Annual Results Report Template

2019
Annual Results Report
Ripper Gauge demonstration sites- Albany port zone

Project code:	PROC-9176109
Prepared by:	Emma Russell
	emma.russell@scfarmers.org.au
	Stirlings to Coast Farmers Inc.
	ceo@scfarmers.org.au
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REPORT SENSITIVITY

Does the report have any of the following sensitivities?

Intended for journal publication	NO
Results are incomplete	2019 results only
Commercial/IP concerns	NO
Embargo date	NO

KEY MESSAGES

- All soil amelioration treatments improved grain yields or were statistically equivalent to the untreated controls (UTC) at the Ripper gauge sites in the Albany PZ in 2019
- It is likely that compaction is not an issue at the Tenterden and Darkan demonstration sites due to the higher percentage of gravel content., therefore the soil amelioration is not showing any improvement in yield.
- Re compaction and environmental conditions heavily impacted the Kojoneerup site in 2019, controlled traffic farming is imperative to protect the benefits of deep ripping in the future.
- The APZ experienced a dry start and finish to the growing season in 2019. These environmental conditions likely impacted the final yield results for two of the four trials.

SUMMARY

- **Tenterden**: There were no statistical increases in yield from any tillage treatments compared to the untreated control
- **Kojoneerup:** There were no significant improvements in yield from any soil amelioration treatments over the untreated control.
- **Darkan:** There were no significant improvements in grain yield from any of the tillage treatments compared to the nil treatment. On average, the control had the highest yield in the 2019 demonstration.
- **Broomehill:** Three of the four tillage treatments yielded significantly higher than the untreated control.

BACKGROUND

Soil amelioration is a key part of farming systems in Western Australia to overcome soil constraints, which limit crop yields. The removal of soil constraints such as compaction and water repellence through strategic tillage practices usually leads to increases in crop yield in successive years. One of the limitations of deep tillage is that the amelioration of compaction is not permanent, and the soil can re-compact even deeper in the profile following these practices.

Currently, the solution is to repeat deep ripping or other ploughing treatments every few years, with the time between tillage operations dependant on the soil type and amount of wheeled traffic on the paddock. This is a costly and repetitive process that may become unsustainable in the long term if soils become compacted to greater depths with successive tillage treatments and heavier machinery. While there is a large network of demonstration sites established across the port zones in WA, there are many soil types where the benefit and longevity of soil amelioration practices are unknown. The use of controlled traffic practices can be implemented to increase the longevity of soil amelioration practices by reducing soil compaction from farm machinery. However, the implementation of controlled traffic farming has been slow in the Albany port zone, especially in comparison to farmers in the Geraldton and Esperance port zones.

OBJECTIVES

Growers in the Albany port zone will use the 'Ripper Gauge' demonstration sites to increase knowledge and adoption of deep ripping and controlled traffic farming for alleviation of non-wetting soils, compaction, and waterlogging on their soil types and farming systems.

METHODS

Three ripping trial sites were established in 2018 in the Albany port zone on distinct soil types. A fourth trial site was established in Tenterden in 2019 to replace the site at Tambellup that was abandoned due to poor crop growth in 2018. Ripping at this site was extremely difficult in 2018 due to the dry summer conditions and high soil strength. This amendment was approved by the GRDC.

Table 1. Trial locations, hosts, crop and soil type, and treatment types

Location	Host	Soil type	Crop	Sowing date	Treatment date	Treatments
Kojaneerup	Josh Goad	Sandplain over gravel	Mako Canola	28th April. 2019	20th March 2018	Tilco 40cm Tilco 65cm Depthcharger 40cm Depthcharger 50cm Nil Scarifier 20cm
Tenterden	Lindsay Watterson	Gravelly loam	Planet Barley	1st May 2019	4th April 2018	Plozza Plough Horsch Tiger Ripper Shallow disc Control
Broomehill	Craig Bignell	Gravelly duplex	Scepter Wheat	22nd May 2019	15th Feb 2018	MBP & rip control "deep" rip Plozza & rip Plozza
Darkan	Paul Duffield	Non wetting Gravel	Planet Barley	6th June 2019	22nd March 2018	Depth Charger Mouldboard Terraland Nil

Trial demonstrations included different ripping treatments at Tenterden (4), Darkan (4), Broomehill (5), and Kojaneerup (6) table 1. Each trial had at least two replicates, which allowed us to conduct statistical analyses on each site. Base line measurements of soil fertility were completed prior to seeding in the initial year at all trial sites. Soil breakout profile of soils was also collected from each trial a week after soil amelioration was completed to determine the degree of soil loosening from mechanical amelioration. Pre-season soil testing was carried out at the three 2018 established trials prior to seeding in 2019 (Tenterden site).

