STIRLINGS TO COAST FARMERS

2019 Trials Review

Growing Agriculture Together

SCF in Action

Welcome to the Stirlings to Coast Farmers

Hello everybody and welcome to the 2019 trials review booklet for Stirlings to Coast Farmers (SCF). I can confidently say this is the largest edition we have ever produced, with 80 pages of trials information.

I would like to thank the farmer trial hosts who take the time and effort to work with SCF staff on these projects. It is impossible to produce a quality trial or demonstration without the support of the host farmers. 2019 was the final year of many projects, and while we have started some new trials, we are on the look-out for new ideas and projects to tackle. What are your problems?

For those that don't know, we have several forums for you to provide feedback to the group about what you need on-farm. We have four research & development comittees:

- Western (Tenterden/Kendenup),
- Eastern (South Stirlings/Green Range)
- Livestock and Technology
- Main R & D group

Each group meets a few times a year to discuss project ideas and opportunities. We are always looking for more farmer participation in these groups to ensure we are covering your needs. Keep an eye out for the Covid-19 restrictions to be eased so we can start catching up again. The western and eastern R & D committees generally meet at night at the Nunijup Hall and Green Range Country Club respectively.

Alternatively, if you think of an idea or problem while going about your day, why don't you call one of our R & D staff members in Phil Honey (Smart Farms Coordinator) 0428 768 589, Phil Mackie (Project Officer) 0437 120 891 or myself (Nathan) on 0429 468 030?

Finally, thank you to our investors (funders) for working with the SCF group. We look forward to working on many more projects that will improve farming practices in our region. Thank you to all SCF staff for their tireless efforts in producing the trials review booklet, it certainly takes a team effort to create a quality product.

On behalf of the SCF team, we wish everybody a prosperous season in 2020, and we look forward to seeing you at our next event.

Regards,

Nathan Dovey, CEO

We would like to thank our Gold Sponsors

as well as our Silver Sponsors

Our agency research partners

CONTENTS

Understanding field trial statistics – what do those letters and numbers mean?

We have tried to present all trial results in one format throughout this trials review booklet. However, due to differences in trial designs, this isn't always possible. The following explanations and definitions should provide you with enough statistical understanding to get the most from the trial results.

The statistical terms most used for SCF trials include Means (or averages) and LSD (Least Significant Difference). Statistical analyses can only be performed on replicated trials.

Replicated trials

Replicated trials are those in which the treatments are repeated more than once (at least twice for farm/paddock scale trials and three times for small plot trials although the more the better in both cases!). This allows for the use of statistical tests which can determine whether differences observed in average (mean) results are likely to be due to the treatments or whether they occurred purely by chance.

Means

The results of replicated trials are often presented as the average (or mean) of all replicates for each treatment. Statistics are used to determine if the difference between means is a result of treatment (e.g. different chemicals) or natural variability (e.g. soil type).

Significant Differences and the Least Significant Difference

In nearly all trial work there will be some difference between treatments, e.g. one rate of fertiliser will result in a higher yield than another. Statistics are used to determine if the difference is a result of treatment or some other factor (e.g. soil type). If there is a significant difference then there is a very strong chance the difference in yield is due to treatments, not some other factor. The level of significance can also play a role, this is denoted with a P value. If it says P<0.05% there is a greater than 95% probability that a difference is a result of treatment and not some other factor.

The LSD Test

To determine if there is a significant difference between two or more treatments a least significant difference (LSD) is often used. If there is a significant difference between two treatments their difference will be greater than the LSD. For example, when comparing the yield of five wheat varieties (Table 1), the difference in yield between variety 4 and 5 is greater than 0.6 t/ha (LSD), therefore it can be said there is a significant difference. This means it is 95% (P=0.05) certain that the difference in yield is a result of variety and not soil type or some other factor. Whilst there is a difference in yield between variety 1 and 2, it is less than 0.6 t/ha, therefore the difference is unable to be determined as a result of variety; it may be due to subtle soil type change or other external factors.

Letters are often used to indicate which varieties are significantly different, using the LSD value (Table 1). In this example, there is no significant difference between varieties 1, 2 and 3, whereas Varieties 4 and 5 are significantly different to each other and the rest of the varieties. Where the LSD result reads as 'NS' this represents that the values are not significantly different from each other. Letters in superscript after the mean (a,b,c etc) denote treatments whose means are statistically the same ie a mean value followed by an 'a' will not be statistically different from any other treatment mean in that table with the same 'a' letter following it.

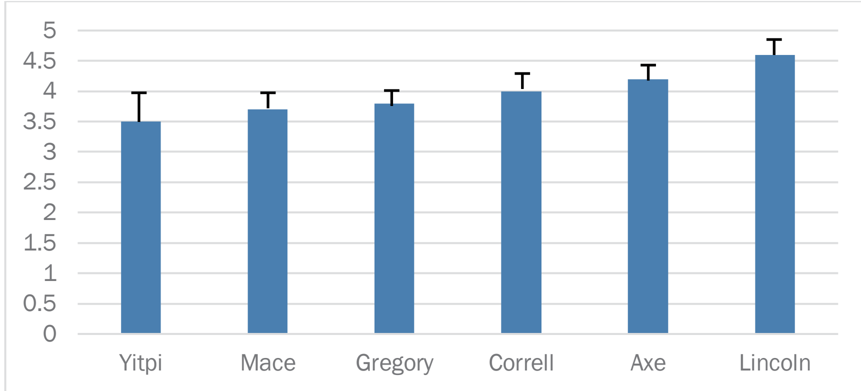
Table 1: Yield of five wheat varieties.

Treatment	Yield (t/ha)
Variety1	2.1[a]
Variety2	2.2[a]
Variety3	2.0[a]
Variety4	2.9[b]
Variety5	1.3[c]
P value	*<0.001*
LSD (P=0.05)	*0.6*

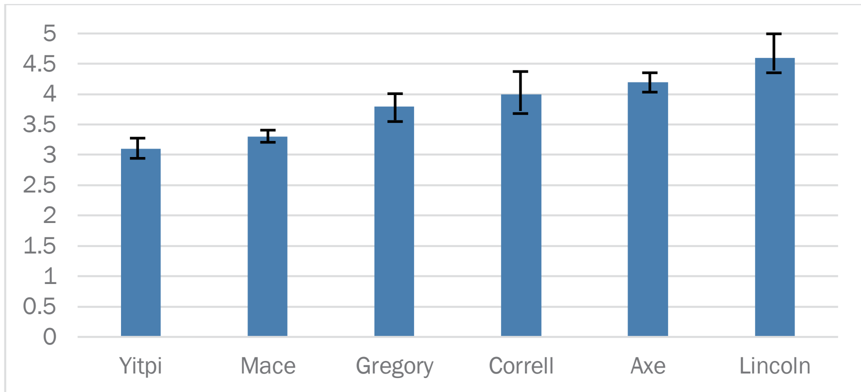
Graphs and error bars

Throughout this publication, statistical results may also be presented as graphs. Error bars at the top of each solid column within bar graphs can represent the LSD or Standard deviation (or standard error). Error bars through points on a line graph are generally the standard deviation or standard error.

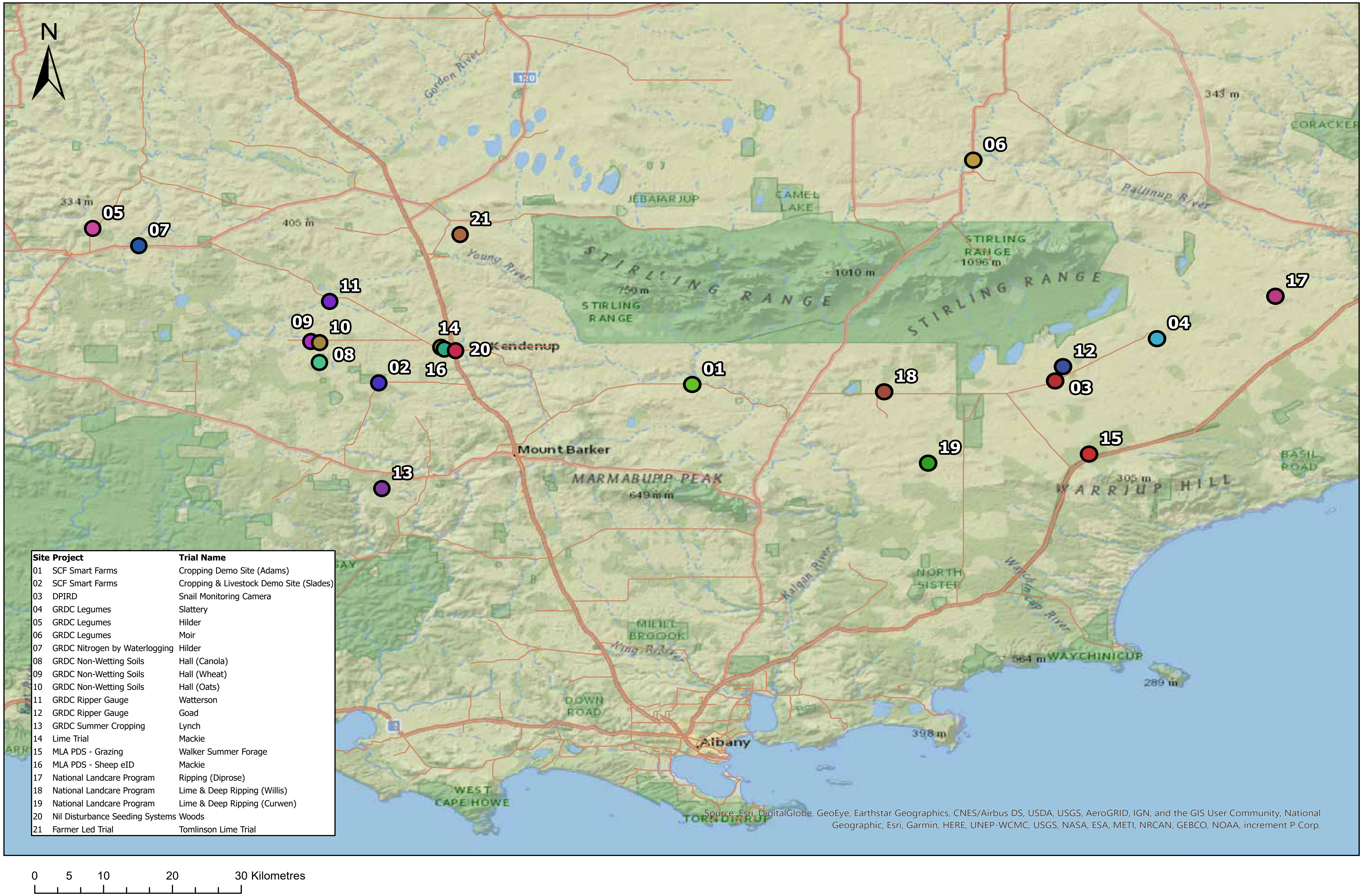
As the error bars in Figure 1 below extend only upwards, they are expressing the LSD between the yields of wheat varieties. Whether a variety (or treatment) is significantly different from another can be determined by looking at the LSD error bars. When the LSD bar does not reach the top of a solid column a significant difference is evident. In Figure 1, there is no significant difference between the grain yields of Yitpi, Mace and Gregory. The yield of Gregory is, however, significantly different from that of Axe and Lincoln, but not of Correll.



Error bars that express the standard deviation extend both up and down from the top of each solid column. A standard deviation is a statistical measurement used to show how much variability exists in a set of data around the average or expected value. A long standard deviation bar indicates a broad range of possible values relative to the expected value. A short standard deviation bar means the data points are considered close to the expected value. The Standard error is a measure of the standard deviation in relation to the sample size (number of observations used to estimate the mean).



SCF trial sites 2019



Site	Project	Trial Name
01	SCF Smart Farms	Cropping Demo Site (Adams)
02	SCF Smart Farms	Cropping & Livestock Demo Site (Slades)
03	DPIRD	Snail Monitoring Camera
04	GRDC Legumes	Slattery
05	GRDC Legumes	Hilder
06	GRDC Legumes	Moir
07	GRDC Nitrogen by Waterlogging	Hilder
08	GRDC Non-Wetting Soils	Hall (Canola)
09	GRDC Non-Wetting Soils	Hall (Wheat)
10	GRDC Non-Wetting Soils	Hall (Oats)
11	GRDC Ripper Gauge	Watterson
12	GRDC Ripper Gauge	Goad
13	GRDC Summer Cropping	Lynch
14	Lime Trial	Mackie
15	MLA PDS - Grazing	Walker Summer Forage
16	MLA PDS - Sheep eID	Mackie
17	National Landcare Program	Ripping (Diprose)
18	National Landcare Program	Lime & Deep Ripping (Willis)
19	National Landcare Program	Lime & Deep Ripping (Curwen)
20	Nil Disturbance Seeding Systems	Woods
21	Farmer Led Trial	Tomlinson Lime Trial

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FUNDED TRIALS

2019 Ripper gauge demonstration sites - Albany port zone

Key messages

- All soil amelioration treatments were statistically equivalent or higher than the untreated controls at the Ripper gauge sites in the Albany port zone in 2019.
- Likely, compaction was not an issue at the Tenterden and Darkan demonstration sites due to their high gravel content. Therefore, soil amelioration did not show any yield improvements at these sites.
- Several environmental conditions impacted the results from the Kojoneerup ripper gauge site in 2019. Soil amelioration via claying is required to eliminate future wind erosion risks.
- The Albany port zone experienced a dry start and dry finish to the growing season in 2019. This impacted yields for at least two of the trials managed by SCF and Southern Dirt.

Summary

- **TENTERDEN**: There were no statistical increases in yield from any of the 2019 tillage treatments compared to the untreated control
- **KOJANEERUP**: There were no significant yield increases from the soil 2018 amelioration treatments over the untreated control.
- **DARKAN:** There were no significant improvements in grain yield from any of the 2018 tillage treatments compared to the nil treatment. On average, the control had the highest yield in the 2019 demonstration, although not statistically significant.
- **BROOMEHILL**: Three of the four 2018 tillage treatments yielded significantly higher than the untreated control.

Results

Tenterden Ripper Gauge

There was no significant yield increase from any tillage treatments at this site. The more intensive tillage did lead to a slight reduction in yield (200-300kg).
The protein was 0.8-1.2% higher, although not statistically significant. *Data not shown*

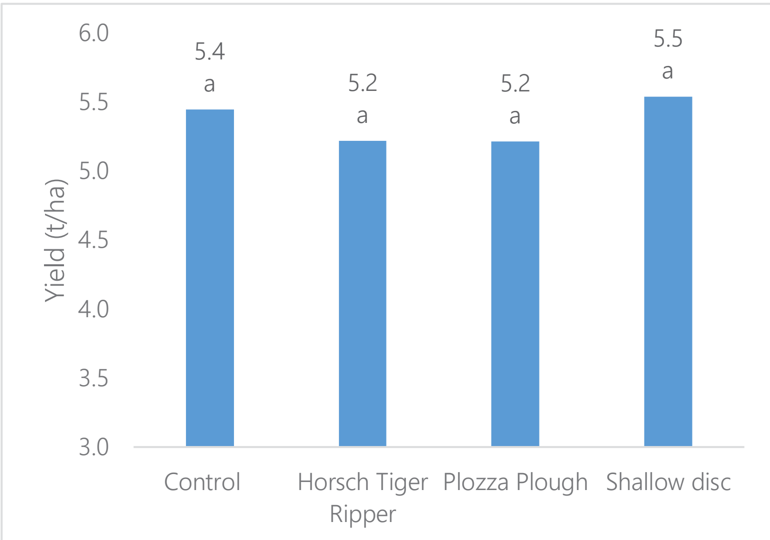

FIGURE 1. 2019 Ripper gauge site located on the Watterson family farm in Tenterden, WA. This graph displays 2019 mean barley grain yields in t/ha. *Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)*

Results

Broomehill Ripper Gauge 2018

Yield data from 2018 showed significant lupin yield (t/ha) increases for the mouldboard plough + deep ripping treatment, and the plozza plough treatment. The plozza plough treatment + deep ripping was 300kg/ha higher than the control but was not statistically significant. Just like the 2019 yield data, there was no significant yield difference between the control and the deep ripping treatment.

