Controlled traffic farming in practice

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Key messages

- Controlled traffic farming (CTF) is not a one size fits all approach as growers develop systems to best suit their business.
- CTF is more than just compaction control and it opens the door for many other agronomic opportunities including inter-row or on-row sowing, chaff lining, better trafficability in wet conditions, easier driving and more accurate input placement.
- Adopting CTF in line with your machinery replacement strategy is a good approach: start by developing a plan then select machinery according to your plan.

Aims

This paper presents examples of successful controlled traffic farming in practice from three farm businesses. These examples have been selected as they provide insight into common questions from non-CTF farmers such as how does livestock or hay fit, how can seeders wider than 12m be included, and the benefits of deep ripping and topsoil inclusion plates.

Background

Controlled traffic farming aims to match the operating width and wheel tracks of all cropping machinery to minimise compaction. This allows plant roots better access to water, oxygen and nutrients which increases yield, quality and improves the efficiency of inputs.

A survey of 84 WA growers, completed in 2016 showed 80% had identified soil compaction on their properties. 89% responded they used deep working points to manage compaction but only 39% used deep ripping and 22% CTF. Growers responded that the main limitations to them adopting CTF were machinery incompatibility and financial constraints, others had decided to do nothing. Development of a CTF system is not always simple with some farms needing to adapt machinery for nearly every operation on the farm.

Three case studies are presented here as examples of how CTF can be adopted − including machinery set up, benefits and challenges. The full economic benefit of CTF is difficult to assess as each farm and business structure is unique. Costs and benefits are presented where known. A summary of the machinery configurations for the three businesses are presented in Appendix 1

Results

Scott and Lisa Thompson, Broomehill

“It just makes sense”

Since 2001 Scott Thompson has been selecting machinery to fit his 12m CTF system in line with his machinery replacement schedule. When asked why he adopted CTF Scott will tell you “It just makes sense”.

Scott’s 3:1 machinery matching ratio system was selected to suit his existing sprayer width of 36m. His key machinery upgrades and implementation process include:

- 2001 12.2m (40ft) seeder – John Deere (JD) Air drill on 10 inch row spacing to match their 36m Rogator self-propelled (SP) sprayer.
- 2010 12.2m Macdon D60 Header front for the Caterpillar Lexion 570 standard wheels on 3.2m centres
- 2012 John Deere Real Time Kinematic (RTK) 2cm autosteer system for seeding tractor and a JD 1820 seeder box on 3m centres.
- 2013 Amazone ZGB8200 tug-a-long spreader on 3m centres and traded in the front wheel assist seeding tractor for 335hp JD 8335RT track machine on 3m centres for seeding, spreading and chasing
- 2014 Claas 750 on 3m centre tracks
- 2016 Header auger extension to unload from the tramlines and a JD 4045 sprayer- 36m boom
- 2017 3pt linkage Amazone ZA-TS spreader and a Marshall 820 on 3m centres for lime / gypsum (shares with the neighbour)

Laying down permanent tramlines started in 2012 at seeding with the purchase of the JD RTK autosteer system, eleven years after beginning the CTF process. The seeder leaves a fourteen-inch split row for the tramlines that provided good in-crop guidance for the original sprayer that didn't have global positioning system (GPS) guidance. The sprayer is now a JD 4045-36m boom with RTK autosteer GPS.
Getting common runlines set up for all machines has been challenging as not all paddocks have four straight sides. The seeder runlines have been used as a base for all machines. For the 12m system Scott learnt how to use the adaptive curve function in the GPS to set up the outside laps. For seeding, harvest and spreading lime Scott does three laps around the outside adaptive track and then starts on the up and back run lines. The three outside laps help in irregular shaped paddocks. The sprayer and spreader (36m) do one lap on the outside then start on the run lines. From 2017 onwards, the Thompsons will have high traffic lanes (tramlines used for every operation, often multiple passes for the sprayer) every 36m. Urea was spread previously on 24m with an Amazone tug-a-long spreader on 3m centres. However due to uneven spreading to 36m this is being upgraded to a 3pt linkage Amazone ZA-TS spreader. Scott and the neighbor will share a Marshall 820 on 3m centres for lime/gypsum spreading on 12m.