Measurements were taken were taken during the growing season, which included NDVI readings, plant counts, soil strength (at field capacity), and grain yield. The yield data were analysed using ARM software for statistical analysis.

We are continuing to ascertain the costs of soil amelioration per hectare for each machine through talking to farmers and contractors that are familiar with each machine over a range of soil conditions and types. We are currently using the farmer experience to estimate the accurate costing of each

machine and working depth. This information will be available to publish in the final trial report in 2021.

The trial demonstrations will continue to be monitored in 2020 to measure the medium-term costs and benefits of each tillage operation. We will monitor the effects on soil compaction and grain yield over time at each of the four demonstration sites.

LOCATION

NOTE: Where field trials have been conducted, please include location details: Latitude and Longitude, or nearest town, using the table below (please add additional rows as required):

Table 1: Summarises the location of the three Ripper gauge trial demonstrations established in the Albany Port Zone in 2018.

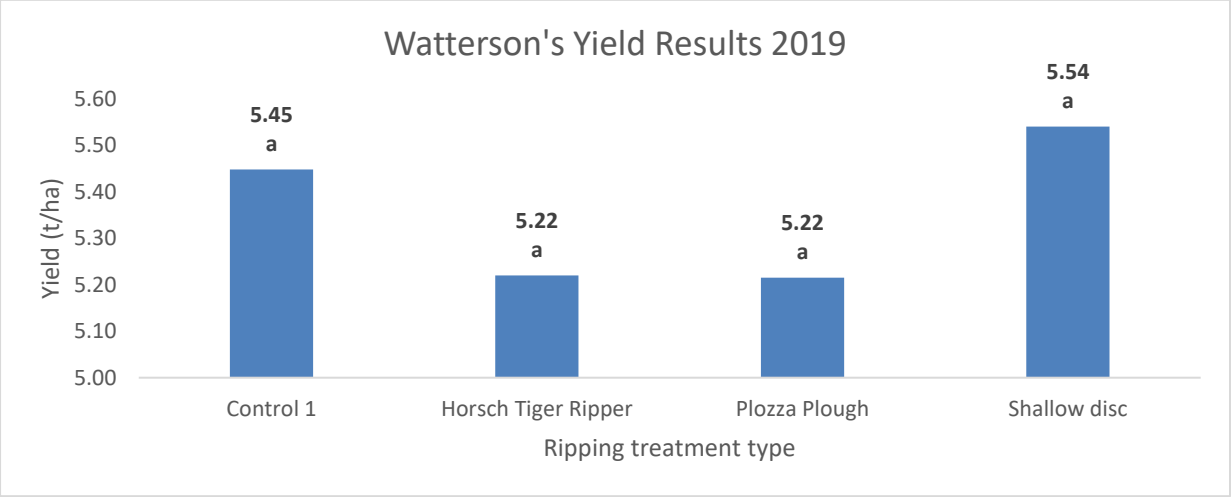
	Latitude (decimal degrees)	Longitude (decimal degrees)
Trial Site #1	-34.511306°	118.331189°
Nearest Town	**Kojaneerup**	
Trial Site #2	-34.25'30.45°	117.25'11.80°
Nearest Town	**Tenterden**	
Trial Site #3	-33.849625°	117.717228°
Nearest Town	**Broomehill**	
Trial Site #3	-33.272609°	116.632916°
Nearest Town	**Darkan**	

If the research results are applicable to a specific GRDC region/s (e.g., North/South/West) or GRDC Agro-Ecological Zone/s, please indicate which in the table below:

Research	Benefiting GRDC Region (can select up to three regions)	Benefiting GRDC Agro-Ecological Zone (see link: http://www.grdc.com.au/About-Us/GRDC-Agroecological-Zones) for guidance about AE-Zone locations	
Ripper Gauge	Western Region Choose an item. Choose an item.	☐ Qld Central ☐ NSW NE/Qld SE ☐ NSW Vic Slopes ☐ Tas Grain ☐ SA as-Lower Yorke Eyre ☐ WA Northern ☐ WA Eastern ☒ WA Mallee	☐ NSW Central ☐ NSW NW/Qld SW ☐ Vic High Rainfall ☐ SA Vic Mallee ☐ SA Vic Bordertown-Wimmera ☐ WA Central ☒ WA Sandplain