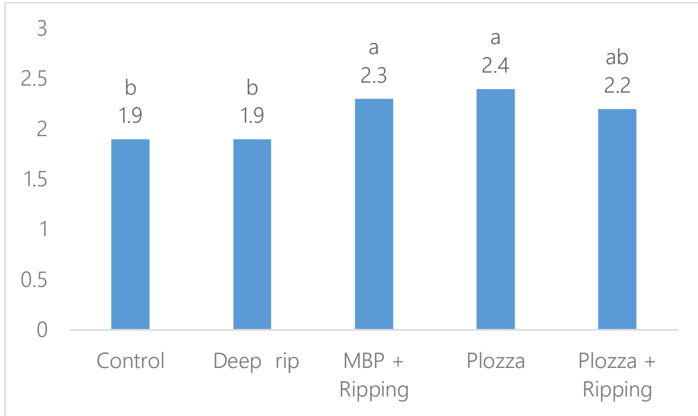

FIGURE 2. Ripper gauge site located on Bignell's property in Broomehill WA. This graph displays the average 2018 Lupin yields in (t/ha). *Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)*

Broomehill Ripper Gauge 2019

Deep ripping was the only tillage treatment that yielded statistically equivalent to the untreated control. The Plozza + Ripping Treatment yielded significantly higher than the control and deep ripping treatment. The Plozza Plough, Mouldboard + Deep Rip, and the Deep rip were statistically equivalent to each other.

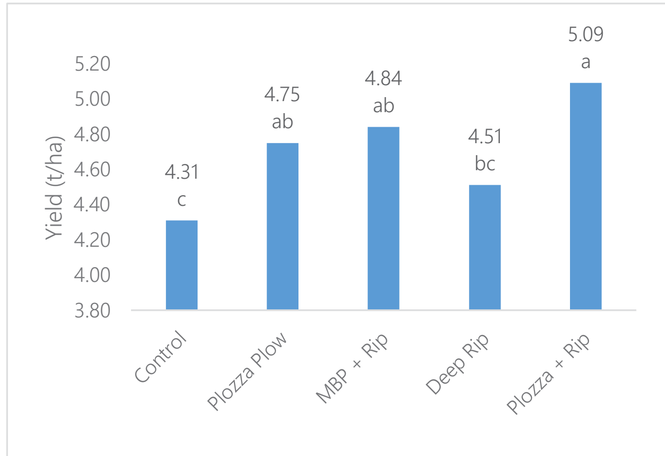

FIGURE 3. Ripper gauge site located on the Bignell's Farm in Broomehill WA. This graph displays the average 2019 Scepter Wheat yields in (t/ha). *Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)*

Kojaneerup Ripper Gauge

This site demonstrated nil yield benefits from the soil amelioration treatments when compared to the control in 2019. The Kojaneerup site was growing its second crop after treatments were installed before the 2018 growing season.

There were no statistical differences in any treatments for either of the NDVI data sets (biomass) or the plant counts (per m²) collected in 2019. *Data not shown.*

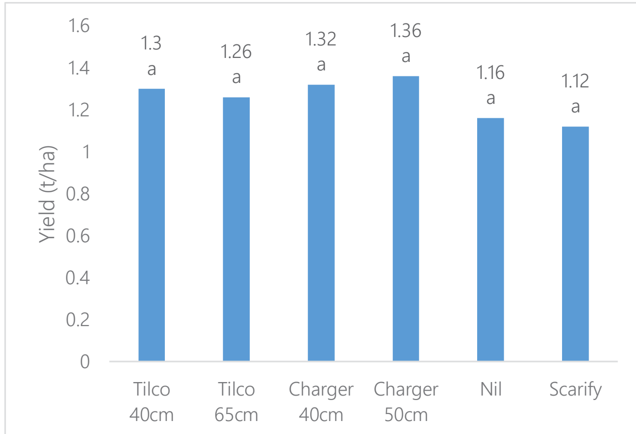

FIGURE 4. Ripper gauge site located on the Goad family farm in Kojaneerup WA. This graph displays mean 2019 canola yields in (t/ha). *Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)*

Darkan Ripper Gauge

At Darkan, there was no significant yield differences between treatments. The control yield was the highest of all treatments, although not significantly different.

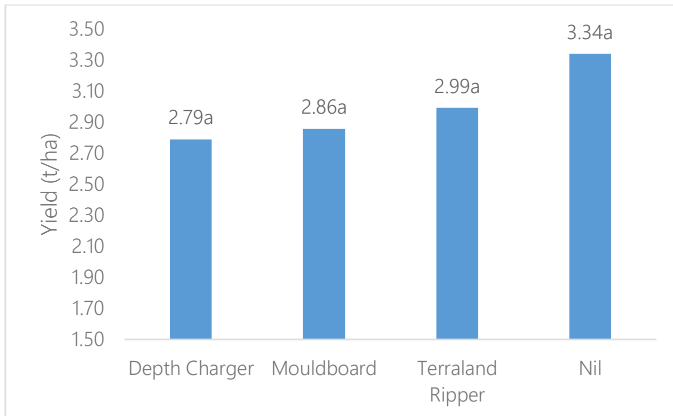

FIGURE 5. Ripper gauge site located on the Duffield family farm in Darkan WA. This graph displays the mean 2019 Planet barley yields in (t/ha).

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Thank you to Southern Dirt collaborating with SCF on this project.

Discussion

Tenterden (SCF Site)

The trial aim was to investigate if ripping would alleviate non-wetting constraints on a gravel soil type that was likely not compacted. The 2019 rainfall for Tenterden was 433mm (median rainfall- 480mm). Despite lower rainfall in 2019, non-wetting topsoil was not expressed during the growing season despite the dry start.

The paddock only had a three-year cropping history before a 4-year pasture phase. Combined with the gravel content (> 50% in the B horizon), we did not expect the subsoil to be compacted.

Although not statistically different, the two more aggressive ripping treatments resulted in higher protein. Tillage oxidises organic matter releasing carbon and nitrogen, leading to higher grain protein levels. Yield appears to have reached rainfall yield potential, so there was no yield response to the higher available nitrogen.

Kojaneerup (SCF Site)

The wind erosion that occurred after deep ripping in 2018 affected last years trial by leaving bare patches and delaying emergence due to extremely non-wetting patches. The Goad family have identified that claying this paddock would be an excellent option to control wind erosion and reduce water repellence.

The lack of significant yield differences suggest machinery traffic may have recompacted the soil and reversed any of the benefits gained from ripping in 2018. When renovating paddocks with mechanical amelioration, research suggests implementing a CTF system to increase the longevity of soil renovation benefits.

A hail event on October 31, 2019, impacted the trial and yield losses were significant. With significant non-wetting patches due to the wind erosion in 2018 and hail damage in 2019, we were unable to find significant yield effects.

Darkan (Southern Dirt)

The Mouldboard treatment was extremely patchy with poor plant germination. The patchy germination also occurred in 2018 because the Mouldboard plough treatment was not rolled to create a seedbed. By the second year, the soil should have settled, and the patchy germination may be due to another factor.

LUREH2O was applied down the tyne at seeding across all treatments to help alleviate non-wetting issues on the forest gravel soil.

The lack of significant yield differences is thought to be due to the high gravel content of the soil, which means soil compaction is not likely to be an issue. Treatments showing yield losses were likely due to the poor plant establishment.

Broomehill (Southern Dirt)

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

The three different tillage treatments at the Broomehill site were aggressive 'mixing' type treatments, with a Plozza and mouldboard plough both designed to invert and/or mix the topsoil to depth. Past research projects funded by GRDC, have shown that the inversion helps with non-wetting topsoils and by breaking up the hardpan. Plant roots can get deeper in the soil after tillage, utilising nutrients and water better which increases grain yield.

The Broomehill site is the most responsive trial in the series to deep tillage. Broomhill is the only demonstration site to have tillage treatments yielding significantly higher in the first and second year after application.

Conclusions

Tillage treatments from the Kojoneerup, Tenterden, and Darkan achieved grain yields that were not statistically higher than the untreated control in 2019. The Broomehill results show there is a significant increase in yield in three of the four tillage treatments compared to the untreated control.

Like the 2018 season, the initial soil moisture levels were low from limited summer rainfall. 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'.

All ripper gauge demonstration sites will be monitored in 2020, the final year of the project.

WAPC
WEST AUSTRALIAN PRODUCERS' CO-OP

JOIN US

We are recruiting new members now!

If you missed joining the WAPC in 2019, several new memberships are now available at the same introductory price of $3,500 (one-off joining fee) plus $500 redeemable share. This joining fee will increase to $7,000 after June and the offer is limited in this period to ensure we don't dilute benefits for existing members. So if you want to join the Co-Op or find out more, please don't leave it too long. Membership forms can be found on the WAPC website or for an information pack, contact:

Christine Kershaw, WAPC CEO: ceo@waproducers.com.au; 0429 236 729

Ken Drummond, WAPC Chair and member; kgd@iinet.au; 0427 541 033

waproducers.com.au

Optimising timing and rate of nitrogen applications in waterlogging conditions

Key messages

- The 'farmer practice' strategy ended up being the best nitrogen (N) strategy for the 2019 season. The crop responded to the applied N up front after good rainfall and resulted in a 5.43 t/ha yield achieving a solid return on investment.
- The Scepter wheat achieved its water limiting yield potential, meaning more N did not increase yield.
- Despite the treatments that received additional N achieving a higher wheat grade, extra N treatments was less profitable.
- Growers remain interested in N timing research and would like to see more results in wet years and waterlogged conditions.

Summary

- There were significantly higher yields achieved in all three nitrogen (N) applications compared to the control.
- Late applications of N applied to the 'split' and 'high N' treatments achieved greater protein percentages, achieving APW2 and APW1 grades respectively. This was in comparison to ASW1 from both the 'control' and 'farmer practice' treatments.
- The dry finish from September to November mitigated the waterlogging conditions after a wet August (87.4mm). In 2019 we were unable to identify the best tactical N application after a waterlogging event due to minimal waterlogging conditions.
- In 2020 members are willing to host the trial again with the support of SCF researchers to collect data, analyse yields and perform cost benefit analysis.

Project Objective

To enable growers to make timely and efficient nitrogen decisions in the Albany port zones by having a rule of thumb around the cost/benefit of applying N to crops on waterlogged soils.

FIGURE 1. Trial map with Nitrogen rate treatments at the Frankland Nitrogen by Waterlogging trial in 2019. The red strip indicates the control, green shows the farmer practice and yellow and orange shows the split and high N treatments respectively

Methods

One farm-scale trial was established in Frankland in 2019 at Simon Hilder's. The site was selected due to persistent waterlogging conditions over the past five years. The trial site sloped from north east down to south-west over 4.8ha. The trial was sown May 24th 2019 with 120kg/ha Scepter wheat with starter fertiliser of 110kg/ha of MAP & Mn and 20kg/ha of MOP (Approximately 11 Kg N). The trial included four replicated N treatments. Four N strategies were developed by SCF researchers, agronomists, and the host farmers.

The trial consisted of four N (Urea) strategies:

- Control (46N)
- Farmer Practice (46N and 60N)
- Split Application (46N, +30N, + 30N)
- High N (46N, +60N, +30N)

The N treatments were applied at three different intervals during the growing season. The fourth application of the High N treatment was not applied due to the dry conditions during spring. The first application was on June 14th, second on July 29th, and the third and final applications were on August 19th, 2019. Grain yield was collected using the headers yield monitor, which was calibrated accurately for the trial. The trial was harvested in one direction, taking cuts from the middle of each treatment.

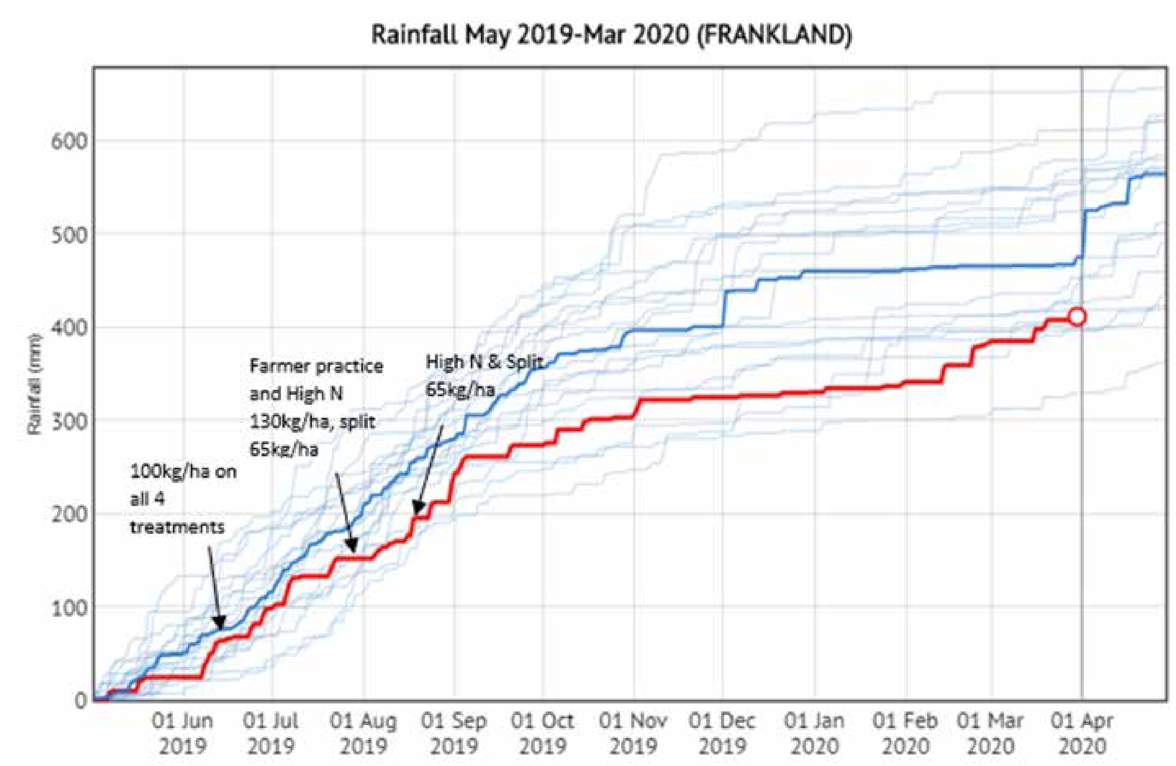

FIGURE 2. Shows the cumulative rainfall (red line) from 1st June 2019 to April 30, 2020, blue line indicates median rainfall for Frankland 2000 to present day. Nitrogen applications went on the trial 14th June 29th July and 19th August 2019. (Data: Australian CliMate 31/03/2020)

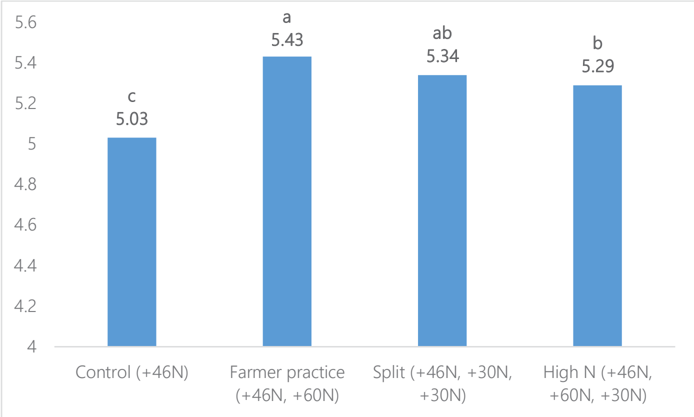

FIGURE 3. 2019 Waterlogging by Nitrogen trial located at Frankland, hosted by the Hilder family. Average Scepter wheat yields in (t/ha) from the four Nitrogen treatments. Numbers quoted after treatments represent kg/ha of Nitrogen applied. Means followed by the same letter or symbol do not significantly differ (P=.05, LSD).

