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Demonstrations and grower survey to assess reasons for cross-working and effect on crop production, 2018

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Key messages

- For the growers surveyed, the main reasons for cross ripping were to mitigate uneven plant establishment from wheel track sinkage lines and to break up the tramlines to increase crop area
- Other reasons for cross seeding included; for more uniform seed placement, trash flow management, to stop the bar sinking, stop bogging and to get soil throw to cover spray tracks.
- There was less wheel sinkage with cross ripping than ripping in the same direction as the main traffic.

Background to the activity

Many growers in the northern wheatbelt are 'cross working' – that is seeding or deep ripping at an angle across the direction of their traffic lines even when they have established a controlled traffic system. This activity was developed to better understand the motivations behind this practice and the effects on crop production because cross working almost doubles the percentage of the paddock area that is wheeled in one season increasing the area of the paddock that is compacted. This is counter intuitive to the principles of controlled traffic farming that aims to reduce the area of a paddock wheeled in one season by confining traffic to permanent wheel tracks. Cross ripping involves deep ripping at an angle to the main traffic direction. It could be argued the effect of cross ripping on re-compaction is minimal if the ripping depth is below 450mm as compaction from the tractor is removed. It also busts up the firm wheel tracks that reduce fuel use for other cropping operations. This is not the case with cross seeding which involves seeding at an angle to the main traffic direction. It may or may not be after deep ripping. The potential impact of compaction is greater as the soil is usually moist at seeding and tractor and air-cart are heavy increasing the risk of sub-soil compaction. There is a need to better understand the reasons for cross working and if it is just a short-term fix or are there other more effective way avoid the causes for cross working and minimise the impact of compaction. Cross seeding almost doubles the percentage of the paddock area that is wheeled in one season and therefore, it is a short term fix to some of these problems. There may be other more effective ways that these issues can be addressed to minimise the impact of compaction.

Activity objectives

1. To survey growers in the Geraldton port zone to understand why and how they are cross working.
2. To assess the effect of cross seeding and cross ripping on crop production compared to normal working at two demonstration sites.

Method

1. Survey

Eight growers identified as cross ripping or cross seeding across their traffic lines were surveyed to understand their reasons for doing so and further details of how they go about it. Growers were asked, either face-to-face or via telephone interview, to provide the following information about their cross working practices.

1. Why did you do it…for what potential benefits?
2. What is your ripping (depth)? Is it across or with traffic?
3. Which seeding bar are you using…tow between or tow behind?
4. Accuracy of GPS…yield maps?
5. Cross seeding angle?
6. Soil types?
7. Sowing date and conditions at sowing?
8. Paddock history /rotation?
9. Other constraints to the paddock?
10. Seeding depth?
11. Other comments?

2. Demonstrations

Two farmer demonstration sites were established to monitor crop growth, yield and quality data under cross working compared to working along the traffic lines: (i) Binnu - cross seeding at 30° to traffic lines but ripping in the direction of traffic and (ii) Three Springs - ripping in same direction as traffic versus cross ripping at 30° (see table 1).

Table 1. Demonstration site details

	Binnu	Three Springs
Soil Type	Yellow deep sand	Grey sand over yellow deep sand
Rotation	Wheat 2015, Canola 2016, Wheat 2017, Wheat 2018	Wheat 2015, Barley 2016, Wheat 2017, Barley 2018
Average annual rainfall (mm)	340	370
Average GSR (mm)	250	270
Controlled traffic?	Yes	Yes
Ripping Direction	Straight	Crossed at 30°
Seeding Direction	Crossed at 45°	Straight
Seeding Bar	John Deere 1820	John Deere 1830
Seeding Date	Early May, dry	Late May, wet
Seeding Depth (mm)	25	25

Plant and crop head density were measured prior to harvest, followed by harvest yield and grain quality. Plant biomass was estimated using normalised difference vegetation index (NDVI) using Greenseeker at Binnu on 17 August) and unmanned aerial vehicle (UAV) at Three Springs.