RESULTS

Tenterden



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

Figure 1. 2019 Ripper gauge site located on the Watterson family farm in Tenterden, WA. This graph displays 2019 barley grain yields in t/ha over the length of the plots

Treatment	Protein %	Screenings %	Specific Wt kg/hL	Moisture %	Colour
Control	11.3 a	19.2 a	58.4 a	10.1 a	57.0 b
Horsch Tiger Ripper	12.5 a	16.4 a	60.4 a	10.2 a	58.0 a
Plozza Plough	12.1 a	13.9 a	61.1 a	10.2 a	58.0 a
Shallow disc	11.3 a	16.4 a	59.7 a	10.1 a	57.0 b

Table 1. Displays the average grain quality results for the 2019 Tenterden ripping trial. Although not statistically different, the two most aggressive ripping treatments resulted in higher grain protein.

Tenterden Summary

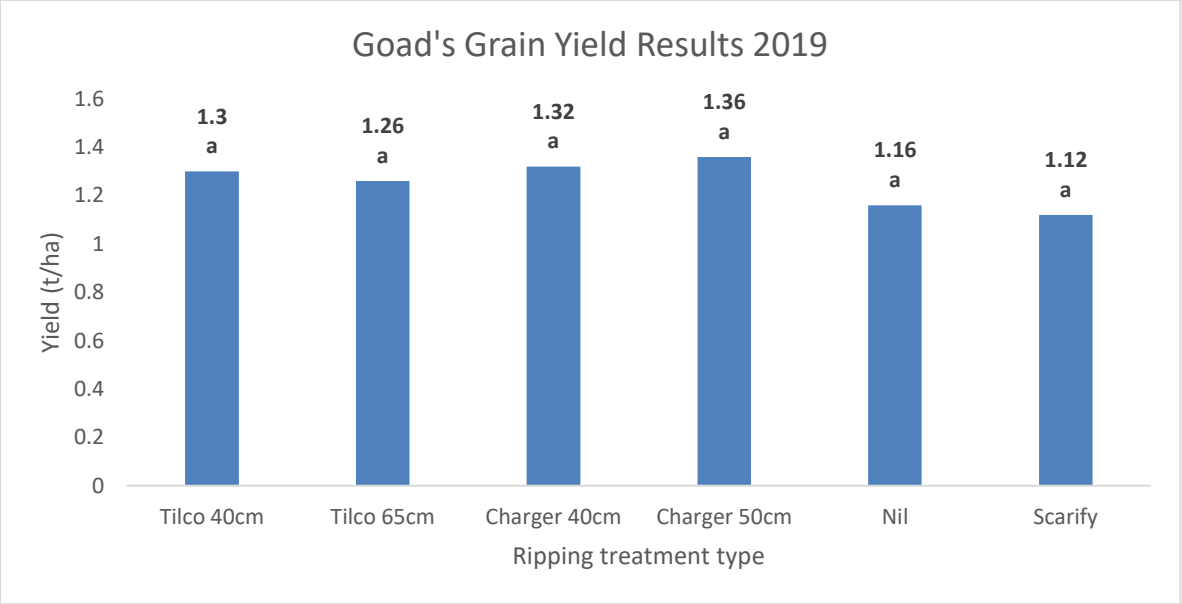
- Yields indicate no significant improvements in grain yield from any of the tillage treatments compared to the nil treatment Figure1.
- The aim of this trial was to investigate if deep ripping would help alleviate non wetting constraints on a non-wetting gravel soil type that was probably not compacted. The rainfall for Tenterden was 433mm (median rainfall (480mm). Despite a dry start to the growing season, non-wetting did not appear to be a significant problem in 2019.
- The paddock selected has only had 3 years of cropping history, and before that was in pasture for 4 years. The low cropping intensity in the paddock combined with a high gravel content (>50%) in the B horizon suggests compaction is less likely to be yield constraining. A soil pit, viewed as part of a field walk in 2019, showed plant roots reaching deep into the soil profile. 'At high gravel levels, we don't expect much compaction to occur in the subsoil under machinery' (per comms Jeremy Lemon DPIRD).

- Despite bringing up clay and orange sandy soil with the Plozza plough, there was discussion at a field day, on September 5, that we did not till deep enough into the soil profile to maximise soil mixing. These were the opinions of soils expert Wayne Pluske.

- Prior to seeding in 2020, soil from each treatment will be collected to perform molarity testing to evaluate the level of non-wetting in each treatment. Molarity testing was not part of the original protocol, but SCF believes this would be a valuable measurement at this demonstration site.