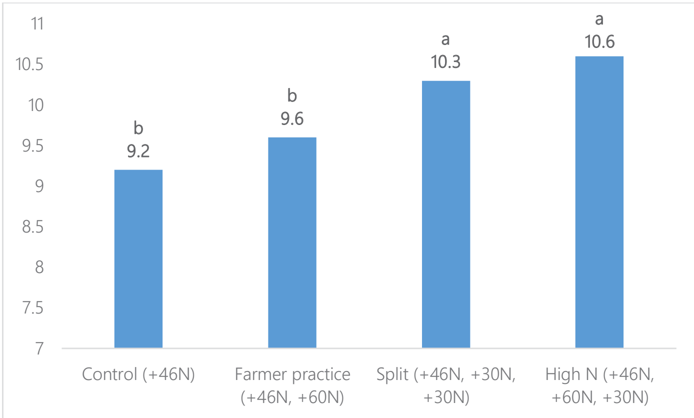

FIGURE 4. Average grain protein percentages from each of the Nitrogen treatments in the 2019, Waterlogging by Nitrogen trial at Hilder's in Frankland. Numbers in the treatment descriptions represent kg/ha of Nitrogen applied. Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

TABLE 1. Average grain screening percentages and hectolitre weight (kg/hL) for the Nitrogen treatments at Frankland 2019. Total Kg N refers to Kg/ha of Nitrogen applied as fertiliser. Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

No.	Treatment	Screenings %		Specific Wt kg/hL	
1	Control (+46 N)- **Total 57 Kg Nitrogen**	0.95	a	82.4	a
2	Farmer practice (+46N, +60N) **Total 117 Kg Nitrogen**	0.80	a	81.5	a
3	Split (+46N, +30N, +30N)- **Total 117 Kg Nitrogen**	0.95	a	81.4	a
4	High N (+46N, +60N, +30N)- **Total 147 Kg Nitrogen**	1.06	a	81.2	a

Results Summary

- There were significantly higher grain yields in the 'farmer practice,' 'split,' and 'high N' treatments compared to the 'control.'
- The 'farmer practice' N treatment yielded 90kg/ha higher than the 'high N' treatment, although the difference was not significant.
- There were no significant differences in yield between the 'split' and 'high N' treatments
- The grain protein percentage was significantly higher in the 'split' and 'high N' applications compared to the 'control'.
- There were no significant differences among the screening percentages, moisture percentages or hectolitre weights in any of the treatments.
- The return on investment in applying a higher nitrogen rate in 2019 was nil. Although the treatment with a higher nitrogen rate made a higher wheat grade, the additional cost of the nitrogen outweighed the benefit from a slightly higher price.

SCF would like to thank project partners Southern Dirt and the GRDC for investing in this project.

TABLE 2. Displays the return on investment of applied nitrogen rates to the 2019 crop to improve wheat quality (not including seeding fertiliser). The table shows the net revenue and the net revenue minus urea (N) costs from the four nitrogen strategies. N is measured in Kg/ha. For example, 100kg/ha of Urea = 46 Kg N/Ha

Treatment	Grade	Grain Price	Urea costs/ha		Yield (t/ha)	Net Revenue($/ha)	Net Revenue – Urea costs ($/ha)
Control (+46N)- **Total 57 Kg N**	ASW	$340	$	50.0	5.03	$1,710	**$1,660**
Farmer practice (+46N, +60N)- **Total 117 Kg N**	ASW	$340	$	115.0	5.43	$1,845	**$1,731**
Split (+46N, +30N, +30N)- **Total 117 Kg N**	APW2	$340	$	115.0	5.34	$1,814	**$1,701**
High N (+46N, +60N, +30N)- **Total 147 Kg N**	APW1	$342	$	147.5	5.29	$1,807	**$1,662**

Conclusions

All N treatments yielded significantly more than the control. The control treatment had 11 Kg of N applied during seeding, and a further 46 Kg (100kg/ha urea) applied on June 14th. This was due to the late selection of the waterlogged site, which was challenging to obtain in a dry 2018 season.

Rule of thumb calculations for wheat at 11% protein state that 40kg/ha of N is required per tonne of grain yield (GRDC Project CSP00174). Therefore, our control yield of 5.03t/ha required 201 Kg of N to be supplied from the soil and fertiliser applications. We provided only 57 Kg N/ha, which meant the soil would have to supply 145 Kg N/Ha to grow that yield.

By contrast, our highest yielding treatment, 'farmer practice,' was supplied 115 Kg of N from fertiliser but would have required a total of 217 Kg of N to grow the 5.43t/ha yield. The 100-unit (approximate) shortfall of N would need to have been supplied from the soil.

The wheat yields obtained from the growing season rainfall of 330mm indicate the crop achieved its water-limited yield potential. Late applications of N, after mid stem elongation, are more likely to improve protein rather than grain yield. We saw evidence of later N applications improving grain protein in this trial.

The 'high N' application achieved APW1, which made $342/t on December 6th 2019, while the 'split application' made APW2 ($340/t). Both the 'control' and 'farmer practice' treatments made ASW1, which was worth $340/t.

Assigning urea, a value of $500/tonne in 2019, meant the additional 65kg/ha of urea in the 'higher N' treatment cost a $32.50/ha more than the 'farmer practice' treatment. Despite the exceptional grain prices, the return on investment of a higher N strategy was negligible. The poor return on investment was partly due to the lack of price differences between the wheat grades during the 2019 season.

The dry finish to the season prevented a fourth N application on the high N treatment; however, the cost of applying any additional N would have reduced profit.

The 'farmer practice' treatment was the best N strategy for season 2019. The crop responded to the applied N upfront and after adequate rainfall, resulted in a 5.43 t/ha yield. The 'split treatment received the same units of N; however, the later N application boosted protein and achieved a higher grade. Based on these results, Scepter growers who regularly have low grain protein should consider late-season N applications to increase protein.

Non-wetting management options for growers in the Albany port zone

SCF would like to thank project partners Southern Dirt and the GRDC for investing in this project.

Key points

- The lack of significance in plant count shows there were no adverse effects to the emergence of the three crop types when wetter was seed coated prior to sowing.
- There were no significant improvements in yield from applying SE14 as a seed coating over the untreated control
- Water repellence was not likely an issue in the trials in 2019 as the site received adequate rainfall post-seeding and throughout the growing season.

Background

Managing non-wetting soils can be more difficult when there are multiple soil constraints in a single paddock. For example, non-wetting soils, compaction, acidity, soil & root borne pathogens, waterlogging, and transient salinity can make it challenging to identify the most constraining factor. Multiple soil constraints make adoption decisions difficult, and growers in the Albany Port Zone (APZ) are no exception. A compounding factor for APZ growers is that paddocks often have areas of exposed cap rock making the use of mechanical amelioration, such as one-way ploughs and other soil inversion tools, difficult. A wrong decision in these soil types can also have long term negative consequences by exposing soils to a variety of risks such as wind erosion.

Deep soil cultivation has been shown to reduce repellence on these soils but impacts on crop establishment causes variability in productivity. Claying sandy soils has been relatively common in the APZ for the last 20 years. It has been highly effective at ameliorating non-wetting topsoils, reducing wind erosion and improving grain yields. However, the time, cost of claying plus incorporation is a substantial barrier to more widespread adoption. Local growers counter this by investing in small amounts of claying on an annual basis.

Non-mechanical management options such as soil wetters placed in-furrow at seeding are becoming a more common tool in alleviating non-wetting constraints on gravel soil types. Recent research looked at the efficacy of seed coated wetters (as opposed to being applied in-furrow) and saw an improved cereal establishment by up to 109% (Anderson et al. 2018).

The non-wetting management options for growers in the APZ project aims to improve the confidence in diagnostic methods for delineating and implementing practices to overcome non-wetting in most soil types, and to enhance the confidence of growers in the decision making for improving soil productivity.

In 2019 three trials were set up with Anthony and Murray Hall in West Kendenup. The trials looked at the effects of applying 2.0 litres of SE14 per tonne of seed to see if it assisted in germination numbers in non-wetting soils on three crop types (canola, wheat and oats).

Results

- There were no significant improvements in yield from applying SE14 as a seed coating over the untreated control in the canola, wheat or oats in 2019 (Fig 1).
- Grain quality analysis in the canola trial shows there are no significant differences in protein, moisture or oil (Table 1).
- There were no statistical differences in any treatments in plant counts (per m2) that were collected from each of the crop and treatment types (Table 2).
- Canola plants were also divided into different growth stages to identify if more plants germinated on the first or second rains *(Data not shown).*

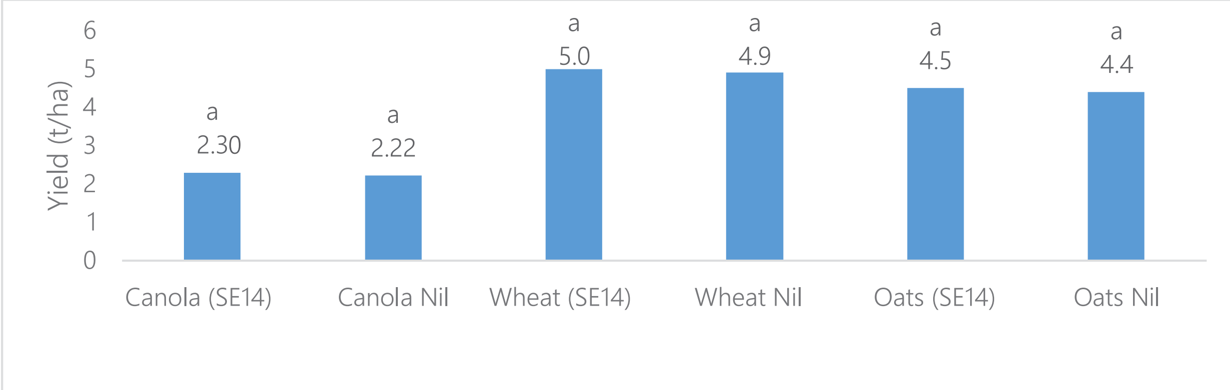

FIGURE 1. Yield (t/ha) of each crop type with 2 Litres of SE14 applied per tonne of seed compared to an untreated control. The three trials in 2019, were hosted by the Hall Family in West Kendenup. Means followed by the same letter or symbol do not significantly differ (P= .05 LSD)

TABLE 1. Grain quality from the canola with 2Litres/tonne SE14 wetter seed coating and untreated

Canola Grain Quality Average							
	Protein	L Admix (g)	L Admix %	S Admix (g)	S Admix %	Moisture	Oil
Canola (SE14)	20.20	2.83	0.57	4.23	0.85	4.23	46.23
Canola Nil	20.27	6.77	1.35	5.63	1.13	4.13	46.27

TABLE 2. Mean plant counts from one metre of planted row (1m/row from Canola Wheat, and Oats from Anthony and Murray Halls property in West Kendenup. Canola plants were counted twice due to a staggered germination. Means followed by the same letter or symbol do not significantly differ (P=0.05, LSD)

Crop Type and Treatment	July 5 2019 Ave plant count p/m^2	July 12 2019 Ave plant count p/m^2
Canola (SE14)	43.3a	56.1a
Canola Nil	44.1a	53.3a
Wheat (SE14)	19a	
Wheat Nil	17a	
Oats (SE14)	39a	
Oats Nil	32a	

Discussion

The main aim of applying the wetter directly to the seed in these trials was to aid in improving wetting of the seeding zone and help improve seed germination in both cereals and canola (Anderson et al. 2018). The lack of significance in plant count shows there were no adverse effects to the three crops with 2.0 Lt/tonne of SE14 wetter applied directly to the seed before seeding. Generally, poor crop establishment on non-wetting soils occurs when crops are dry sown with limited rainfall pre- and post-seeding (Anderson et al., 2018). In 2019 despite the drier start to the season June through September achieved adequate rainfall at West Kendenup. Therefore, water repellence was less likely to be an issue in 2019 with greater than 65mm falling in June, July and August.

Anderson et al. 2018 stated that seed coating with wetters improved cereal establishment and increased plant density and tillers, which is an important role in final yields. Despite no significant increases in yield or grain quality, the three trials had excellent yields, which indicates that water was not a limiting factor in 2019.

In 2020 SCF has established another non-wetting trial hosted by Michael and Clare Webster at Tenterden. The trial includes 11 different treatments comparing various rates and application techniques of SE14 plus a new soil wetting agent from BASF called Divine Integrate. The farm-scale trial focuses on canola only in 2020.

References

Anderson, G Erickson, T, Davies, S and McDonald, G (2018) 'Seeds coated with wetters improved cereal germination on water repellent soils' GRDC Grains Research Updates 2018, Darkan, 28 February 2018.

Demonstrations of legumes crops for reliable profitability in the Western region

Key points

- Legumes are more susceptible to frosts and high temperatures during flowering than cereals and canola.
- When legumes prices are high, the margins are competitive with conventional crops such as wheat, barley and canola.
- Growers can learn legume agronomy very quickly. Planting legumes in favourable environmental conditions is a much more significant factor.
- Ongoing research and demonstration work is required to continue driving grower adoption of legume crops in WA. Increased cropping diversity is an ongoing ambition for the entire grains industry.

Summary

One of the aims of this project was to increase crop diversity by adding a legume into the crop rotation. Adding a legume to the cropping phase can help improve soil health, disease & weed benefits that will help farmers maintain or improve overall crop yields. In 2018 three legume demonstrations were established in Frankland, Kojonup, and Carrolup with four legume crops grown. In 2019 these trial sites were sown over with a cereal and yield data was collected.

The wheat in Frankland achieved a slightly higher yield than the grower's 5-year average of 5t/ha, with 5.1 – 5.6t/h obtained in the different legume treatments. It was a dry start and dry finish to the 2019 growing season, with most of the rainfall falling between June – August. The Frankland lupin treatment yielded significantly less than the other legume treatments in 2019. Researchers are unsure why the 2018 lupin treatment yielded less in 2019. Soil samples collected in early April 2020 may provide some clarity.