Compatibility of other machinery to the JD guidance system has been an issue, however Scott is finding new machinery will now accommodate JD into their Canbus for ease of steering so an external Auto Trac™ Universal ATU is not necessary. Using JD Swath pro control with accurately mapped paddock boundaries for most operations is proving a great tool for easier driving. Set run lines and highly accurate repeatable GPS have improved the success of inter-row sowing.

With the equipment for all main cropping operations lined up it is now about fine-tuning the system. In 2016 the header auger was extended by adding a barrel and 1.8m fitted flighting and a longer outlet chute for $7000. This has worked well to allow unloading into the chaser bin operating on the tramlines. This year Scott and a neighbour have brought a Flatrac tramline renovator to share. The hard firm tramlines were definitely a benefit for trafficability in wet conditions in 2016 however ruts up to 10 inches deep can form in the tracks that will require renovation.

Scott has noticed the soils getting softer over time however it is as much about the extra opportunities with CTF as it is for managing compaction. Additional benefits include using an offset hitch at seeding to seed between last year's rows and improved stubble handing, better trafficability on firm tramlines in wet conditions, and using a chaff deck for harvest weed seed control. Scott engineered his own chaff diverters in 2012 that he revised in 2013 after visiting Mark Wandel in 2013 as part of a Northern Agricultural Catchment Council (NACC) funded tour with the North Stirlings Pallinup Natural Resources group.

Every system has its challenges and one Scott sees is fitting livestock in the system. He has noticed water infiltration is worse after summer grazing and the sheep tend to spread weeds. Sheep are a very important part of Scott's business. As a compromise he has reduced stock numbers and manages them with a lower summer grazing density and higher winter grazing density. He will not graze paddocks over summer if he thinks they need a break or are too weedy. Mustering in the ute can be a bit bouncy going over rutted tramlines but in the motorbike it is not really an issue. Sheep graze chaff lines and can spread them although it does vary depending on soil type. They also like camping on the tramlines.

Other challenges Scott has found are having to move fences, water points, and access tracks, purchasing machinery to fit on 3m, uneven spreading, harvesters with one sided augers and getting staff to understand the importance of staying on the tramlines.

Scott is waiting to see the outcome of DAFWA's deep ripping trials he is hosting before including deep ripping into the program. They plan to identify areas to target for deep ripping using the EM38 information already collected across the farm. This information has already been used to variable rate, lime, gypsum and potash.

"Developing a CTF exposes other problems such as tramline renovation, guidance lines, needing to be fussy but is really a paradigm not a problem and makes it all good fun!"

Brian and Tracy McAlpine, Latham

"CTF is now a necessity not a choice"

Brian is a grower who began CTF in 2004, withdrew from the system in 2013 due to a number of reasons, and yet is now looking to come back to CTF again.

Brian McAlpine from Latham first started developing a CTF system in 2004 based on 12.5m. This width was chosen due to having a 12.5m (41ft) Ausplow DBS bar with 10 inch row spacing.

Key machinery purchases and alterations the McAlpines have made developing a CTF system, are as follows:

- 2004 RTK JD Guidance, JD 9760 with 42ft Honey Bee to match existing 12.5m DBS bar.
- 2005 37.5 m Hydraboom with JD 8520 3m cotton reel spacers, another seeding unit 8520, 12.5m DBS bar, JD Airseeder on 3m spacing.

- 2005 JD 9770 Midwest 42ft 3m wheel spacing.
- 2009 Miller Nitro with small home-made extensions to make it 37.5m
- 2013 Went away from 12.5m CTF with purchase of 27.2 m Morris Contour 2 bar.
- 2016 39.3m Case 4430 Patriot (1.4m extensions)

Buying RTK John Deere guidance in 2004 for $22 000 was their first significant investment in establishing a CTF. In 2005 they increased their cropping area and chose to purchase another 12.5m seeding unit to keep everything matching rather than increase the bar size. Using this system together with deep ripping, liming and green manuring the McAlpines saw significant yield gains and was very proud of their soil condition.