- Although not statistically different, the two more aggressive ripping treatments resulted in higher protein Table 1. Tillage oxidises organic matter releasing the carbon and associated nutrients, including N. Higher N usually leads to higher grain protein levels. Yield appears to have reached rainfall yield potential, so therefore no room for higher yields from extra N. Protein percentage by treatment in the trial is in the same order as the intensity of tillage. The protein column is significant at 10%, although not at 5%.

Kojoneerup



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

Figure 3. Ripper gauge site located on the Goad family farm in Kojaneerup WA. This graph displays 2019 canola yields in (t/ha) over the whole length of the plots

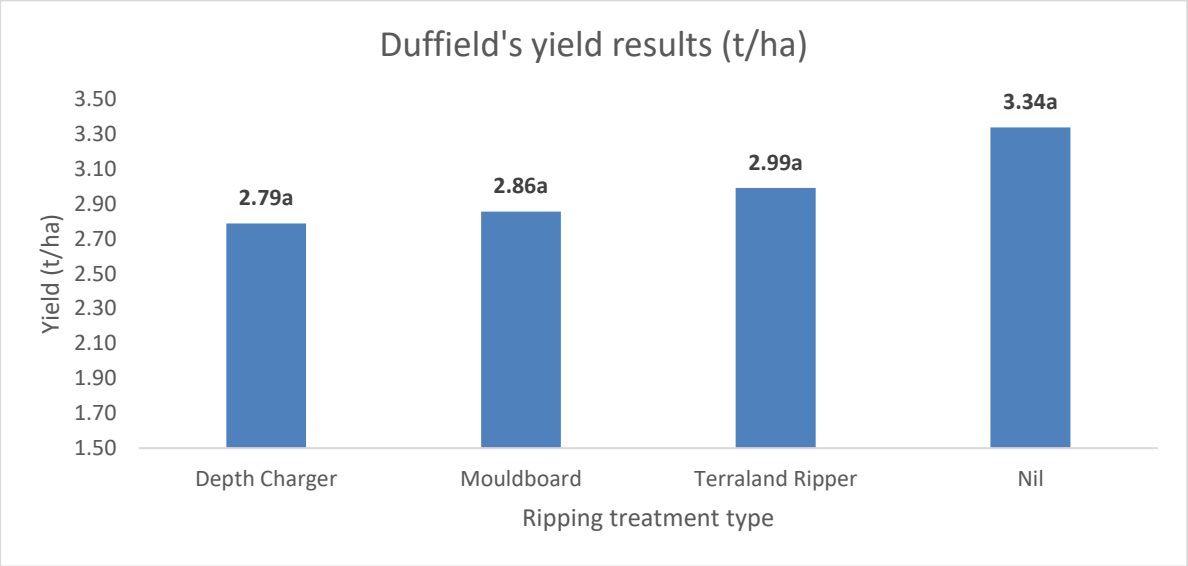
Table 2. Displays the average NDVI readings from June 6, July 15, and August 2, at the Kojaneerup (Goad) Ripper Gauge demonstration site in 2019. The average plant counts per metre squared were also recorded on July 15.

Number	Treatment	Ave NDVI June 6	Ave NDVI July 15	Ave NDVI August 2	Average Plant m/2
1	Tilco 40cm	0.32	0.59	0.62	27
2	Tilco 65cm	0.25	0.58	0.73	27
3	Depthcharger 40cm	0.32	0.59	0.59	28
4	Depthcharger 50cm	0.26	0.59	0.64	22
5	Nil	0.33	0.57	0.60	27
6	Scarifier 20cm	0.30	0.55	0.59	31

Kojaneerup Summary

- Graphs show there are no significant improvements in grain yield from any of the tillage treatments compared to the nil treatment in 2019 Figure 3.
- There were no statistical differences in any treatments for either of the NDVI data sets or the plant counts (per m^2) that were collected.
- The wind erosion that occurred after deep ripping was implemented in 2018 affected the trial in 2019. The 2018 wind erosion caused delays in emergence, which left bare patched within the trial. It is going to be important for the future to protect the soil surface that has been impacted by wind erosion. Claying is a great option for sand plains, though a costly option, if done correctly, will give long term benefits of controlling wind erosion as well as reducing water repellence and improve water and nutrient holding capacity.
- A hail event on October 31 heavily impacted the trial. The grower received a 26% hail loss claim from his insurance company, on the trial paddock.
- The Goads are not currently on CTF. The heavy machinery that has been driven over the trial in the last two years has likely recompacted the ripping site and reversed any of the initial benefits gained from the ripping. If renovating paddock with mechanical amelioration, it is worth implementing a CTF system within the farming enterprise to increase the longevity of soil renovation benefits (Isbister et al.). The cost of ripping after a few years negates any yield gains seen in the initial years.
- With the wind erosion in 2018 and hail damage in 2019, it was more difficult to assess potential grain yield differences between the different treatments applied in 2018.