Four new legume demonstrations were established in 2019 at Amelup, Gnowellen, Muradup, and Broomehill. Chickpeas, Lentils, Lupins, Faba beans, and Field peas were grown. Jurien Lupins performed the best in both the Muradup and Broomehill trials. The Lupin prices in 19/20 season were excellent, reaching over $500/t post-harvest. At the Muradup trial, the grower wanted to investigate the effects of double seeding Faba beans compared to single-pass (standard) seeding. The double seeded treatment was sown over twice effectively getting a 250kg/ha seeding rate and 220kg/ha of starter fertiliser. The single-seeded treatment seeding rate was 125kg/ha and 110kg/ha of fertiliser. The double seeded Faba bean treatment yielded 1t/ha higher (2.56t/ha) than the single sown treatment, which equated to a return of $1300, $513 more than the single-seeded treatment. It will be interesting to see the barley yield results at this site, from the over-sown 2020 crop.

Results

Frankland Legume Demo Yield

In 2019 wheat was sown over the 2018 legume trial. The wheat was monitored and yield data was collected. Harvest results showed Lupins yielded significantly less compared to the Lentils, Field peas, Faba beans and Canola treatments Fig 1.

The combined revenue per hectare from each of the legume treatments is displayed in Table 1. The Faba bean treatment combined revenue achieved nearly $700 more than the next legume treatment. The 2018 Faba bean price was exceptional and well above the 10-year average of $508/ tonne.

There was no difference between the average grain quality in the 2019 wheat crop at Frankland (*Data not shown*).

Muradup Legume Demonstration Site

The grain yields indicate there was a 1t/ha yield increase in the double seeded Faba beans compared to the single-seeded Faba beans. The double seeded faba beans sowing rate was 250kg/ha and had 220kg/ha of starter fertiliser applied. The single-seeded Faba beans seeding rate was 125kg/ha and 110kg/ha of starter fertiliser was applied.

The gross margin of the double seeded Faba beans was $383/ha more than the single-seeded treatment after the seed and fertiliser cost were accounted for. Assuming a contract seeding rate of $55/ha, the gross margin of double seeding was $328/ha.

The returns from the Jurien lupins achieved the highest revenue/ha in the 2019 trial. The 10-year average Lupin price is $334, and therefore the 2019 price of $509 was well above average. The double seeded Faba beans had a return of $1300 per hectare $153 less than Lupins. The 10-year average price for Faba beans is $509/tonne.

The Eliza Serradella and Vetch were hand-harvested as the header comb was unable to pick up the pods at such a low height. However, dry matter cuts collected on the 31st of September calculated a 5.8t/ha, and 11.7t/ha dry matter yield for Serradella and Vetch respectively This amount of biomass would have made for excellent sheep feed.

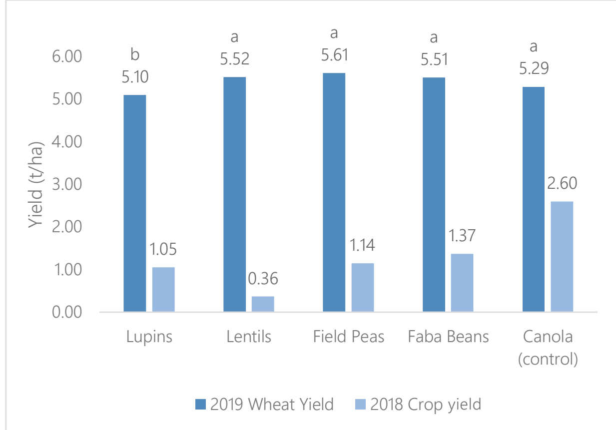

FIGURE 1. Summary of the grain yields achieved at the Frankland demonstration site (Hilder) in 2018-19. The figures indicate the t/ ha of grain yield for each crop. *Means followed by the same letter or symbol do not significantly differ (p=0.5, LSD)*

TABLE 1. Revenue ($/ha) achieved with a wheat crop in 2019 sown over the 2018 legume demonstration

Treatment	Yield (t/ha)	Wheat Price ($/t)	Revenue ($/ha) 2019	Revenue ($/ha) 2018	Total Revenue ($/ha)
Lupins	5.10	305	1556	369	1925
Lentils	5.52	305	1684	193	1877
Field Peas	5.61	305	1711	640	2351
Faba Beans	5.51	305	1681	1366	3047
Canola	5.29	305	1613	1482	3095

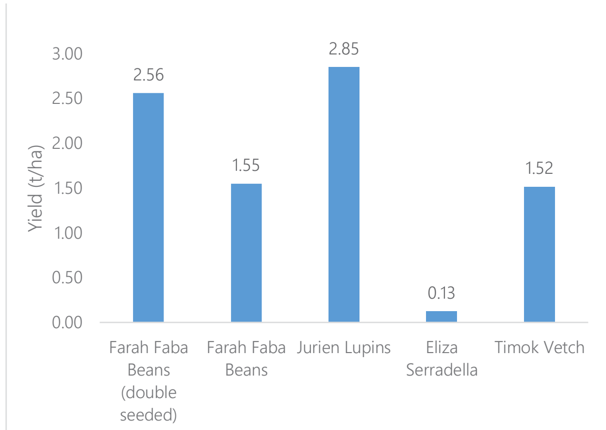

FIGURE 2. Grain yields (tonnes/hectare) achieved at the Muradup demonstration site (Webb's). The trial was sown on the 30th of April 2019.

TABLE 2. Revenue ($/ha) achieved from each of the legume treatments in 2019 at the Muradup Legume Demonstration site.

Treatment	Yield (t/ha)	Price ($/ha)	Revenue ($/ha)
Farah Faba Beans (double seeded)	2.56	$ 508	$ 1300
Jurien Lupin	2.85	$ 510	$ 1453
Farah Faba Bean	1.55	$ 508	$ 787
Eliza Serradella	0.13	$ 4900	$ 637
Timok Vetch	1.52	$ 783	$ 1190

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Broomehill Legume Demonstration Site

The Jurien lupins yielded significantly more than the lentils, faba beans and chickpeas in 2019. The Lupins yielded 1 tonne more than the chickpeas fig 8.

Despite the Lupins achieving the highest yield in the 2019 demonstration, the Bolt lentils achieved the highest revenue. The average 10-Year pricing of $334/tonne would have put the Lupins with the lowest revenue of $734. All other legume prices are on par with their 10-year averages.

Implications

The grain prices for Lupins were exceptional in 2019, getting up to $510/t due to minimal supply and high demand. The average 10-year price for Lupins is $334/t. The other 2019 prices for the demonstrated legumes were equal with the 10-year averages. In 2018, high prices were achieved by Faba Beans getting $1000 per tonne, but Faba beans were significantly lower in 2019 at $508/t.

All legume crops appear to have higher pricing fluctuations than mainstream crops like wheat, barley and canola. When prices are high, growers can achieve similar revenues to the standard crops as seen at the Broomehill site in 2019 (nearly all legumes) and with Faba beans at Frankland in 2018. Ideally, the industry needs to develop more markets for legume crops which would reduce price volatility and lift average prices from year to year. With a little more pricing certainty, it is likely growers would add legumes to their cropping programs more often. Growing legume crops more often would lead to an increase in agronomic skills and knowledge, which would ultimately reduce yield volatility.

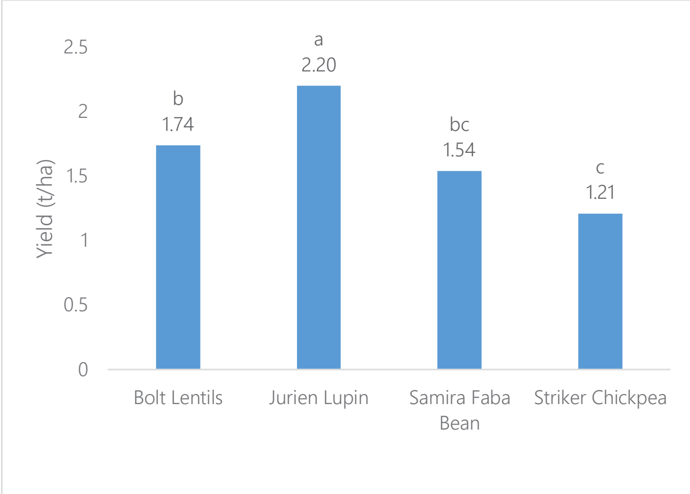

FIGURE 3. Grain yields achieved at the Broomehill demonstration site (Bignell's). The figures indicate the t/ha of grain yield for each crop. The trial was sown on the 18th of May 2019. *Means followed by the same letter or symbol do not significantly differ (p=0.5, LSD)*

TABLE 3. Revenue ($/ha) achieved from each of the legume treatments in 2019 at the Broomehill Legume Demonstration site.

Treatment	Yield (t/ha)	Price ($/ha)	Revenue ($/ha)
Bolt Lentils	1.74	$645.00	$1,122.30
Jurien Lupin	2.20	$510.00	$1,122.00
Samira Faba Bean	1.54	$508.00	$782.32
Striker Chickpea	1.21	$735.00	$889.35

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Summer cropping demonstrations in the Western region

Key points

- The growing season rainfall in 2019 was below average at Perillup, and the summer cropping demonstration did not suffer from water-logging.
- Grain growers in this region believe that the soil drying effects from growing summer crops has potentially the greatest benefit to winter cropping yields.
- In 2019, there was a 770kg/ha barley yield increase above the control from the plots where cowpea was grown in the summer.
- There was a 470kg/ha decline in winter barley yield in the plot that was planted to canola between January 30 and May 9, 2019.
- Nutritional requirements of summer crops need to be considered when selecting species. Cowpeas fixed useful nitrogen in the 90 growing days.

Key Summary

- The barley grown over the summer cowpea crop yielded 770kg/ha more than the control (wheat stubble). The increased yield was possibly due to the extra nitrate-nitrogen produced by the legume.
- The winter barley grown over the canola summer crop yielded 471kg/ha less than the control (wheat stubble). Soil tests indicate the canola used more macronutrients than the other treatments, especially potassium and sulphur.
- The 2019 rainfall was below average, and the demonstration site did not suffer from waterlogging. We were unable to measure the benefits obtained from the summer crops drying out the soil profile in 2019.
- We were unable to detect any significant differences in NDVI assessments (biomass) taken during the 2019 growing season.

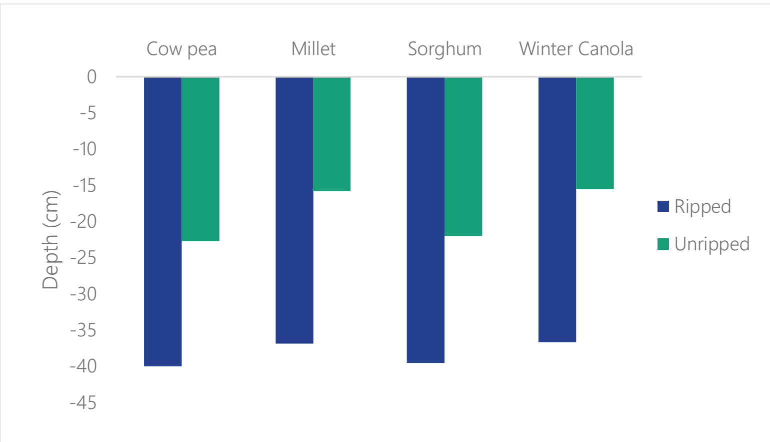

FIGURE 1. Push-rod readings collected on April 17, 2019; the readings are the soil depth (cm) that resistance exceeds 2500kpa.

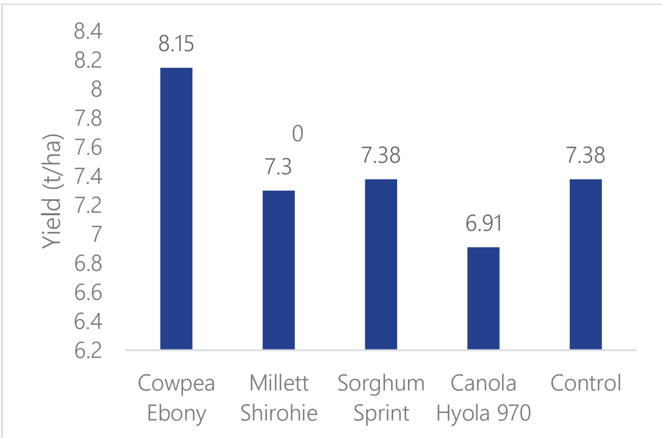

FIGURE 2. The 2019 winter barley yields in (t/ha) from the single plots at the Lynch's 2019 summer cropping demonstration site.

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FIGURE 3. Actual and median monthly rainfall figures from September 2018 to December 2019 for the Mount Barker research station.

TABLE 1. Average NDVI (biomass) readings from April 17, (summer crops), July 3, August 12 & 22, and October 21, at the Lynch summer cropping demonstration site in 2019. The last four NDVI readings were taken from the barley sown over the summer crops.

		NDVI Average				
Treatment	2019 Summer Crop	17-Apr-19 Summer crops	3-Jul-19 Barley	12-Aug-19 Barley	22-Aug-19 Barley	21-Oct-19 Barley
1	**Cowpea** *Ebony*	0.64	0.66	0.70	0.70	0.62
2	**Millett** *Shirohie*	0.58	0.65	0.69	0.70	0.61
3	**Sorghum** *Sprint*	0.63	0.64	0.69	0.70	0.62
4	**Canola** *Hyola 970*	0.57	0.62	0.68	0.70	0.62
5	**Control** *wheat stubble*	0.60	0.61	0.69	0.70	0.65

TABLE 2. The soil test results (0-10cm) summarised from the start and end of the summer cropping phase in 2019. Site averages from January 30, were taken from a representative transect across the whole trial site. Average soil figures calculated on May 9, were derived from four separate topsoil (0-10cm) transects taken within the individual summer cropping plots.

Date collected	30/01/2019	9/05/2019	9/05/2019	9/05/2019	9/05/2019	9/05/2019
Treatment	*Site Ave.*	*Canola*	*Cowpea*	*Sorghum*	*Millet*	*Average*
pH (CaCl2)	5.3	5.8	5.7	5.8	5.6	5.7
pH water	6.3	6.4	6.3	6.4	6.2	6.3
EC	0.201	0.138	0.230	0.278	0.153	0.200
OC	3.8	3.0	3.4	3.2	3.0	3.1
NO3-N	42	35	63	46	39	46
NH4-N	1	8	2.5	2	2	4
P (colwell)	40	35	45	56	39	43
PBI + ColP	NA	32	52	68	32	46
K	36	24	56	50	33	40
S	20	14	26	36	18	23

Summary

- The barley sown over the cowpea treatment yielded 770kg/ha more than the barley sown over the sorghum, millet and surrounding paddock (control), which was a wheat stubble.
- The barley planted over the canola treatment was the lowest yielding barley plot in the demonstration site.
- The millet and sorghum treatments yielded similar to the 2018 wheat stubble (control) treatment.
- The highest soil nitrate levels were measured in the cowpea crop, indicating that the only legume in the trial was able to fix some nitrogen in the 90 days it was growing.
- Soil nitrate, phosphorus, potassium and sulphur levels were all lowest in the canola summer cropping treatment.
- There was no difference between NDVI (biomass) eadings at any of the crop stages in 2019.
- The growing season rainfall was 372.2mm which was recorded from May – October at the Mt Barker research station, 4km north east of the trial site.
- The ripping strips were implemented in the trial but unfortunately was unable to get individual yields from each piece, using the header yield monitor.
- Predicta-B samples were collected in April 2020, but there did not appear to be any significant disease differences between treatments that were relevant to the barley crop in 2019 *(Data not shown).*

Removing small conical snails from canola

Using rotary grain cleaners and/or a snail crushing grain roller to remove small conical snails from canola

KEY POINTS

- Stirlings to Coast Farmers (SCF) cleaned 150t of canola using a rotary grain cleaner and a Kingsway snail crushing grain roller.
- Cleaning small conical snails out of canola using a rotary grain cleaner fitted with 2.5mm slotted screens reduced the number of small conical snails in canola by 19% with <1% grain losses.
- Using 2.2 mm screens removed 95% of snails but canola losses were 5.5%.
- The snail roller reduced snail numbers in canola by up to 91% when the gap between the rollers was tightest.
- Neither cleaning or rolling the grain affected oil, moisture or protein content.
- However, tightening the gap between the rollers can increase admixture and damage seeds.
- Stirlings to Coast Farmers (SCF) also reported growers experiences cleaning canola during the 2019-20 harvest.

