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

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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.

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REFERENCES

Blackwell,P.S., Webb,B and Sharma,D. (2003). Tramline Designs for better Weed control and Wheat value from non-spraying tramlines in a dry season. *Agribusiness Crop Updates 2003; Sheridan Hotel, February 2003*, Department of Agriculture WA.

Blackwell,P.S. and Kerkmans,M. (2004). Pre-furrowing after pasture.
Liebe Group Crop Updates 2004; Liebe Group; Buntine, WA, 0896642030

Blackwell,P.S., Ford,R. and Webb,B. (2005). Inter-row deep ripping. *Trial and Demo Reports 2005; Department of Agriculture Western Australia, Geraldton Regional Office*, 0899568555.

Blackwell,P.S. (2005). Very wide wheat rows for shallow soil and dry seasons on the eastern edge of the NAR. *Liebe Group Crop Updates 2005*; Liebe Group; Buntine, WA, 0896642030.