Life started to get busy with off-farm commitments in 2011. Facing a combination of challenges including staffing two shifts at seeding and harvest, less time on farm for management and dry seasons highlighting the importance of getting the crop in early, they decided to move away from CTF. They purchased a 27.2m (86ft) Morris C2 bar with a triple bin and a bigger Case Steiger 600hp tractor currently on triples. This reduced financial risk with less machinery management costs per hectare and simplified staff management.

In 2015 travelling around the WA northern grainbelt, Brian saw the research that DAFWA was doing on deeper ripping and topsoil inclusion plates, which was delivering very good yield responses. After visiting other CTF farmers and doing some research into CTF again, Brian came to the conclusion that “CTF is now a necessity not a choice”.

The McAlpines had been regularly deep ripping to 350mm but in recent years the deep ripping program was put on hold due to a series of dry seasons. They have observed their crop yields are plateauing so there was a need to look for the next thing to lift productivity and a return to CTF was seen as one avenue for improvement.

Now cropping 6500ha they are working towards a CTF system of 13.1m. In 2016 they brought a new Case Patriot sprayer extended by 1.4m so it is now 39.3m. There were a few problems with the extension but this is now fixed. They spread urea on 26.2m centres and ammonium sulphate across 13.1m using a 12 tonne Marshall Multi-spreader. Lime is spread across 6-8m immediately prior to deep ripping.

Deep ripping was included back in the program in 2016 using the 6.7m/22ft Gessner ripper brought in 1989. They did fit topsoil inclusion plates behind the tines and used them to rip 2000ha. Conditions were good for topsoil plates at the time of ripping as the topsoil was dry so it flowed well and did leave some better loamier yellow sand at the top. Behind the ripper they used a set of steel ‘Flexicoil’ packers. Brian said they did a pretty good job although the paddock was rougher after using the inclusion plates, but he hopes it will smooth out with time. Unfortunately frost damage in ripped paddocks has meant it was not possible to see any improvements in yield.

The McAlpine’s next priority in establishing the new CTF system is setting up tramlines. The next purchase on the wish list is RTK GPS on the seeding tractor to improve the repeatability. They have been using OmniSTAR HP (10cm accuracy 95% of the time) and have recently upgraded to Trimble Centerpoint® RTX (4cm accuracy 95% of the time), which in 2016 they found it was much more reliable. At this stage the wheel tracks are not fully matched. Further implementation of matching will be considered as machinery is replaced and its efficiency and economic benefit.

Brian is excited about what opportunities the future can bring getting back into soil renovation, deep ripping with topsoil inclusion plates and other on-farm natural resource management improvements. Timeliness of seeding and increasing the depth of the soil profile so plant roots can access more moisture are critical to reduce risk in an increasingly variable rainfall environment.

Faulkner Bros, Beacon

“We have not specifically brought machines for CTF, as they are upgraded we just make sure it fits”

Beacon farmers Ray, Jason and Stuart, started developing a CTF system in 2007. Stuart attended the CTF conference in Perth that year which reaffirmed that the plans the brothers had for implementing CTF and RTK autosteer GPS were going to benefit their farm business.

A couple of years before they had purchased two 18.3m Ausplow DBS seeder (60ft 61 tines) so they decided to base the system on this width which was optimal for their seeding programs efficiency at the time. They also had one 36.6m sprayer and planned to match in the headers when they were due to be upgraded. The following were key machinery upgrades:

- 2007 gpsAg RTK autosteer guidance (2cm) for the seeding tractors
- 2008 traded one 4WD tractor on triples for a Cat Challenger MT865B 520 530 hp, 3m centres with 30 inch tracks
- 2009 traded a second 4WD tractor for Cat Challenger MT865C, traded in the two harvesters with 36ft header fronts for two Case 7088’s with 12.2m fronts
- 2016 brought a Case 7240 fitted with an 18.3m Midwest front, 55m Agrifac SP sprayer
- 2017 planned Case 7240 fitted with an 18.3m Midwest front

The first purchase was RTK autosteer GPS guidance for the seeding tractors. As guidance for other machines, they left bare tramlines by lifting the tines behind the wheel tracks. Bare tramlines have been great for guidance, particularly as the fleet have had a mix of guidance systems that have meant it was challenging to share guidance lines. They are easy to see, the hard road reduces dust during summer spraying and provides better traction when seeding in wet conditions.