Darkan – Planet Barley



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

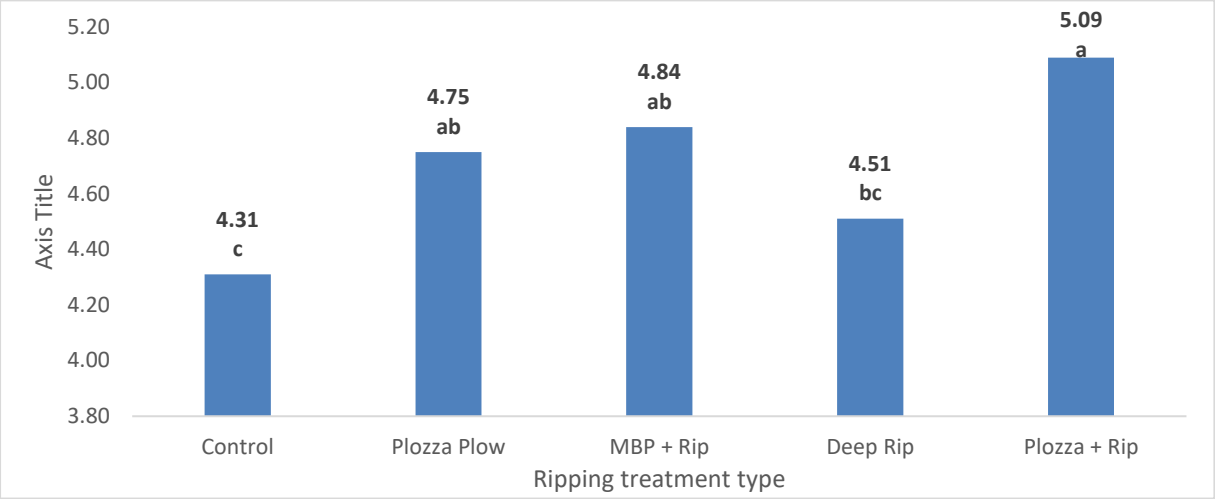
Figure 4. Ripper gauge site located on the Duffield family farm in Darkan WA. This graph displays the average 2019 Planet barley yields in (t/ha) over the whole length of the plots

Table 3. Summary of the Normal Different Vegetation Index (NDVI) readings from July 30, August 20, and September 20, at the Darkan (Duffield)) Ripper Gauge demonstration site in 2019.

Treatment	Ave NDVI July 30	Ave NDVI Aug 20	Ave NDVI Sept 20
Depth Charger	0.35	0.48	0.63
Mouldboard	0.23	0.36	0.57
Terraland	0.31	0.47	0.67
Nil	0.27	0.55	0.65

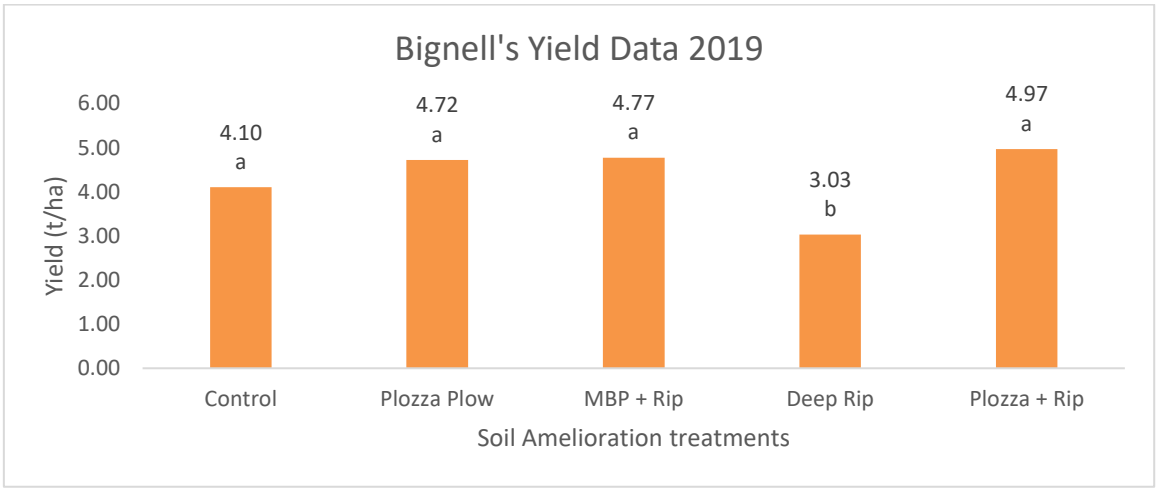
- Graphs show there are no significant improvements in grain yield from any of the tillage treatments compared to the nil treatment in 2019
- The control had the highest yield recorded within the trial compared to the ripping treatments
- The Mouldboard treatment was extremely patchy with poor plant germination. This was similar to 2018 because the Mouldboard plough treatment was not ‘smoothed over’ with an additional implement to assist seed placement.
- Lure H_2O was placed down the tyne at seeding across all treatments to help alleviate non-wetting issues on the forest gravel soil in 2019.