Background

Small conical snails are an emerging pest in southern WA. They can damage crops at germination, reduce pasture biomass and potentially downgrade harvested grain if not managed carefully.

Snail management requires a strategic approach that can include removing the green bridge, burning windrows and timely baiting early in the season to prevent snails from breeding. However, even with a good program of control, snails can be a problem at harvest.

The 2019/20 grain harvest in WA saw the tightening delivery standards for snail numbers in both canola and barley, causing concern among growers about how to achieve these new limits.

Grain-cleaning snail rollers have been used for >10 years in the Yorke Peninsula to remove snails from grains such as canola, wheat, barley, lentils and beans.

Prior to the 2019-20 harvest, Stirling to Coast Farmers (SCF) processed 150 t of canola to determine the optimal method for removing small conical snails with minimal grain loss or damage. The canola used for the trial was classified CANS and had on average 30 small conical snails per 500g sample.

The trial used a rotary grain cleaner and a grain crushing snail roller to remove snails from the grain.

Before and after cleaning or rolling we took 500g samples of canola and measured:

- snail numbers and mortality, shell size and shell damage.
- admixture, damaged seeds, protein, oil and moisture.

Following the trial SCF monitored their members who were cleaning and rolling canola during the 2019-20 harvest to learn from their experiences.

PHOTO 1. A pile of small conical snails removed from canola using a 4-barrel rotary grain cleaner with 2.5mm slotted screens.

Rotary grain cleaner results

We tested a DE Engineers 4-barrel rotary grain cleaner with: 2.5mm or 2.2 mm slotted screens. Using the rotary grain cleaner with 2.5mm slotted screens resulted in a 19% reduction in snails ($p<0.001$) with snail numbers dropping from 30 to 24 per 500g (Figure 1). This reduction was less than predicted from grower experience in the 2018-19 harvest where the 2.5mm screens were seen to remove large numbers of small conical snails (see Figure 1). Cleaning with the 2.2mm slotted screens resulted in a 95% reduction in snail numbers ($p<0.001$) or from 30 to 2 snails per 500g. While this was a great result for snail reduction, the grain losses were 5.5%.

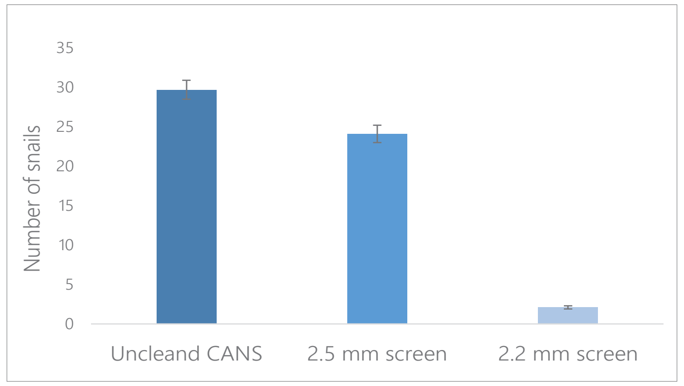

FIGURE 1. Number of small conical snails per 500g sample in canola after cleaning with a rotary grain cleaner using 2.5 mm or 2.2 mm slotted screens. Number of samples: CANS = 51, 2.5mm = 52, 2.2mm = 14.

The CANS used in the trial was a mix of varieties with an average seed size of 1.85mm.

Rotary grain cleaners rely on the difference in size between the snail and the grain to remove snails and there is often a trade-off between removing more snails and minimising grain loss. For this reason, rotary grain cleaners may not be able to clean grain to specification without unacceptable losses. In the 2019-20 harvest a number of growers used rotary grain cleaners prior to rolling their grain, normally with round hole screens. Cleaners reduced snail numbers by 80% on average while grain losses were generally 2% or less. Some growers successfully re-cleaned their seconds grain and delivered it.

PHOTO 2. Snails on the left were removed from the canola (centre) using a rotary grain cleaner with 2.5mm slotted screens. The snails on the right could not be removed using the same screens.

Snail roller

A Kingsway Welding snail crushing grain roller with a combination of four rubber and metal rollers was used in the trial. The settings adjusted on the roller were the hopper opening, which controls grain flow into rollers, and the gap width between the rollers.

PHOTO 3. The snail roller processing canola during the trial.

The PTO speed driving the rollers can also influence the number of snails removed from the grain. Running the roller faster does not necessarily crush more snails and can cause the rollers to heat up and be damaged. Unfortunately, the PTO speed in this trial had to remain fixed at 450 rpm which is higher than the 400-430rpm recommended for canola. This highlights the importance of using a modern tractor to drive the snail roller so that PTO speeds can be easily adjusted.

Snail roller results

Using the snail roller with a roller gap less than or equal to 0.7mm significantly reduced the number of small conical snails in the canola by 43 - 91% ($p<0.001$, see Figure 3). The lowest snail numbers (2 per 500g sample) were achieved where the gap between the rollers was tightest, estimated to be 0.1mm. It is impossible to measure the gap when it is this tight.

Tightening the gap between rollers increased admixture and seed damage (see Figure 3). The admixture increased from 1.3% for the unrolled grain to 3% for that rolled with a 0.1mm gap. This level is still within the 5% limit for CAN1/CAG1 grades but any increase in admixture incurs a price discount.

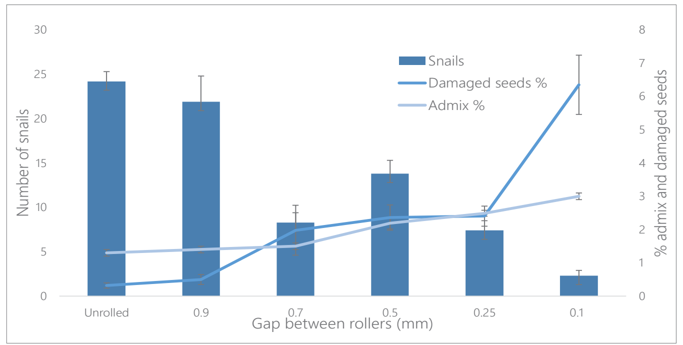

FIGURE 2. The blue columns represent the number of small conical snails per 500g sample of unrolled and rolled canola with a decreasing gap width between the rollers. The lines show the percentage of admix and damaged seeds with tightening of the rollers. Number of samples: Unrolled (52), 0.9 (7), 0.7 (12), 0.5 (17), 0.25 (33), 0.1 (11).

The number of damaged seeds also increased from 0.32% for the unrolled canola to 6.35% in the grain rolled with the tightest gap, more than double the 3% limit for CAN1/CAG1.

We found that with >25 snails per 500g it was harder to remove all the small conical snails in canola than anticipated. We had to run the roller slow and tight to get snail numbers down which caused increased grain damage. Anecdotal information from growers in SA suggests that snails stored for a long time (as was the case here) will have much harder shells.

During the 2019-20 harvest a number of SCF growers either bought or hired a snail roller. Generally growers with higher numbers of snails used a combination of cleaning and rolling or double rolling, to reduce snail numbers and meet GIWA standards. Increases in admix were less than measured here, on average between 1 - 2.2%.

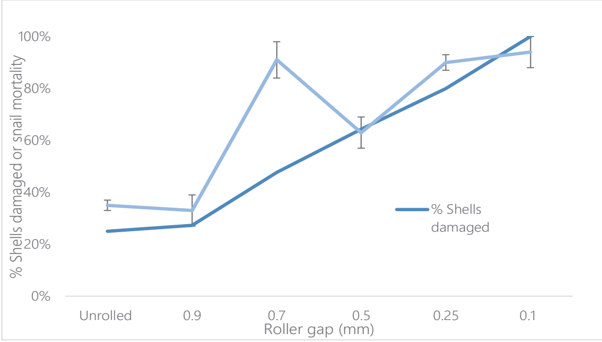

FIGURE 3. The percentage of shell damage and snail mortality in unrolled and rolled canola with a decreasing gap width (mm) between the rollers. Results are not presented for some samples because they had no snails or too few for a reasonable estimate of survival. Number of samples: Unrolled (52), 0.9 (7), 0.7 (12), 0.5 (17), 0.25 (33), 0.1 (11).

Cleaning the grain with the 2.5mm slotted screens did not reduce snail survival and there were too few snails from the 2.2mm slotted screens to make an assessment. Rolling the grain significantly reduced the survival of the small conical snails (Figure 4) when the gap was 0.7mm or less. Sixty five percent of the small conical snails were still alive in the unrolled grain, but this dropped to 6% with a 0.1mm gap.

The increase in snail mortality was mirrored by an increase in snail shell damage with the tightening of the gap (mm) on the snail roller (Figure 4). Shell damage increased from 25% in the unrolled grain to 100% in the canola rolled with a 0.1mm gap. This would have significantly contributed to the death of the small conical snails.

Conclusions

Our trials demonstrated that small conical snails can be successfully removed from canola using a combination of rotary grain cleaning and grain crushing snail rollers. However, if snail numbers are high, care needs to be taken to reduce damage to the canola. During the 2019-20 harvest, SCF members demonstrated that this could be achieved by either cleaning the grain hard prior to rolling and processing the seconds separately, or by rolling grain twice.

Acknowledgments

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GRDC for funding the trial,
CBH for making the grain available and providing staff and facilities for grain testing,
DPIRD: Svetlana Micic for helping with the snail measurements and Andrew van Burgel for statistical analysis, SCF members who helped with the trial.

Growers can now get five 20kg bags for the price of four 20kg bags on Pacific Seeds Triazine Tolerant hybrid canola, Hyola 350TT for the 2019-20 season.

Pacific Seeds is also offering HYOLA 350TT and HYOLA 559TT in bulk bags of 350kg or 500kg for the 2019-20 season, with reduced pricing and extended terms. Talk to your agent today.

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Seed size of Hyola 350TT is 150,000.

Pacific Seeds
Growing possibilities

The cost of removing snails from canola

Small conical snails are an emerging pest in southern WA, and even with appropriate pest management earlier in the year, grain can require cleaning at harvest to avoid costly downgrading. This concern is particularly relevant given the tightening of receival standards for snails in canola and barley during the 2019-2020 harvest.
Stirling to Coast Farmers worked with farm advisor Rod Grieve (Evans and Grieve) to compare the options available for removing small conical snails from canola and estimate the costs.

Currently growers can either:

- Use a rotary grain cleaner,
- Use a snail crushing grain roller (either a small or large model), or,
- Use a professional grain cleaner.

The analysis considered:

- The capital costs of cleaners or rollers and associated field bins, augers etc.
- Depreciation of machinery over time.
- Labour and fuel cost.
- Estimated grain losses.
- Changes in grain quality (increases in admixture or seed damage).
- The change in cost with grain volume.

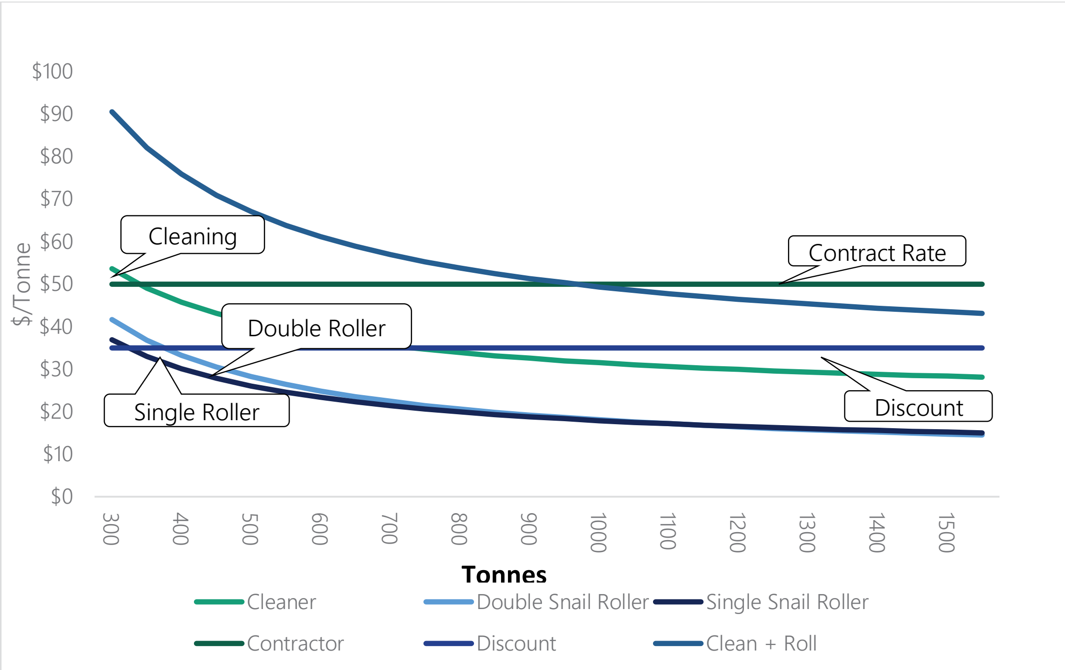

FIGURE 1. Graph showing the cost per tonne of cleaning small conical snails from canola with increasing volumes of grain. Methods assessed include cleaning with a rotary grain cleaner (Clean only), using a professional grain cleaner (Contract rate), using a single or double snail roller, taking the discount at delivery (Discount), or a combination of both cleaning and rolling.

TABLE 1. The individual cost per tonne of cleaning small conical snails from canola for volumes between 300 and 1500 t. Methods assessed as for figure 1

	Tonnes processed												
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
Single Snail Roller	$31	$24	$20	$17	$15	$14	$13	$12	$11	$11	$10	$10	$9
Discount	$35	$35	$35	$35	$35	$35	$35	$35	$35	$35	$35	$35	$35
Double Snail Roller	$36	$27	$22	$19	$16	$15	$13	$12	$11	$10	$10	$9	$9
Contractor	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50
Cleaner	$54	$46	$41	$38	$36	$34	$33	$31	$31	$30	$29	$29	$28
Clean + Roll	$85	$70	$61	$55	$51	$48	$45	$43	$42	$40	$39	$38	$38

Taking a discount on delivery

In the 2018/19 harvest growers paid an average of $35/t for delivering canola with >10 snails per 500g. In the 2019/20 harvest the limit was 10 snails per 500g so for growers with greater than that accepting a discount was not an option. Some growers were forced to use some form of cleaning to get snail numbers below 10 per 500g. A discount applied to canola with 2-10 snails per 500g which was unknown at the time of publishing.

Rotary grain cleaners

Using a rotary grain cleaner was one of the more expensive cleaning options, largely due to grain losses, which we estimated at 5% with seconds valued at $200/t. There is obviously a trade off between using finer sieves to remove more snails and incurring larger grain losses. In our canola trial reducing the slotted screed size by 0.3mm increased grain losses by 5%, but reduced snail numbers by 95%. If growers can manage to process or use their seconds, this would reduce the cost of using a rotary grain cleaner.