In 2016 the Faulkners purchased a Case 7240 fitted with an 18.3m Midwest front. During harvest they found they were able to slow down the machine to 10km/h which significantly reduced fuel use. The second machine, a Case 7230 with a 12.2m front, was working at 14km/h to keep the tonnes per hour similar. The machine with the 18.3m front averaged 5t/hr more for the whole season compared to the 12.2m machine. They plan to get another 18.3m machine for their second header in 2017.

Running a compromised system of 18.3m seeders, 36.6m sprayer and 12.2m headers, the Faulkners overlap the sprayer on the edge to get the sprayer running on the main tramlines. This was the obvious choice as the sprayer has autoswitching on the boom. They only do one headland lap in the sprayer− slowing down to turn at the ends when spraying/seeding. No paddock is perfectly symmetrical so it doesn't really take any extra time overlapping a machine. In 2016 they have purchased a 55m Agrifac SP sprayer that will mean they have a 3:1 matching ratio. Like the harvester, they are hoping a wider sprayer will mean they can slow down from 33km/h to 25km/h reducing dust, fuel use and achieving better coverage.

With all the main machinery operating widths matching and most tracks about 3m centres there are a few machines/operations that are yet to be matched. These include being able to unload into the chaser bin from the tramlines and replacing the dual wheels on the header with tracks. The estimated cost of these modifications such as approximately $70,000 to put tracks on the header was considered too high. Stuart observes "we are not true CTF converts; everything doesn't have to be perfect".

The Faulkner's also run about 4000-5000 head of sheep. They don't find any issues having sheep in the system as long as they reduce grazing to reduce damage on heavier soil types when it's wet. They also run a relatively low stocking rate, which is typical of the area.

The main challenge to the system is weeds in the bare tramlines, particularly barley grass. In 2017, they will put back the tines on the wheel tracks at seeding and run them slightly shallow to get some soil throw for Treflan™ to work effectively.

Other challenges are lime spreading and hay production. Lime spreading is still done at 9.1m widths, so is quite slow. Hay production doesn't fit the CTF system, so they don't worry about CTF for hay paddocks. The Faulkners grow oat hay on their poorer soil types. Oats are mainly used for grazing as a standing crop, but if there is a good break the crop will be taken through to hay or grain.

Faulkners started deep ripping fallow paddocks a few years ago with an Auseeder Easitiller® on 600mm row spacing that they reduced from 12 to 9m. Flexicoil packers are towed behind the ripper. They have been running inclusion plates on the ripper to help incorporate lime that is spread prior to ripping. Ripping to 250-350mm Faulkners have seen a yield increase of about 15%. The brothers have found ripping in spring gives the soil time to settle down reducing plant establishment issues. However they do need to lift the centre of the seeding bar when it is running on the main tramlines as ripping lifts the soil surface making the unripped tramlines deeper increasing the cultivation depth.

The Faulkners believe getting all the traffic in one place with CTF has definitely helped the soils. The heavier soils particularly are quite soft and more friable between tracks. The first year they were fully matched in 2009 it had been a wet harvest the previous season. Old header tracks were very obvious and they could see tracks from the old 'round and round' farming which reaffirmed they were on the right path.

Conclusion

CTF systems are based on common principles of matching farm machinery widths and wheel track centres. Developing a fully matched CTF system is not possible in one year without a large investment, which is unviable for most farm businesses. CTF systems evolve as the businesses upgrade machinery over a number of years. Machinery purchases are made based on each farm's set of circumstances and priorities. Farm businesses with large seeding programs and/or livestock systems will require some compromises to maintain efficiency and economic benefits.

The 'Controlled Traffic Farming' calculator developed by DAFWA's GRDC funded project is a useful tool to help farmers and their consultants make CTF machinery investment decisions. It calculates the percent of the paddock wheeled by different machinery combinations and the estimated benefit of managing compaction.

