main drains after rainfall events. When the furrows are trafficked following rain, we now no longer form deeper and deeper wheel marks across the collector drains. Cost at about $10 / lineal metre is a bit expensive, but probably worth it long term.

MONITORING

Several soil pits have been dug in the last few years, with interesting results. Compared to long term improved perennial pasture, soil bulk densities have improved from 1.2gms/cc to .9gms/cc after four years in beds. Two year old beds are in between, so it appears that the soil structure is improving each year. Penetration in dry soil is now possible to 50cm and root growth at depth is correspondingly better. Moisture content at various depths measured by tensiometer, tends to show that roots are accessing more moisture at depth under beds, than on the flat. In summer there is now no hard compacted layer between 100-300mm. Our cracking self mulching soils don't tend to have a permanent hard pan when wet.

STILL TO IMPROVE

Harvest indices are very low, .3-.4, We might grow 4.5t wheat/ha and leave 9t straw/ha although usually a little better. We put nitrogen out at GS 32 and try to manipulate the canopy, grow fungal disease resistant varieties etc. Stubble handling without burning is difficult in high rainfall areas where phytotoxicity, slugs and ground larks are all, as yet, unsolved problems. Microbe application is showing some promise. Grazing of barley stubbles thus treated are preferentially grazed, with stock maintaining condition well. Wheat stubble plus mineral mix including 6% urea, was thinned right out. However, straw falling into the furrows becomes a problem, filling them. We use a lister bar with grader blades set high to deepen furrows, the blades preventing spillage back into the furrow. A chopper on the header means we can direct seed without too many problems into canola and pulse stubbles. In the future, land grading may be advantageous in removing the less than perfect drainage of low spots. Initially, it was more economical to get a high percentage of the land drained as cheaply as possible.

CONCLUSION

While the installation of raised beds has meant an incidental application of controlled traffic, the improvement in soil structure in the beds, as compared to the turning lands, where water logging has also been minimized, indicate that traffic has a serious deleterious affect on soil structure, and hence root penetration and plant growth.

Some rules; don't take short cuts in establishment, plan well using topographical maps. If the slopes allow, run beds north-south to even sunlight distribution, keeping in mind that the lower flows should be on the steeper slopes. Rip deep enough to establish 200mm high beds after settling. This allows for free board if grades aren't perfect, and shallow water pools in furrows. On low grades collector drains are much better with underground drains installed. Dams to collect run off, and even out peak flows when this discharges to public land, makes authorities happy.

Murdeduke – Raised beds and CTF

Bruce Willson, Winchelsea, Vic

INTRODUCTION

Bruce's father bought the original farm block in the 1960's, which was then later split in the mid 1970's. With attention to detail and an open mind to new idea's Bruce has led a successful farming operation for a number of years.

Bruce and Judy Wilson own the 3000 hectare property "Murdeduke" and manage a further 1500 hectares in the high rainfall zone of south-west Victoria, near Winchelsea. In partnership with their son Lachie they manage a mix of enterprises (60% cropping and 40% livestock) including:

- 2600 hectare cropping system with a typical rotation of canola, wheat, barley, and on the odd occasion field peas on well drained soils.
- 200 stud Angus cows and 450 commercial Angus cows, with an extensive Embryo Transfer operation
- 3000 first cross ewes prime lambs
- 2000 wethers, with numbers reducing to increase prime lamb production
- 170 hectares of lucerne – providing excellent gross margins from prime lambs and great for drying the subsoil profile
- 1500 sows run on three 40ha units in the crop rotation, run as a separate business 'Pastoral Pork'

The country ranges from well drained rolling lunette's to flat swampy country. Lunettes represent the deposition sites of wind blown sands and clays from swamps and lakes. The soils on the lunette's are dominantly highly fertile deep black self-mulching sandy clays over a deep cracking clay. The majority of the lower lying soils are gradational self-mulching black clays (Vertosols), which are often sodic at depth.

The introduction of raised bed farming has revolutionised their lives and has allowed them to expand their cropping system to paddocks, which would otherwise lay waterlogged in any average season. Success has been experienced with the beds allowing the Wilson's to expand their farming operation through leasing and purchasing new land.

Raised bed farming and potentially controlled traffic farming on the already well-drained paddocks are two positive leaps towards a sustainable, profitable farming system. However Bruce and Lachie are keen to take management to the next level, this is where precision agriculture can play a role. The understanding of within paddock variability, in combination with current best management practices, should offer the ability of achieving maximum potential gross margins/hectare and simultaneously minimise environmental impacts.