The distribution and sinkage depth of wheel tracks was measured for normal traffic and cross-seeded treatments in August.

Results

1. Survey

Eight growers surveyed were cross working sandy (yellow sands, some heavy sands) sandy loam or red loam soils. Seven of these had a controlled traffic system. Seven were deep ripping at depths ranging from 300mm to 750mm, with five of these cross ripping at an angle of 15 or 30 degrees. One of these growers was also cross seeding (cross seeding at 15 degrees, cross ripping at 30 degrees). Two growers were deep ripping along traffic lines but cross seeding at 45 or 3-5 degrees.

The reasons why the surveyed growers were cross working are listed in table 2.

Table 2. Reasons for cross working identified in the grower survey. (Numbers represent number of growers identifying a particular reason)

Why cross work	Ripping	Seeding	Total
Trash flow management	0	1	1
Break up tramlines - nothing grows	2	0	2
Disadvantage to headlands	0	1	1
Get rid of wheel tracks	1	0	1
Level the paddock wheel track sinkage causes uneven plant establishment	3	0	3
Stop bar sinking	0	1	1
Stop bogging	0	1	1
To get more uniform seed placement	0	1	1
To get soil throw to incorporate trifluralin (on sand)	0	1	1
To stop machine falling into rip line	1	0	1
Total	**7**	**6**	**13**

NB: While eight growers participated in the survey, some had more than one reason for cross seeding/ripping.

The most common reasons for cross ripping were to level the paddock after ripping as wheel track sinkage causes uneven plant establishment (3/7) and to break up the tramlines because nothing grows in them (2/7). Other reasons included getting rid of wheel tracks and stopping the machine falling into the rip line.

Reasons for cross seeding were varied and included: to get more uniform seed placement, trash flow management, stop the bar sinking, stop bogging, to get soil throw to incorporate trifluralin (because the soil doesn't throw into the tramline).
Growers also identified disadvantages of cross seeding: ‘doubles the area of the paddock that is wheeled in one season’ and ‘may still to use track renovators to level wheel tracks and ruts’. A disadvantage of cross ripping was that there is ‘still some wheel track sinkage’.

2. Demonstrations

Monthly rainfall records at DPIRD weather stations near the demonstration sites show high summer rainfall (decile 8 and 7) followed by deciles 4 and 7 growing season rainfall for Binnu and Three Springs, respectively, after a May break (table 3). The annual rainfall at the weather stations is similar to that recorded on farm at each site.

Table 3. 2018 Monthly, growing season (GSR) and annual rainfall (mm) at DPIRD weather stations close to the demonstration sites.

Sites	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	GSR	Ann
Binnu (BI)	62	0	8	1	22	49	80	56	13	12	0	21	220	324

Three Springs (TS001)	85	0	0	0	42	51	105	67	14	8	4	0	279	376

At the Binnu site there appeared to be little difference in plant establishment and plant biomass (NDVI) between the normal traffic and cross-seeded treatments (table 4) but there was more sinkage from traffic on the cross-seeded side (figure 2), and this may have reduced potential yield due to extra wheeling.

In comparison, at Three Springs there was better plant establishment on the cross-ripped treatment and much less sinkage (table 4).

Table 4. Plant and head density, grain quality, yields and depth of sinkage tracks for normal traffic seeding and cross-seeding

	Binnu		Three Springs	
	Normal	Cross Seeded	Normal	Cross Ripped
Plants/m²	83	85	67	73
Heads/m²	263	225	-	-
Protein %	10.1	9.4	-	-
Yield kg/ha	3367	2819	-	-
NDVI*	0.49	0.43	0.63	0.46
Sinkage Main Tracks	8.5cm	11cm	11.5cm	5cm
Sinkage Small Tracks	2cm	6.5cm	8cm	3.8cm