Single and double snail rollers

Using a snail roller alone was relatively cheap, because; although the capital cost of the machinery was similar to a rotary grain cleaner, there were no grain losses. Rolling grain to crush snails can damage the canola causing an increase in admixture and seed damage which we tried to account for in this analysis. If admixture increases by 1% at $600/t, there is an added cost of $6/t which contributes about 25% to the cost of rolling. While an increase seed damage could move grain from CAN1 into CAN2 grades, Rod has indicated that most contracts offer CAN2 at no discount, so we did not include a penalty for this change. If canola has a large number of snails, then rolling the grain once may not make the receival standards and rolling a second time may be necessary which will obviously increase the cost.

Contract cleaning

This was difficult to estimate because accurate information about the rates charged by professional seed cleaners to remove small conical snails from canola was hard to obtain. Anecdotally a number of seed cleaners have said that it is difficult to clean small conical snails from grain without incurring significant losses, particularly if the snails are the same size as the canola.

We set the cost per tonne for cleaning the grain at $30/t, which, with an estimated 5% grain losses, means that the cost of getting grain professionally cleaned works out at $50/t. While we have set this as a flat rate here it is likely that the actual cost will vary depending on the volume to be cleaned.

Cleaning and rolling

This was the most expensive option due to the capital cost to purchase a cleaner and roller, and grain losses from the cleaner. However, this system offers growers more flexibility, as, depending on snail numbers and sizes, growers can clean and/or roll in any given year. Growers can clean canola using finer sieves to bring snail numbers right down and lightly roll to crush any remaining snails. Using a light roll on most of the grain will keep admixture low and decrease seed damage, while the seconds from cleaning may then be rolled slow and tightly to recover some value. The value of using a bigger snail roller is that it can process grain at 40-50 t/hr and keep up with a rotary cleaner.

Labour costs

Cleaning or rolling grain is generally a full-time role and not something you can set and forget. Labour costs were based on the need for someone to constantly monitor the grain flow from chaser bins, through various augers and field bins to cleaners, rollers and ultimately onto a truck. In addition, augers and tractors need refuelling, the roller temperature may need monitoring and snail numbers need to be checked to get the best results. While labour contributed between 2 and 7% of the cost of cleaning or rolling grain (which is relatively small), it can be difficult to employ and retain reliable staff in a farming operation and employing an extra employee over harvest to do this may not be a simple thing.

This research would not have been possible without GRDC investment.
Thanks to Rod Grieve (Evans and Grieve) for performing the economic analysis for this report and Harry Jensen (Great Southern Seed Grading) for information on grain cleaning here and in South Australia.

Removing small conical snails from barley

Using a snail crushing grain roller to remove small conical snails from barley

KEY POINTS

- Stirlings to Coast Farmers (SCF) sampled 70t Planet barley while it was being processed using a snail crushing grain roller.
- The snail roller reduced snail numbers in the barley by 70%, from 2.2 to < 1 per ½ hectolitre on average.
- The grower determined the optimal gap between rollers was 0.8mm as this setting did not damage grain while still achieving malt or feed receival standards most of the time.
- Rolling the grain did not affect measurements of hectolitre weight, screenings, skinned or cracked grain, protein, moisture or colour.
- Rolling grain can reduce snail numbers in barley to acceptable receival standards, but the set up needs to be right to maximise throughput while keeping the rollers cool.

Background

Small conical snails are an emerging pest in southern WA. They can damage crops at germination, reduce pasture biomass and potentially downgrade harvested grain if not managed carefully.

Snail management requires a strategic approach that can include removing the green bridge, burning windrows and timely baiting early in the season to prevent snails from breeding. However, even with a good control program, snails can be a problem at harvest.

The 2019/20 grain harvest in WA saw the tightening standards for snail numbers in barley: currently there is a zero tolerance for snails in both grades of malt barley and a limit of one snail per ½ hectolitre in feed barley.

Snail crushing grain rollers have been used for less than 10 years in the Yorke Peninsula to remove snails from grains such as canola, wheat, barley, lentils and beans.

Over the 2019/20 harvest Stirling to Coast Farmers (SCF) set out to measure how effective a snail roller was at removing small conical snails from barley in order to meet the current receival standards. We also wanted to determine the optimal set up of the roller to maximise snail removal whilst minimising grain damage.

SCF sampled 70 tonnes of Planet barley before and after it was processed with a snail crushing grain roller. Before rolling, the barley had on average 2.2 small conical snails per ½ hectolitre.

We measured snail numbers and mortality, hectolitre weight, screenings, skinned and broken grains, protein, moisture and colour using CBH facilities and the current GIWA receival standards.

FIGURE 1. Barley moving from the auger into the hopper of the snail roller. A sensor ensures the hopper remains full to maximise grain turn-over and improve snail removal.

FIGURE 2. The barley flowing between the rollers during sampling. The roller temperature may need to be monitored to make sure it does not exceed 65°C. Using a gap of 0.8mm the roller temperature remained between 48-50°C.

Snail roller

This trial used a modified Shmik snail crushing grain roller which had a combination of rubber and metal rollers. Prior to the trial, the grower had modified the hopper shape and auger to optimise both grain flow and snail removal. The roller speed was 620 rpm and the gap between rollers was 0.8mm. The gap was initially set at 0.4mm but this caused the rollers to exceed 65°C which can potentially cause the rubber to fail. Rolling using a 0.8mm gap maintained roller temperatures of 48-50 °C. Modifications were made to the hopper of the snail roller to ensure that the hopper remained full during rolling. Having a full hopper helped to crush the maximum number of snails while maintaining rolling efficiency.

Snail roller results

Using the snail roller with a roller gap set at 0.8mm significantly reduced the number of small conical snails from an average of 2.19 to 0.67 snails per ½ hectolitre ($p<0.001$) which represents a 70% decrease in snail numbers. Prior to rolling, the samples had 1-7 snails per ½ hectolitre, whereas after rolling the samples had 0-2 snails (Figure 1).

Rolling the grain significantly increased snail mortality by 90% ($p < 0.001$) with the average number of live snails per ½ hectolitre reduced from 1 to 0.1 (n=21).

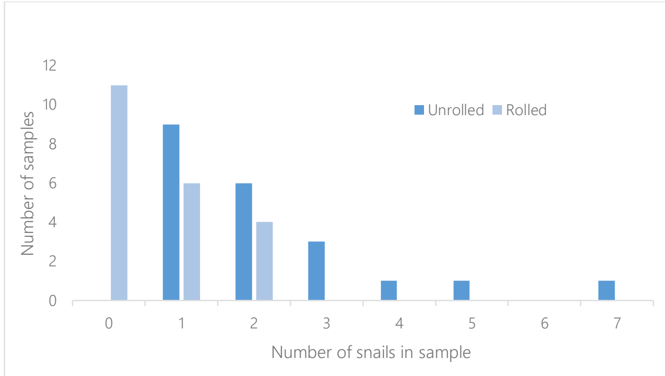

FIGURE 3. The number of snails per ½ hectolitre in unrolled and rolled barley (n=21). 1 snail = more than half a snail shell.

Rolling the barley using a 0.8mm gap between the rollers did not cause any changes to grain quality. There was no significant change in any of the following quality measurements: hectolitre weight, protein, moisture, colour, screenings, skinned or broken grains. This is a reassuring result which demonstrates that under these conditions, rolling barley to remove snails is unlikely to compromise grain quality.

TABLE 1. Grain quality measurements conducted on ½ hectolitre samples using CBH facilities and GIWA barley receival standards. Averages and standard errors are given for 21 samples each rolled and unrolled.

Receival standard	Unrolled	Rolled
Number of snails	2.19	0.67
Std. error	0.34	0.17
Number of live snails	1.00	0.10
Std. error	0.14	0.07
Hectolitre weight (g)	316.9	317.8
Std. error	1.05	1.39
Protein %	11.33	11.54
Std. error	0.09	0.06
Moisture %	12.02	12.00
Std. error	0.03	0.03
Colour	55.8	56.1
Std. error	0.12	0.09
Screenings (g)	33.4	35.0
Std. error	0.76	0.88
Skinned grains/100	6.29	6.86
Std. error	0.64	0.43
Broken grains/100	4.00	3.85
Std. error	0.52	0.36

Summary of rolling trial

The roller removed a large proportion of snails from the barley and allowed 52% of the barley to make malt whereas none of the barley would have achieved malt prior to rolling. This was achieved without damaging the grain and maintaining capacity. However, 29% of the rolled grain was classified as feed barley and 19% was undeliverable because it still had 1 or 2 snails per ½ hectolitre, respectively. To consistently meet the malt grade growers may have to clean barley prior to rolling or roll the grain more slowly and with a tighter gap. This technique has been effective to remove small conical snails from canola.

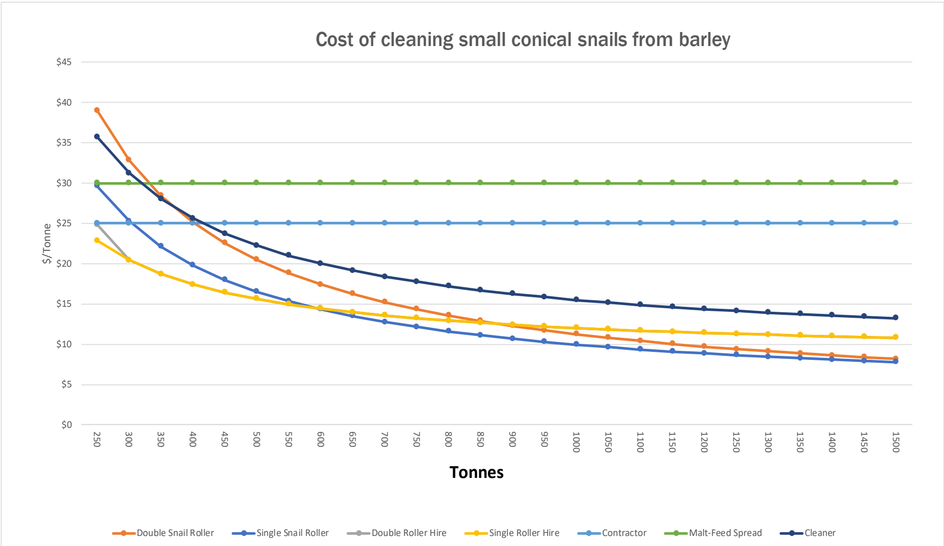

FIGURE 4. Graph showing the cost per tonne of cleaning small conical snails from barley with increasing volumes of grain. Methods assessed include taking the discount at delivery (Discount), using a professional grain cleaner (Contract cost), cleaning with a rotary grain cleaner (Grain cleaner), and buying or hiring a single or double snail roller.

Cost of removing small conical snails from barley

Stirlings to Coast Farmers (SCF) worked with farm advisor Rod Grieve (*Evans and Grieve*) to compare the options available for removing small conical snails from barley and estimate the costs.

Currently growers can either:

- Accept a discount or downgrade
- Use a rotary grain cleaner,
- Hire or buy a snail crushing grain roller (either a small or large model), or,
- Use a professional grain cleaner.

The analysis considered:

- The capital costs of cleaners or rollers and associated field bins, augers etc.
- Depreciation of machinery over time.
- Labour and fuel cost.
- Estimated grain losses.
- Changes in grain quality.
- The change in cost with grain volume.

Taking a discount or downgrading on delivery

In the 2019/20 harvest there was no segregation for barley with higher snail numbers so we couldn't estimate the average discount for exceeding snail tolerances. It was more likely that growers with 1 or more snails had their grain downgraded from malt to feed grades where the average spread was $30/t. Since $30/t is higher than the cost of any other cleaning methods for volumes >350t, most growers would be better off cleaning their grain than accept a discount or down grade due to snails.

Contract cleaning

This is difficult to estimate because accurate information about the rates charged by professional seed cleaners to remove small conical snails from barley are hard to obtain. Anecdotally seed cleaners have said that it is difficult to clean small conical snails from grain without incurring significant losses, particularly if the snails are the same size as the grain. We set the cost per tonne for cleaning the grain at $20/t, which, with an estimated 5% grain losses, means that the cost of getting grain professionally cleaned works out at $25/t. While we have set this as a flat rate here it is likely that the actual cost will vary depending on the volume to be cleaned.

	Tonnes processed												
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
Discount	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
Rotary cleaner	$31	$26	$22	$20	$18	$17	$16	$15	$15	$14	$14	$14	$13
Contractor	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25
Hire Single Roller	$20	$17	$16	$14	$14	$13	$12	$12	$12	$11	$11	$11	$11
Hire Double Roller	$20	$17	$16	$14	$14	$13	$12	$12	$12	$11	$11	$11	$11
Buy Single Snail Roller	$25	$20	$17	$14	$13	$12	$11	$10	$9	$9	$8	$8	$8
Buy Double Snail Roller	$33	$25	$21	$17	$15	$14	$12	$11	$10	$10	$9	$9	$8

TABLE 2. The individual cost per tonne of cleaning small conical snails from barley for volumes between 300 and 1500 t. Methods assessed as for figure 4.

Rotary grain cleaners

While we did not test a rotary grain cleaner in this trial, it is likely to be the first option for many growers if they already have a cleaner on farm. From our canola cleaning trials we know that using a grain cleaner can be one of the more expensive cleaning options, largely due to grain losses, which we estimated at 5%. There is obviously a trade-off between using finer sieves to remove more snails and incurring larger grain losses. In the canola trial we found that reducing the slotted screed size by 0.3mm increased grain losses by 5% but reduced snail numbers by 95%. If growers can manage to process or use their seconds, this would obviously reduce the cost of using a rotary grain cleaner. If a grower has high numbers of snails it may be necessary to use a grain cleaner prior to rolling.

Single and double snail rollers

We compared the cost of hiring or buying a snail roller since both options were used by growers in the 2019-20 harvest. The cost to dry hire a single or double snail roller was $5 or $7 respectively. However, the costs associated with running the roller such as labour, fuel augers and field bins etc. will be the same whether growers hire or buy. The difference in cost of hiring a single or double snail roller was negligible after growers cleaned their first 300t as the speed of the bigger roller compensated for the extra cost. Hiring a roller was cheaper than buying a roller for the first 600-850t cleaned but thereafter became more expensive. The risk of not being able to hire a roller in a timely manner during harvest should be considered if you do not have adequate grain storage on farm.

In this analysis there was no extra cost associated with using a grain roller due to grain damage. However, if you had more snails and were required to run the roller harder to achieve the receival standard, then this will increase the cost of using rollers. Similarly, if growers with high snail numbers were required to either clean the grain before rolling or roll the grain twice to make specification, then the cost of using a roller will increase.

Labour costs

Cleaning or rolling grain is generally a full-time role and not something you can set and forget. Labour costs were based on the need for someone to regularly monitor the grain flow from chaser bins, through various augers and field bins to cleaners, rollers and ultimately onto a truck. In addition, augers and tractors need refuelling, the roller temperature needs monitoring and snail numbers need to be checked regularly. While labour contributed to between only 2 - 7% of the cost of cleaning or rolling grain, it can be difficult to employ and retain reliable staff in any farming operation, and needing an extra employee over harvest in order to clean grain is a significant consideration.

Conclusions

The tolerances for small conical snails in barley are necessarily low, being zero for malt grades and 1 for feed. As a result, it is important to be able to manage snails after harvest. This trial demonstrates that it is possible to remove small conical snails from barley and meet the malt receival standard without damaging the grain.

The grain sampled here had relatively low numbers of snails prior to cleaning (2.2 snails per ½ hectolitre) and we would have liked to have sampled grain with higher snail numbers in order to thoroughly test the roller's capability. However small conical snail numbers in cereals remain relatively low in southern WA. It is most likely that, as with canola, barley containing a higher number of snails will need to be either cleaned and rolled or double-rolled to achieve the tight receival standards.