Broomehill – Scepter wheat



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

Figure 5. Ripper gauge site located on the Bignell's Farm in Broomehill WA. This graph displays the average 2019 Scepter Wheat yields in (t/ha) with the plots cut to equal lengths.



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

Figure 6. Ripper gauge site located on the Bignell's Farm in Broomehill WA. This graph displays the average 2019 Scepter Wheat yields in (t/ha) with varying plot lengths that cover distinctly different soil types within trial plots.

Table 4. Summary of the Normal Different Vegetation Index (NDVI) readings from August 2, August 19, and September 19, at the Darkan (Duffield),) Ripper Gauge demonstration site in 2019.

Treatment	Ave NDVI Aug 2	Ave NDVI Aug 19	Ave NDVI Sept 19
MBP & rip	0.38	0.50	0.69
control	0.43	0.49	0.70
"deep" rip	0.38	0.53	0.71
Plozza & rip	0.44	0.57	0.72
Plozza	0.41	0.56	0.70

- Three of the four amelioration treatments yielded significantly higher than the untreated control. The Deep Rip treatment yield 200kg more than the control but was not significantly different from the control Fig 5.

- The Plozza + Ripping Treatment yielded significantly higher than the control and deep ripping treatment (580kg over the Deep rip). The Plozza Plough, Mouldboard + Deep Rip, and the Deep rip were statistically equivalent to each other, Fig 5.

- The trial was harvested by collecting yield from the entire length of each plot. However, the trial layout shows there are long plots and short plots within the trial due to soil amelioration stopping halfway through the paddock because of soil type changes. *Appendix 2.*

- The first nine treatments run the full length of the paddock 0.9ha while the remaining 6 plots run halfway along the paddock (0.5ha). The southern end of the long plots shows how the soil type changes dramatically. The soil type at the southern end is a lighter, sandy soil. This impacts yield and reduces the overall plot yield (t/ha) averages.

- Analysis of the yields in comparison to the plot lengths show variation that does not appear to be due to the treatment effects alone. For example, the deep ripping (only) average yield was 3.03t/ha (fig 6), with the replicates consisting of (2 long plots and one short). The 'new' yield, after the plots were restricted to the same soil type, was 4.51 t/ha (fig 5); which equated to a 1.48t/ha difference for 'supposedly' the same treatment.

- For this reason, we analysed the yield data based on shorter plots lengths from the same soil type to ensure a more robust analysis of each tillage treatment compared to the control.

- There were no statistical differences in any treatments for either of the NDVI data sets or the plant counts (per m^2) that were collected in Table 4.

CONCLUSIONS

The Kojoneerup, Tenterden, and Darkan grain yields from all tillage treatments were equal to the untreated control in 2019. The Broomehill site results show there a significant increase in yield in three of the four tillage treatments compared to the untreated control.

The three different tillage treatments at the Broomehill site were aggressive 'mixing' type treatments, with a Plozza and mouldboard plough both designed to invert the topsoil. Past research projects funded by GRDC, have shown that the inversion helps with non-wetting topsoils and by breaking up the hard pan. This allows plant roots to get deeper utilising nutrients and water better which increases yield.

Due to the gravelly soils at the Tenterden and Darkan sites, it is likely that compaction is not an issue due to the high gravel content. It is hard to draw soil-strength conclusions from gravel soils using penetrometer data. Research shows that high gravel content, >15–20% by volume, act as a supporting framework; therefore, it protects the soil matter considerably from compaction (Rücknagel et al., 2013).