*Binnu: 17 August 2018, Greenseeker; Three Springs: 4 October 2018, UAV

NDVI however was higher in the normal traffic than the cross-ripped side of the paddock indicating a higher yield potential. The difference in NDVI may have been due to a soil type effect as a high resolution drone image showed the cross ripped measurements were taken in a lower biomass zone (i.e possibly lower yielding soil type) (Figure 1). Overall the cross-ripped treatment looked more flat and well distributed whereas the normal treatment looked bumpy, soft, and with gaps in barley establishment. The 3cm resolution did highlight an interesting effect of the deep ripper that had offset shallow leading tines. The front row of tines ripped 30cm deep and the back row of tines at 60cm. The NDVI imagery indicated lower biomass in the shallow ripped lines than the deeper ripped, suggesting a higher yield potential. Unfortunately, the demonstration was harvested before harvest measurements could be taken.

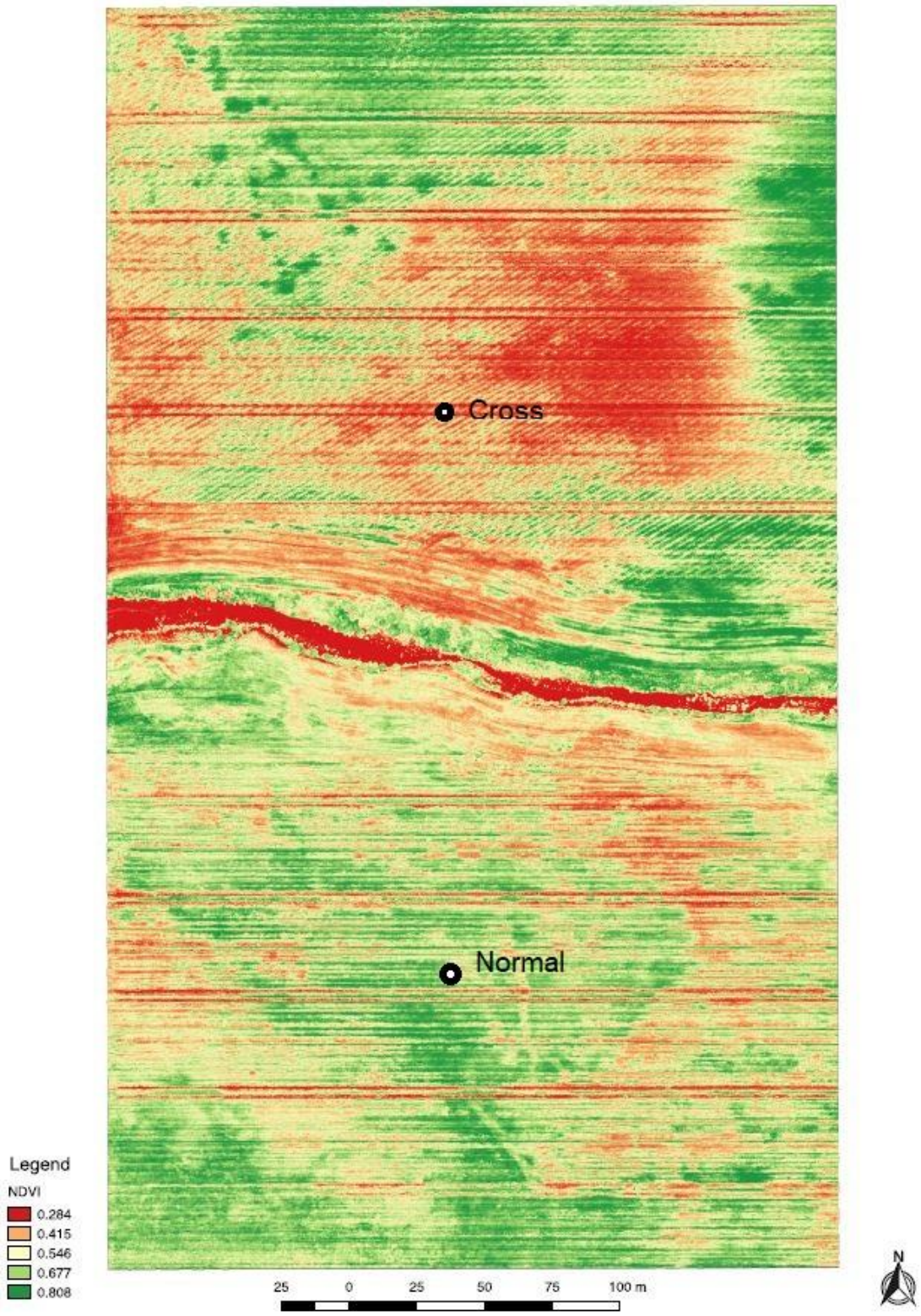

Figure 1. NDVI map using UAV of Three Springs demonstration site of cross ripped (top) versus ripping in the normal traffic direction (bottom)

The sinkage depth of wheel tracks at each demonstration site was estimated and is illustrated in figure 2.