What's next?

SCF have their own snail roller which was hired out during the 2019-20 harvest to growers as needed. We will continue to monitor growers who are cleaning grain with either the SCF roller or their own machines and share information gathered on the best techniques to clean small conical snails out of grain.

Acknowledgments

SCF would like to thank

- GRDC for investing in the trial,
- CBH for providing facilities for testing grain samples,
- Rod Grieve (*Evans and Grieve*) for completing the economic analyses on the cost of removing snails from barley.
- DPIRD: Svetlana Micic for advice with the snail measurements and Andrew van Burgel for statistical analysis,
- SCF members for allowing us to sample their grain during harvest and sharing their valuable experience with others.

Smart farms initiative

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

Australian Government

National Landcare Program

The Stirlings to Coast Farmers (SCF) Smart Farm Initiative is a three-year project that road-tests and implements a range of digital tools & technology to show how farmers can improve yield and productivity through technology adoption, learning and awareness. Some of the many tools tested & implemented on the SCF Smart Farms include sensor solutions (weather stations, GPS location trackers, soil moisture probes & tank level sensors), connectivity options (wireless internet, WiFi, Sigfox & LoraWAN); and also information technology equipment (machine learning, drones, security trackers & remote monitoring).

In late 2019 SCF established two smart farm demonstration sites in the high rainfall zone of southern WA, with both sites having slightly different operation & technology focuses:

The first smart farm demonstration site is located in Woogenellup, and this site is hosting a range of technology solutions to demonstrate how farmers can take advantage of new technology in grain production systems. Further to this, there will also be a strong focus on the use of digital systems to help farmers better manage climate variability and how to adapt to an increase in frequency and intensity of extreme weather events. This trial site is utilising a mixture of cellular technologies and LoRaWAN connectivity for sensor networks.

The second smart farm demonstration site is located in West Kendenup. It focuses on a range of AgTech solutions available that will help grain farmers mitigate risk by integrating sheep/pasture systems into their cropping systems. This farm is utilising a variety of IoT solutions such as weather stations and data to improve soil health and crop/pasture performance. This demonstration site is using a combination of LoRaWAN & SigFox sensor networks.

In addition to the two demonstration sites, Stirlings to Coast Farmers will be holding mini-trial experiments in additional locations throughout our membership base to test other complementary technologies.

Project Aims:

- Define what AgTech solutions are currently available, what works and what currently doesn't.
- Identify any upcoming technologies that are most likely going to contribute effectively to improved practice change.
- Improve grower knowledge on the use of digital technologies.
- Improve climate resilience – Improve the ability for landholders & managers to predict, plan, respond and recover to/from adverse seasonal conditions.
- Improve soil health, fertility and crop performance - reducing the effects of soil acidity, compaction, waterlogging and chemical/pesticide use.
- Pasture and feedlot performance – maximising feed conversion efficiencies through improved pasture and crop management.
- Removing the barriers to technology adoption by identifying which tools are most useful and likely to return an economic benefit to the farm.
- Improve on-farm connectivity and decision-making processes through the use of IoT equipment and decision support platforms.

Smart Farm Trials:

A wide range of technologies currently being assessed include:

Hyper-Local Weather Forecasting –

In Partnership with DTN, SCF is presently testing the application of internet-connected weather-stations that utilise predictive weather forecasting models. These systems use an adaptive learning model, where current weather data is compared against predicted weather.

Soil Moisture Probes

SCF is currently trialling soil moisture probe solutions from AxisTech & an in-house custom-built solution. These probes measure soil moisture content and soil temperature to depths of up to 80cm. This information can then be implemented into sowing and nutrient applicated decisions.

Remote Rain Gauges

A range of remote rain-gauges have been dispersed across both demonstration sites. These rain-gauges measure rainfall events in 0.2mm increments, in the ultimate bid to gain a better understanding of rainfall variation against the landscape.

Tank Monitoring

Managing water levels for stock and spraying purposes is imperative, to keeping operations moving forward. SCF will be analyse a range of tank monitoring solutions from low-cost stations to advanced monitoring stations that allow farmers to add in additional sensors and have messaging alert systems in place, to make sure you never run out of water.

UAV Based Weed Mapping & VR Knockdown Applications

In partnership with Hummingbird Technologies, Stirlings to Coast Farmers is testing the potential for drone-based imagery to be utilised in developing spray maps. These drone-based maps could potentially be a lower-cost alternative option to utilising GreenSeekers or Weed-its.

Aggregated & Customised Dashboarding

Aggregating data from a wide range of sensors is a time-effective way of managing all your data in one place, with one single login. The Smart Farm Initiative will be utilising PairTree for aggregated data services, where the SCF soil moisture probe data will be displayed in conjunction with plant biomass/NDVI imagery, virtual weather stations & additional sensor data streams.

Farm Connectivity

A mixture of cellular, point to point WiFi & infrastructure WiFi solutions will be tested and analysed to improve on-farm connectivity beyond the farmhouse, and into farm-buildings and stockyards. This is in addition to the publicly available, subscription-based SigFox network established in Mount Barker and self-hosted LoRaWAN networks established on-farm.

Key Considerations when implementing Smart Farm Technologies

- Identify your on-farm problems before choosing your sensor. Consider current sensors available, and where you might like to head towards the future.
- Determine what sensor networks currently exist in your area before choosing your connectivity method. Cellular based stations may be more cost-effective than LoRaWAN or Sigfox based solutions if you're not planning to connect too many devices.
- Consider the long-term cost-benefit of implementing IoT, rather than just the upfront price. Significant savings can be made on tank monitoring & remote rain-gauge technologies.
- Make sure the system is fit for purpose, well designed, and you have access to excellent customer support. Things won't always work!
- Some sensors have their limitations, so make sure you select the right sensor for the purpose. For handy sensor selection hints, check out the SCF Smart Farms Workshop Manual or request a free copy.

Smart Farm Calculator

Not sure what the long-term cost benefits of implementing remote rain-gauges or tank monitoring are? We've created a free calculator to help determine the costs/savings over 5 years. To find out more, please visit **https://bit.ly/smartfarmcalculator.**

Acknowledgements:

The development of the Smart Farm Demonstration Sites was made possible through funding support from the Australian Government National Landcare Program: Smart Farms Small Grants program & the WA Government

Improving soil health by ameliorating subsoil compaction and subsoil acidity

Key Messages

- Ameliorating subsoil compaction and improving subsoil acidity improved barley grain yields by >1t/Ha at this trial site in 2019.
- Soil pH changes, in only 12 months, confirm Inclusion plates are effective at moving lime into the acidic subsoil.
- Results from the first 12 months confirm that high lime rates on the soil surface do not reduce subsoil acidity. Potential lime movement into the acidic subsoil is expected to take many years without tillage.
- Lime sourced on-farm performed equally to imported lime when adjusted for neutralising value percentage (NV%). Determining future value of on-farm lime sources may require different lime tests.
- The longer-term monitoring of this deep ripping site and other SCF Tillage sites will help estimate costs and benefits of applying controlled traffic farming (CTF) in our region.

Purpose

To evaluate if deep ripping with inclusion plates moves surface applied lime into the acidic sub-soil at a greater rate than lime spread on the soil surface. Secondary opportunity: To evaluate on-farm Lime source vs commercial Lime.

Summary

The aim for this trial was to evaluate if applying lime prior to deep ripping, with inclusion plates, was worthwhile economically for growers on the south coast of WA. It is expected that lime will move into the acidic subsoil much faster after ripping than surface applied lime and this could accelerate the payback for the ripping and lime costs through higher grain yields.

Some growers have been applying robust amounts of lime for the last two decades on the south coast. Deep ripping to remove compaction is a relatively new practice that farmers are starting to adopt on a wide-scale basis. Researchers hope to show that liming before deep ripping will alleviate acidic subsoils faster with minimal extra cost since deep ripping is already being completed in compacted soils. NB: Inclusion plates create extra 'drag' on the tractor which increases fuel usage as well being a wearing part themselves. The exact costs of running inclusion plates have not been analysed in this project.

Treatments

Treatment 1. Deep Rip + Inclusion plates with Nil Lime

Treatment 2. Deep Rip + Inclusion plates with 5t/Ha Boyanup Lime

Treatment 3. Deep Rip + Inclusion plates with 12t/Ha Willis (on-farm) Lime

Treatment 4. Lime – 5t/Ha Boyanup Lime without deep ripping

Treatment 5. CONTROL- Nil Ripping and Nil Lime

Site measurements

SOIL TYPE: site is deeper duplex sand over gravel/clay at >45cm to duplex layer. The trial area was grid sampled for sub soil compaction.

TABLE 1. Treatment average yields with two replicates and two measurements of yield. One set of yield data was collected using a weigh trailer. The second yield data set was obtained from the header yield monitor. *Figures followed by the same letter or symbol do not significantly differ (P=.05, LSD)*

Treatment	JD Yield Map (t/Ha)	Weigh Trailer plot Yield (t/Ha)	
Deep Rip with Nil Lime	4.93 t/Ha	4.92 t/Ha	ab
CONTROL Nil Rip & Nil Lime	4.40 t/Ha	4.29 t/Ha	a
Deep Rip + 12t/ha Willis Lime	5.23 t/Ha	5.33 t/Ha	b
Nil Rip + 5t/ha Boyanup Lime	4.29 t/Ha	4.20 t/Ha	a
Deep Rip + 5t/ha Boyanup Lime	5.49 t/Ha	5.44 t/Ha	b

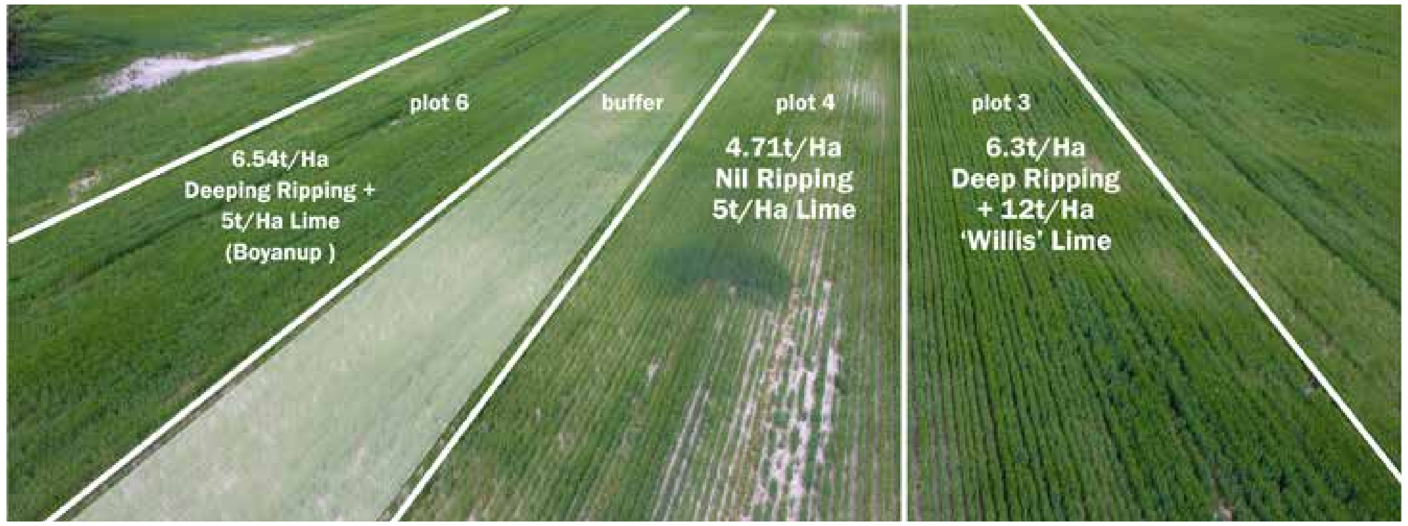

FIGURE 1. Displays the differences in biomass from four different treatments at the Willis trial site. Photo taken 19 September 2019.

2019 Results

Trial harvested 16 November 2019 and plot yields measured using both a weigh trailer and analysis of John Deere Yield map for the trial site. There was less than 4% variation between the two methods.

Without the aid of the yield map data the treatment differences were not significant at the P= 0.05 level but significant at the P= 0.1 level. Within plot analysis of the trial by Murdoch University shows treatment differences at P= 0.05. This is because in the sandy Duplex soil, the variation in depth to clay adds more variability in yields within replicates.

The trial is only 12 months old and SCF will monitor for at least two more seasons. With three years of yield data we will be able to complete a simple cost benefit analysis between the treatments.

Trial Site Subsoil Acidity

The trial site was intensively soil tested in February 2019. Results confirmed that soil pH was consistently lowest at 10-30cm soil depth with pH ranging from 3.8 to 4.27 (highly acidic).

TABLE 2. Summarises the soil pH ($CaCl_2$) for the five different treatments in December 2019, after the lime treatments were applied in March 2019.

Treatment	Soil Depth	pH CaCl2	Soil Depth	pH CaCl2
CONTROL- Nil Rip & Nil Lime	0-10cm	4.75	10-30cm	4.20
Deep Rip & Nil Lime	0-10cm	4.55	10-30cm	4.30
Deep Rip 12t/ha Willis Lime	0-10cm	6.15	10-30cm	5.25
5t/ha Boyanup Lime- Nil Rip	0-10cm	6.35	10-30cm	4.40
Deep Rip + 5t/ha Boyanup Lime	0-10cm	6.4	10-30cm	6.15

TABLE 3. Average soil pH pre-season (for whole site) and post-harvest for each of the treatments. Values in red denote very low pH levels that are suboptimal for crop growth

	Pre-season pH (CaCl2) Averages	Post-Harvest: Control plots pH	Post-Harvest: Deep ripped + Boyanup Lime 5t/Ha plots pH *Within rip lines*	Post-Harvest: Deep ripped + Boyanup Lime 5t/Ha plots pH: *Outside of Rip Lines*	Post-Harvest: Deep Ripped + Willis Lime 12t/Ha: *Within Rip Lines*	Post-Harvest: Deep Ripped + Willis Lime 12t/Ha *Outside of Rip Lines*
Topsoil 0-10cm	4.7	4.6	6.3	6.3	5.9	5.9
Subsoil 15-25cm	4.1	4.2	6.1	4.4	6.0	4.5

TABLE 4. Comparison of particle size distribution and neutralising value of imported Boyanup Lime and Willis's on-farm sourced lime.

		Particle Size Fractions (%) from dry* sieving					%NV
Sample	%Moist	>2mm	>1mm	>0.5mm	>0.25mm	<0.25mm	
Willis Average	16	28	12	18	24	18	35
Boyanup	5	0	1	33	52	14	86

Points to note

- Deep Ripping alone has given a 0.53t/ha yield advantage over the control (Nil Lime & Nil Rip) .
- Deep Ripping + 5t/ha Boyanup Lime has given an additional 0.56t/ha to ripping alone for a total of 1.09t/ha higher yield than the control.
- Deep Ripping + 12t/ha Willis Lime has given an extra 0.3t/ha yield advantage over ripping alone for a total of 0.83t/ha higher yield than the control.
- The yield differences between the ripping treatments and the different lime sources were not significantly different. (Remembering the liming rates (t/ha) were different but the effective neutralising value were the same).
- The increased grain yield from deep ripping was pleasing to see, although not unexpected because results were consistent with other research on similar soils.
- The lack of yield response from 5t/ha Boyanup lime applied to the soil surface was not surprising based on previous research.
- The differences in the top soil pH change in the topsoil (0-10cm) of 5t/ha Boyanup Lime treatment (Nil Rip) compared to the control (Nil Lime & Nil Rip) was significant, only 9 months after application.
- The pH of the control treatment in the 10-30cm is similar to the 5t/ha Boyanup Lime surface applied. This indicates little movement of lime into the acidic subsoil after only 10 months.