Similar to the 2018 season, the soil moisture levels were low from limited summer rainfall in 2019 when the Tenterden ripping treatments were implemented on April 4, 2019. The best soil conditions for ripping are when soil moisture is present but less than field capacity. Moisture in the soil reduces soil strength, which allows the tillage implement to reach greater depths. In 2019, the soil at the Tenterden site was very dry until mid-June when the season finally 'broke'.

Research shows that the benefits of deep ripping are likely to be reversed after two or three years without CTF implementation and this this has been seen at the Goad trial site in 2018-19. 80% of compaction occurs in a single machinery pass; and it is imperative to protect the benefits of deep ripping through CTF. Research shows that where CTF is not currently being used, machinery will regularly run over 40 percent or more of paddocks each year; which means that after two years you could reasonably expect the paddock to have 40-80% of the soil re-compacted from machinery.

SOCIAL MEDIA POSTING

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SOCIAL MEDIA ACCOUNTS:

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Twitter: https://twitter.com/theGRDC
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Is there any reason why this report cannot be communicated on social media? (Insert info here)

If no, please provide the following:

1. Who is the target audience for this content? (e.g., growers, adviser, researchers, policy makers, etc.)
    a. *Growers, advisors, agronomists and researchers*

2. At what time of year is this content most relevant to the target audience?
    a. *December to April (after harvest and before seeding)*

3. On which of GRDC's social media accounts would you like this content posted? Please provide text (2-3 sentences for Facebook and LinkedIn and 140 characters for Twitter), images, graphs, or charts that support the content. Where applicable, please include any relevant Twitter handles (usernames) for project staff.
    a.

PROJECT SOCIAL MEDIA ACCOUNTS

Facebook:	Twitter: @dovey_nathan (lead researcher Stirlings to Coast Farmers)
Stirlings to Coast Farmers	
Southern DIRT	@Stirlings2Coast
	@DirtSouthern

Contact the social media team at socialmedia@grdc.com.au with any questions.

Please note that publication of content to GRDC social media accounts is at the discretion of GRDC's social media team.

REFERENCES & USEFUL LINKS

List of key publication references and web links relevant to the project and for further exploration of the topic.

Managing wind erosion in southern Western Australia – Justin Laycock DPIRD - https://www.agric.wa.gov.au/wind-erosion/managing-wind-erosion-southern-western-australia

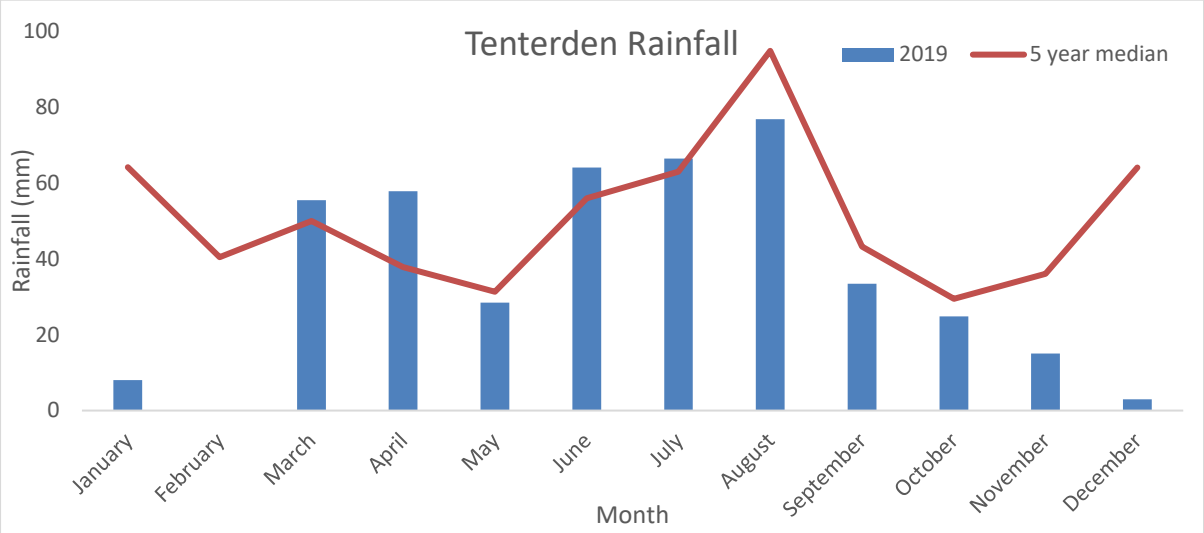
The changing options for soil compaction management in the WA wheatbelt - Bindi Isbister Department of Agriculture and Food WA, James Hagan, Department of Agriculture and Fisheries QLD, and Paul Blackwell, Department of Agriculture and Food WA