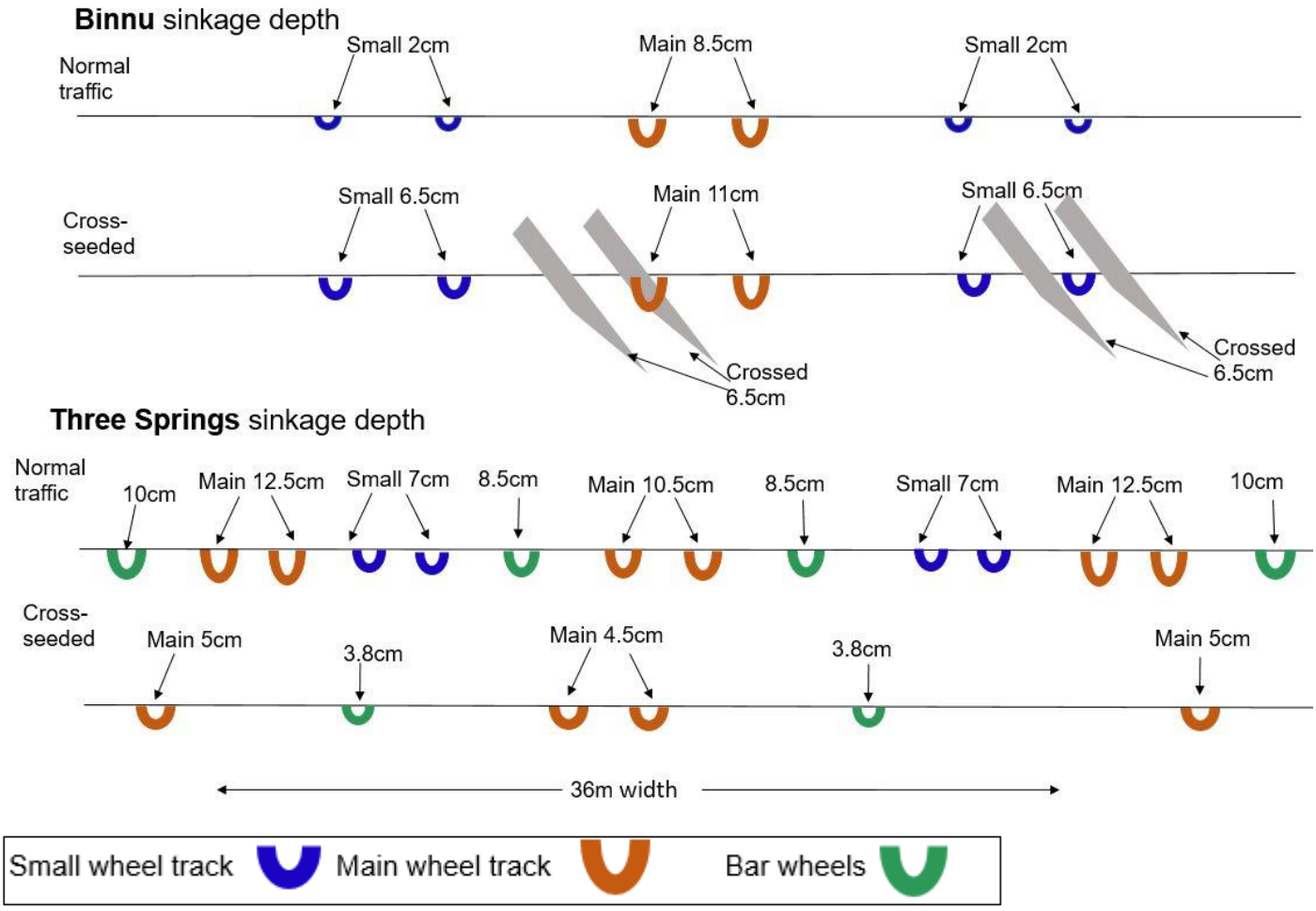

Figure 2. Sinkage depths measured for normal traffic and cross-working treatment at Binnu (cross seeded) and Three Springs (cross ripped) demonstration sites

Yields in the main wheel and small wheel strips were compared to the average for both normal traffic and cross-seeded treatments at Binnu. The yield penalty in the main wheel tracks was much greater than the small wheel tracks irrespective of treatment. There was less sinkage in the small wheel tracks than main wheel tracks, therefore less compaction and less yield penalty irrespective of soil type

Table 6. Yield reduction effect of wheel track on yield for normal traffic versus and cross worked at Binnu site.

Traffic direction, wheel track	Yield penalty (%)
Normal, main wheel	78
Normal, small wheel	37
Cross, main wheel	84
Cross, small wheel	46

Conclusions

Survey

A summary of growers' perceptions of the benefits of cross working identified in the survey and some disadvantages are shown in table 5.

Table 5. Benefits and disadvantages of cross seeding and cross ripping

	Cross seeding	Cross ripping
Benefits	• Improved seed placement • Less bogging issues • Less dragging of seeding bar • Improved trash flow management, great for getting through dense stubble loads • Better incorporation of treflan as soil doesn't throw much in the tramlines	• Improved seed placement • Flattens wheel tracks and ruts, allowing better seed placement again • Reduces wheel sinkage • Is more aggressive than track renovator machines, and better at renovating tracks • Tyres and machines falling less into ruts and rip lines • Reduces fuel consumption • Bust out wide tramlines where the crop won't grow (to increase crop growing area again) • If the paddock has already been deep ripped it creates diagonal water pathways, which compliment straight furrow pathways, and breaks out new ground • Don't have to remove wheel track tynes (leave all tynes in) • Cross rip after seeding lupins wet, only a 10% reduction in establishment
Disadvantages	• May still need to use track renovators to level wheel tracks and ruts • Doubles the area of the paddock wheeled in one season	• Still some wheel track sinkage

Demonstrations

The wheel track sinkage observations support the reasons farmers are giving for cross ripping, that there is less wheel sinkage of traffic. This can be explained by the unbroken zones between the ripping tines which are holding the machinery up. In contrast, when travelling in the same direction as the main traffic, there are observations that if the machine drifts off the main tramlines the wheels can fall into the soft rip-line and sink.

At these demonstration sites there was no clear benefit of cross working on plant establishment, contrary to one of the reasons given for cross seeding. Further investigations of where growers are seeing this benefit would be helpful to determine the soil properties and agronomic practices where this is being observed (e.g. on non-wetting soils there can be more even establishment with cross seeding).

The yield measurements are inconclusive due to soil type variation at Three Springs (different yield potential); therefore further research is required to quantify whether there is actually a yield difference attributable to direction of working.

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