CTF is more than just improving yield from compaction control. There are significant agronomic opportunities associated with more precise operation of machinery, such as reduced overlap, inter-row seeding, and chaff lining. A

CTF system is never ‘set in stone’ and can be adapted or changed as farm priorities change or new technologies become available.

Useful links

‘Controlled Traffic Farming’ calculator https://grdc.com.au/apps

Controlled Traffic Farming Technical Manual, Northern Agricultural Catchment Council

Key words

Controlled traffic farming, soil compaction, deep ripping, soil renovation, machinery modifications

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Appendix 1

Table 1 Three examples of current CTF systems in WA

Operation	Thompson	McAlpine	Faulkner Bros
Location	Broomehill	Latham	Beacon
GSR rainfall mm	310	221	200-250
Enterprise	2800ha crop and 5500 merinos	6500ha Crop	15-16000ha crop and ~4-5000 sheep
Soil types	gravelly sandy duplex, sandy duplex, loamy duplex, heavier clays (patchy)	Tamma Tussock sandplain, gravel/ironstone ridges, pockets of heavier clays and red loam flats	Heavy salmon and York gum, gimlet, sandy mallee, Wodgil sand
CTF system	12m, 36m, wheel tracks 3m centres	13.1m, 26.2, 39.3m, not specific matching tracks	18.3m and 55m, majority of machines on 3m centres Prior to 2017 12.2m, 36.6m and 18.3m
Seeding	12.2m (40ft) JD Air drill on 10inch rows, JD 1820 seeder box, 9000Lt (6000Lt Treflan™ and 3000Lt Flexi-N) liquid cart, 335hp JD 8335RT track machine, JD RTK autosteer, all machines 3m centres	27.2m (86ft) Morris C2 bar with a triple bin and Case Steiger 600hp tractor currently on triples, Trimble Centerpoint RTX autosteer GPS	2 x 18.3m Ausplow DBS seeders 300mm spacing, Morris tow between aircart on 3m and Cat Challenger 530hp and 570hp tractors on 3 m centres Agleader GPS guidance RTK autosteer
Spraying	Self propelled JD4045, 36m, JD RTK Autosteer	Case Patriot sprayer extended by 1.4m so it is now 39.3m.	JD SP sprayer 36.6m on 3m centres JD guidance Starfire 2, Agrifac SP sprayer 55m 3m centres JD guidance SF6000, Sonic 36.6m Tow behind sprayer pulled by FWA tractor 2.6m centres
Harvest	Claas 750 in 3m centre tracks, 12.2m Macdon D60 header front, JD RTK Autosteer, extended auger to unload into a chaser bin on the tramlines	Case 8240 with dual wheels and a MacDon D65 13.7m front	2 x Case 7240 headers on duals 18.3m Midwest fronts, Agleader GPS RTK guidance Prior to 2017 12.2m header fronts Dunstan 31 tonne Chaser bin on 3m centres with the FWA tractor 2.6m
Spreading	JD 8335RT track machine, JD RTK autosteer, Amazone ZGB8200 tug-a-long spreader – 3m axles 24-36m spreading width. Plan to upgrade to 3pt linkage Amazone ZA TS spreader for UREA and a Marshall 820 spreader on 3m centres for lime/gypsum	12t Marshall spreader-26.2m and 13.1m ammonium sulphate and 6-8m lime prior to ripping	10t Marshall Spreader UREA 36.6m towed by Case Magnum 310 Both on 2.6m centres, planning to change both to 3m Lime spread 9.15m
Other features	Offset hitch seeding between last year’s rows, chaff lining, Flatrac tramline renovator (share with neighbour).	Ripping 450mm with 6.7m/22ft Gessner ripper with Flexicoil packers. Topsoil inclusion plates for sandplain	Bare tramlines, deep ripping Auseeder Easitiller®. 9.1m 600mm spacing with Flexicoil packers and topsoil inclusion plates
Main benefits observed	Softer soils, more efficient paddock working, easier driving, better trafficability in wet conditions, more	Softer soils, able to address compaction and acidity in one pass with deep ripping and	More friable soils, better fuel efficiency, less dust when spraying, better traction in wet conditions, yield increase from

	agronomic opportunities	topsoil slotting	deep ripping and lime incorporation with inclusion plates