RAISED BEDS

- Always considered the lunette paddocks to be like 'one big raised bed'
- 1200ha 2m wide raised beds
- Knife points and press wheels for depth control improve plant distribution and crop establishment.
- Interested in determining ideal press wheel pressures. How should it vary with soil moisture?
- Beds lead to rapid soil improvements in just one year. Heavy sodic clays converted to friable healthy workable soil in year 1, and this happens every time! The soil structure improves due to

the removal of waterlogging and wheeled compaction and thus the soil health improves through more organic matter and more frequent wetting and drying cycles.

- Gradually reinstalling beds with the autosteer to eliminate the problem of uneven bed widths, which cause trouble particularly at sowing.
- Beds improve water infiltration rates and crops achieve higher water use efficiencies. These factors limit the amount of run-off from raised beds.
- The next step is to improve the design of main collector drains which run perpendicular to the furrows

CTF

- 1400ha CTF (2005 is the first season)
- 24m tram tracks for spraying and spreading
- Two 8m Gyral planters both designed to sow beds and flat
- CAT header on 4m wheel centres to fit raised beds. Where to next?
- Working up and down the slope where possible, otherwise work east west to minimise wind damage to canola windrows.
- Early stages and will evolve over time.
- Where do livestock fit? A proportion of the country is rocky basalt unable to be cleared. A National Landcare Program funded project 'Grain and Graze' has five integrated projects to help mixed grazing and cropping farmers increase profits and enhance the environment – stubble management, lucerne on beds, integrated pest management, native grasslands and pastures on beds.

PADDOCK LAYOUT

- Rocks are a big issue. Have cleared many rocks at great expense, but the return on investment says it is worthwhile. Have crushed some rock piles and will use for internal roads.
- Need to determine CTF design to maximise harvest efficiencies
- Undulating paddocks are difficult to install effective raised beds. May need to laser level.
- Contour maps are critical for determining paddock design for raised beds.

PRECISION AGRICULTURE

- Guidance (2cm RTK GPS-Ag autosteer) has proved it's worth – a fantastic initial investment. Less fatigue, less inputs, and no delays from fog and dust. You know exactly where you are – allows site specific management
- The collaboration of CTF, autosteer and yield monitoring allows for accurate strip trials
- Spatial info includes 5-6yrs yield data, EM surveys, contour maps, aerial photos and satellite imagery.
- Managing spatial data requires technical support. Computer systems include PAM, AgriMaster (financial) and Farm Works.
- Will begin this year to test consistent trends in paddock variability to determine potential for variable rate (VRT). Pig paddocks introduce significant variability, which may be worth managing?
- Yield data is good for identifying large scale differences such as large scale trials such as lime and manure (pig paddock) responses.
- Satellite imagery provides a more intense picture of responses and should be useful for understanding and then managing spatial variability.

SATELLITE IMAGERY

- Purchased IKONOS imagery last year and found it to be valuable. Planning on going again this year.
- Able to gain more benefit from this imagery than from yield maps.
- Reduced the working width of the spreader from 36m to 24m to improve accuracy (avoid visible striping) and to match the CTF system.
- Satellite imagery provides a more intense picture of crop responses and should be useful for understanding and then managing spatial variability.

Bruce Wilson
0417 587 387

The CTF Advantage and the Next Leap

Don Yule et al

These are some pre-conference views, I expect the Conference to shape the future. I believe these views apply to all industries.

We are on a good thing. The simple choice of controlled traffic has had amazing consequences. It applies across industries, it has supported a massive array of improved practices, new technologies and innovative ideas, it has created opportunities across the board. Controlled Traffic Farming is farming systems built on the controlled traffic base, CTF is systemic, comprehensive, strategic and sustainable. We can be confident that CTF is on the right track, that CTF is the way of the future, we can "reach for the sky". Don't be a loner, seek discussion, advice and help.

Be serious about CTF, part of the future is still to get **all** the basics right. Often the early adopters make choices that end up being wrong, and these are difficult to change. My initial change was successful, why keep changing? Why not enjoy? If you stand still, you are going backwards. Use your experience to drive further change.

What is this good thing?

- **Comprehensive Strategic Planning.** What do I want my farm business to look like in 5 years? Review annually.
- **Clear Action Plans to get there**
  - Never compromise on the strategic direction
  - Never take the mediocre option
  - Compromise on actions but understand the implications
  - Don't be afraid to make mistakes, you can repair them.
- **What planning?**
  - Professional farm design
  - Paddock layout
  - Controlled traffic
  - Using CT to make CTF
- **What is comprehensive?**
  - Machinery
  - Resource management
  - Technology
  - Research
  - Productivity
  - Environment
  - Social
  - Economic

The CTF Advantage
CTF growers have been successful. But how many are on controlled traffic? How many are pushing the agronomy? How many have continuous improvement programs?