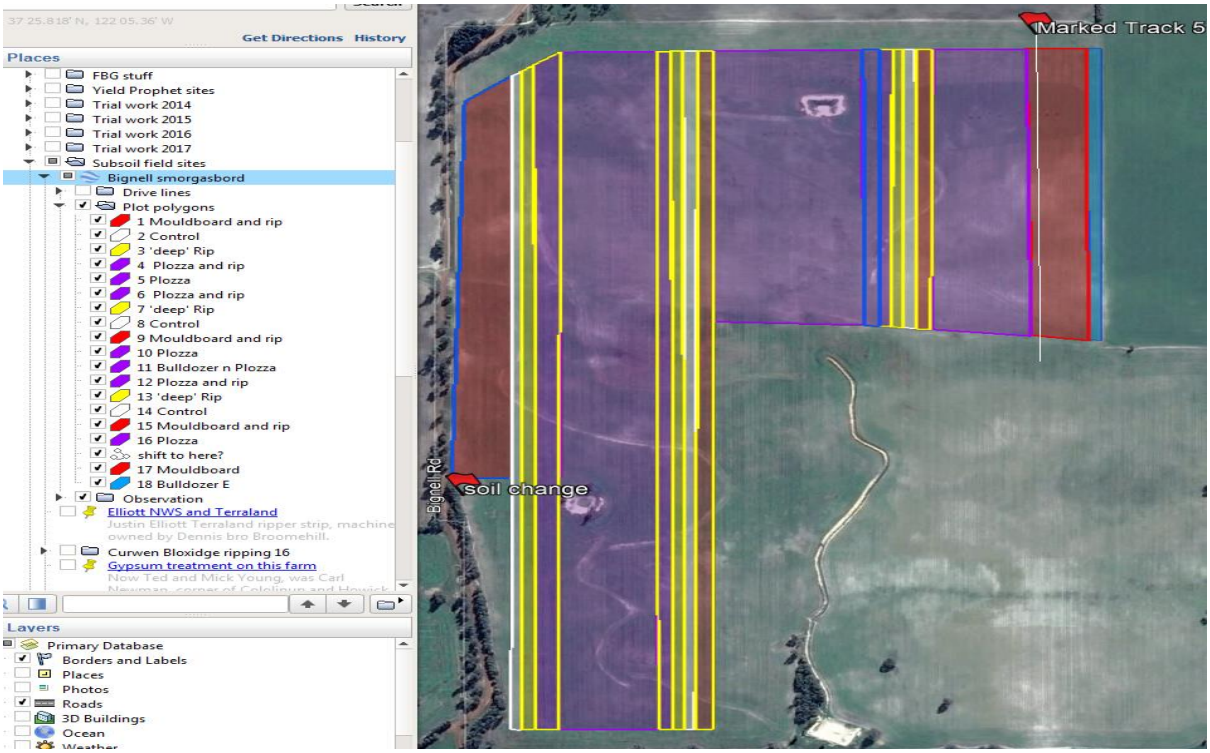
The influence of soil gravel content on compaction behaviour and pre-compression stress, Jan Rücknagel, Philipp Götze, Bodo Hofmann, Olaf Christen, Karin Marschall, Geoderma, Volumes 209–210, 2013, Pages 226-232, ISSN 0016-7061

Innovative ploughing method stands up to sand – GRDC groundcover page 43 of GC South; West issue 136 September – October 2018

Ripping benefits quickly negated by wheel traffic - GRDC groundcover GC West issue 118

Appendix


Tenterden Rainfall
2019
5 year median
Rainfall (mm)
100
80
60
40
20
0
January
February
March
April
May
June
July
August
September
October
November
December
Month


Get Directions
History
Places
FBG stuff
Yield Prophet sites
Trial work 2014
Trial work 2015
Trial work 2016
Trial work 2017
Subsoil field sites
Bignell smorgasbord
Drive lines
Plot polygons
1 Mouldboard and rip
2 Control
3 'deep' Rip
4 Plozza and rip
5 Plozza
6 Plozza and rip
7 'deep' Rip
8 Control
9 Mouldboard and rip
10 Plozza
11 Bulldozer n Plozza
12 Plozza and rip
13 'deep' Rip
14 Control
15 Mouldboard and rip
16 Plozza
shift to here?
17 Mouldboard
18 Bulldozer E
Observation
Elliott NWS and Terraland
Curwen Bloxidge ripping 16
Gypsum treatment on this farm
Layers
Primary Database
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Marked Track 5
soil change
Bignell Rd