- **The Machinery advantage.** Match **all wheels**, start with the harvester and associated haul out equipment. Narrow tyres. Match **all** implement and equipment widths, accurate guess rows are critical. When all implements are considered the options become more obvious. Use "standard" dimensions. CTF growers should drive the machinery agenda, demand from manufacturers what you need, don't take what they have. Demand compliance from contractors and share farmers.

- **The Resources advantage.** Top quality soil in a stable landscape. Control of degradation and constraints, improved fertility and soil health, less variability, more options. High input use efficiency. High surface cover is the driver –infiltration, erosion, organic matter, fertility, biology. Controlled traffic makes all these possible, do not compromise on CT. One wheeling is enough and the more your soil improves the more damage one wheeling will do.
- **The Technology advantage.** CTF has developed massively since our last conference in 1998. Much of that is driven by new technology - GPS, auto-steer, GIS, satellite imagery, precision agriculture, zero till and weed control. 2cm guidance is a must. As a transition, hiring 2 cm for marking out of the wheel tracks and basic width is cost effective. A network of base stations is a must, the current duplication is holding back adoption. Use technology as tools for your CTF systems, and use CTF to make the most of these technologies. These technologies will automatically provide your farm records at a scale of a few square metres. CTF growers must drive suppliers towards technology compatibility.
- **The Research advantage.** Basic research methodology is plan, act, measure and review – the same methodology as adult learning and action research. CTF and new technologies mean that your research needs can be achieved by you on your farm. Use trial strips and measure with the automated, spatial technology. Use professional support for research planning, assessment and review. This should be the future role of most scientists, to support your on-farm research. Use the technology to understand the responses – yield monitoring for measuring, imagery for causes, GPS for topography, and GIS for recording, analyzing and reporting.
- **The Productivity advantage.** The singular aim of the cropping program is to turn these CTF advantages into long term, whole farm, annual productivity and dollars. We have barely scratched the surface of what is possible and CTF growers need to collectively drive the Research advantage to identify the potential and to change how science and technology is provided to you. Better soils = new opportunities - high yield, quality and reliability, high value crops. CTF soils are only a few years old and will continue to improve. CTF growers are the best in the pack. Should our best growers on our best soils produce commodity products or niche market products? Commodity products provide an outlet for "seconds" but CTF "firsts" are niche products. What are the niche crop opportunities? Feedlotting with manure spreading makes sense – value adds, reduces nutrient export, recycles organic nutrients, and reduces paddock variability.
- **The Environmental advantage.** Farming like nature. High crop activity, cover and soil quality, low runoff and deep drainage (erosion and salinity), balance between inputs and outputs, improving natural resources, whole farm planning, quantified and recorded performance. CTF supports catchment approaches and catchment authorities are approving CTF.
- **The Marketing advantage**. CTF provides quantity, quality assurance, reliability, variety. If purchasers want product identification, you can provide, through the Technology advantage, the best PI in the World, and you can do it now. Can CTF products be marketed like organic products? There are Marketing advantages that haven't been exploited and this requires cooperative approaches.
- **The Social advantage**. These CTF advantages add up to a Social advantage. CTF systems will improve the lifestyles of farm families and improve the environment of rural communities. The change to CTF has built skills and confidence, the capacity to change more and to tackle big issues. And this leads to continuous improvement. The future needs **cooperation with independence**. IKONOS imagery and shared base stations encourage cooperation. Independence is a strength and driver of innovation but cooperation is needed to drive the machinery agenda, to get agency and service support, to share information, equipment and contractors, and for Marketing advantage. **Farm labour** is a national issue. To compete in the labour market, farms need to be profitable, fun and attractive to your children. The number of young and "next generation" people on CTF farms is a key indicator. **Contracting and share farming** are major issues for all industries. Contractors need to be partnered not tolerated, share farms need to be CTF. CTF systems can cross farm boundaries within catchments to increase efficiency and decrease environmental impacts. CTF growers should drive sensible, catchment wide approaches, effective cooperation and responsible

custodianship of the land. CTF can drive improvement of the standing of farming in the wider community.

- **The Economic advantage**. Higher income, lower unit costs, increased efficiency, higher farm values. Support from financial institutions.

CTF now has a critical mass and we need to use that critical mass to shape the future. I have suggested major opportunities but growers must express the direction and drive the process. This Conference is a place to start and we have created a program to encourage that. We will hold forums to plan future directions and to include annual Conferences to maintain the momentum. We need an initiative to drive CTF improvement and adoption. We need to use the skills and influence of growers at this Conference to manage our bureaucratic world.

CTF has come a long way but is still at the foot of the mountain of opportunity. We must work our way together up the mountain.