Why the two sources of Lime?

The imported Boyanup lime (screened) with high NV is a good comparison with Willis's own on-farm lime. High rates are used because the objective was to test different subsoil acidity treatment options while dealing with the sub soil compaction. For the two sources of lime, rates were adjusted for NV% in determining application rates.

The effectiveness of a lime source as an ameliorant for soil acidity depends not only on the neutralising value (%NV) but also on the particle size distribution. Lime particles less than 0.5 mm are most effective in neutralising soil acidity in the first year of application (Dr Craig Russell, UWA Albany Centre, pers comm).

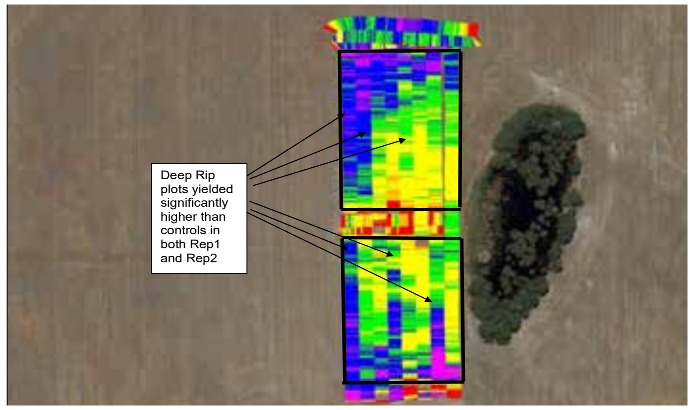

FIGURE 2. Yield map output for the Lime Ripping trial site at Clint Willis's property.

FIGURE 3. Soil profile at SCF Spring Field Day showing test dye color confirming lime at depth concentrated in rip lines > pH 5.5 (green) vs soil between rip lines < pH 4.2 (Yellow by color chart).

Discussion

The 2019 results clearly showed a yield advantage to ameliorating compaction and subsoil acidity through liming before deep ripping. We hypothesized there would be a yield improvement from the deep ripping, but it was surprising to see the liming + ripping having an additive effect on grain yield. Surprising because lime applied on the soil surface without incorporation rarely improves grain yield in year one, which is what we saw in this trial.

Results from a single year of data indicate growers should apply lime before deep ripping in sand plain soils when they have subsoil acidity. Amelioration of subsoil acidity was faster in this trial compared to surface applied lime. SCF researchers look forward to collecting yield results in the next two seasons to further evaluate yields and soil pH changes over time. It will be especially interesting to monitor the performance of the two different lime sources over the coming years. Initial estimates of lime costs are that the farm sourced lime applied at 12t/ha is cheaper than applying 5t/ha of commercial lime.

SCF would like to thank the Willis family for their cooperation in managing this trial for SCF and the funder: National Landcare Program.

Summer forage crop demonstration

Stirling to Coast Farmers (SCF) wanted to investigate the use of summer forage crops to take advantage of the summer rain that generally falls on the south coast as a potential cost-effective feed for livestock during the autumn period when feed is usually scarce.

A summer forage demonstration site was hosted by SCF member Jeremy Walker at Green Range in 2019/20. Jeremy grew Shirohie millet and Pallaton Raphano as alternate summer forage crops.

The site consisted of a 67ha paddock of Shirohie millet; 2000 lambs were put on the paddock to graze for a 37-day grazing period. The lambs were weighed into the paddock on November 28, 2019 at an average weight of 41.8kg, and weighed off on January 3, 2020 with an average weight of 46.2kg.

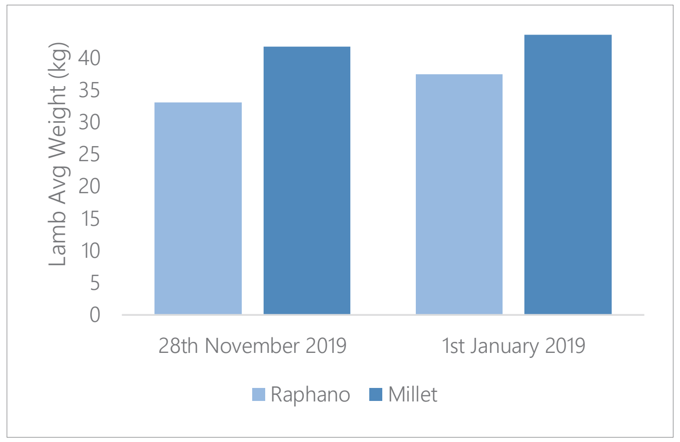

FIGURE 1. Crossbred lamb liveweight gains (kg) grazing Shirohie millet and Pallaton Raphano paddock over a 37-day period from November 28, 2019 to January 3, 2020. Average weight gain was 4.4kg per animal

The average weight gain per animal was 4.4kg over the 37 days. This gave an average daily weight gain of 118 grams. The average lamb liveweight gain across the 67ha was 3.5kg per hectare, per day (fig 1.)

The Pallaton Raphano demonstration trial had 300 lambs grazing a 12ha paddock over a 37-day grazing period. The lambs were weighed onto the paddock on November 28, 2019 with an average weight of 33.1kg and weighed off the paddock with an average weight of 37.5kg. This equated to a an average liveweight gain of 4.4kg. The average live weight gain across the 12-hectare paddock was 2.95kg per hectare.

FIGURE 2. Shirohie millet crop before grazing 28th November 2019 at Jeremy Walker's – Green Range

Visually there was more biomass in the millet paddock compared to the Raphano. Considering the dry period, where less than 10mm of rain fell between seeding (Oct 3, 2019) and January 3, 2019, Jeremy was happy with the liveweight gains off both forage crops.

With little rainfall over summer in 2019/20, the green feed grown in the demonstration paddocks was valuable for his mixed farming enterprise. The rainfall data shows there was 21.5mm in October 2019, 4.6mm in November, and 4.5mm in December. The cost of both the millet and Raphano seed was approx. $100/ha and $15/ha for fertiliser.

Growing summer crops means Jeremy can grow cost-effective feed, which will be available to livestock during the summer-autumn period when feed is normally scarce. Despite the recent summer being very dry, Jeremy was able to extract value from his summer cropping activities. SCF have recently obtained continued funding from MLA to continue measuring the feed value and liveweight gain from summer crops. We are interested in measuring these crops, and others, in a more average rainfall year when the south coast would receive higher rainfall than it did in the 2019/20 summer.

FIGURE 3. Pallaton Raphano crop before grazing 28th November 2019 at Jeremy Walker's – Green Range, WA.

Growing long season winter wheats on the South-coast of WA

Key points

- Early autumn rainfall provides an opportunity to establish crops much earlier than currently practiced in the southern high rainfall zone (HRZ) of WA.
- Winter wheats can be sown from early to late April depending on soil moisture conditions.
- Early sown winter wheats can provide valuable grazing opportunities for mixed farmers in the southern HRZ of WA, with minimal yield penalties.
- Winter wheats have much less risk from frost damage when sown earlier compared to spring type varieties due to their vernalisation requirements.
- Stirlings to Coast Farmers research has shown that winter wheats (E.g. Illabo and DS Bennett) can grow equivalent yields to mid and fast maturing wheats (E.g. Trojan and Scepter) sown late April onwards.

Key terms

- WINTER WHEAT: Winter wheats require a vernalisation period for them to progress beyond the tillering phase. For example, DS Bennett, Naparoo, Longsword
- VERNALISATION: Induction of the plants flowering process due to prolonged exposure to cold temperatures.
- SPRING WHEATS: Wheat that does not require vernalisation which means it can be sown in the autumn so it can flower in spring. For example, Mace, Scepter, Trojan, DS Pascal.
- PHOTOPERIOD: Refers to the time that a plant is exposed to light in a 24-hour period.
- OPTIMAL FLOWERING TIME: Defined as the time that minimises the combined risk of frost, drought and heat stress and therefore maximises grain yield.

Introduction

When selecting a variety and sowing time combination, the intention is to match plant development with seasonal pattern and most importantly to get the crop to flower during the optimal period for yield. The optimal flowering period is a trade-off between increasing drought and heat, and declining frost risk. There is no 'perfect' time to flower where these risks are nil, only an optimal time when risks are minimised and yield potential maximised. Winter rainfall in southern WA is declining, and season breaking rains are inconsistent. Despite winter rainfall declining, southern growers, often get opportunities to sow early through summer and early autumn rainfall events.

Winter wheat has a vernalisation requirement, which means the plant needs a certain period of cold temperatures before they will develop past tillering. At early sowing dates, flowering time will be more consistent in a winter wheat compared to a spring wheat variety. When spring wheat, such as Scepter, is sown early, it flowers early, which means it has a high risk of frost damage. Winter wheat sown in late March will not flower much later than when planted in April. SCF secured funding through the Royalties for Regions, Agricultural Innovation Fund, to investigate if winter wheat could provide benefits to cropping systems in the southern high rainfall zone of WA.

Winter wheat extends the sowing window until much earlier in the growing season compared to the narrow sowing window for traditional spring varieties. When growers seed earlier, if conditions allow, more crops are going to be planted within their optimal sowing window, which means whole-farm crop yields will increase. SCF conducted a combination of small plot trials, with two times of sowing, and broad-scale farmer trials between 2016-18. The research was conducted on a range of wheat maturities from slow winter types (DS Bennett) to fast spring types, like Scepter. Trials covered a range of seeding times, which enabled SCF to explore which maturity types suited the environment on the south coast of WA.

FIGURE 1. Photo of the second time of sowing at the Kendenup plot trial in 2018. Photo was taken on August 15, 2018.

FIGURE 2. Lynch farm-scale long season wheat trial at Perillup, WA in 2017. This was the highest yielding farm-scale trial grown in the project between 2016-18. Seeding date was April 27.

TABLE 1. Summary of grain yields from the broad-scale long-season wheat trials in 2018. Sites encountered a range of environmental conditions, including frosts. (W) indicates a winter type wheat variety. NB: Cobalt (4.3d ▲) at Perillup suffered Kangaroo damage reducing yield and DS Pascal (1.3b*) suffered frost damage. *Means followed by the same letter or symbol do not significantly differ (p=0.5, LSD)*

Location	Perillup	Kojaneerup	West Kendenup	South Stirlings
Sowing date	April 27	May 4	Mya 9	April 12
GS Rainfall	414mm	221mm	362mm	256mm
ADV.0008 (W)	6.7ab			3.4a
Cobalt	4.3d▲	3.6b	4.6b	
DS Bennett (W)	7.3a	3.3bc		3.3a
DS Pascal	5.5bc	3.2c	3.7d	1.3b*
Kinsei	5.8bc		4.3bc	
Longsword (W)	5.1cd	3.3bc	4.2c	3.3a
Trojan		2.7d	4.3bc	
Plant Barley		4.8a	6.1a	

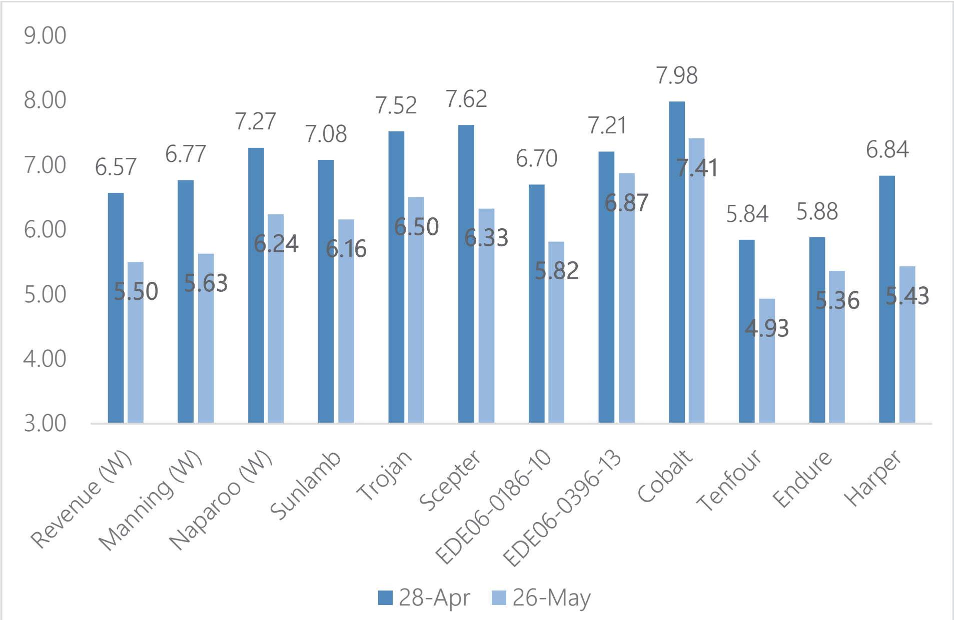

FIGURE 3. Small plot yields for the 2016 long-season wheat trial located at Kendenup, WA. The first time of sowing (TOS) was April 28 and the second TOS were May 26, 2016. (W) indicates a winter-type maturity.

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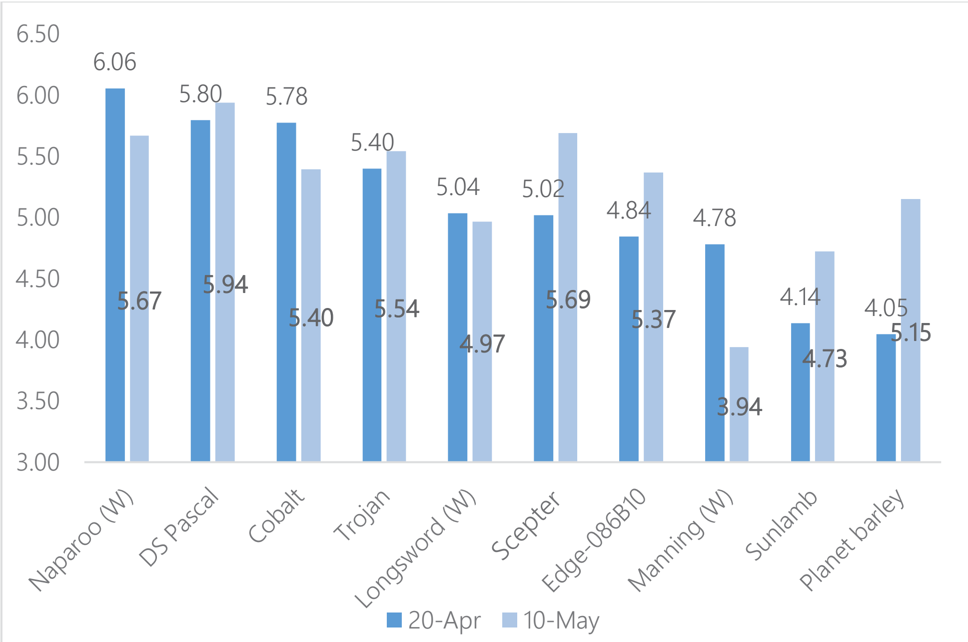

FIGURE 4. Small plot yields for the 2017 long season wheat trial located at Manypeaks, WA. The first time of sowing (TOS) was April 20 and the second TOS were May 10, 2017. (W) indicates a winter-type maturity.

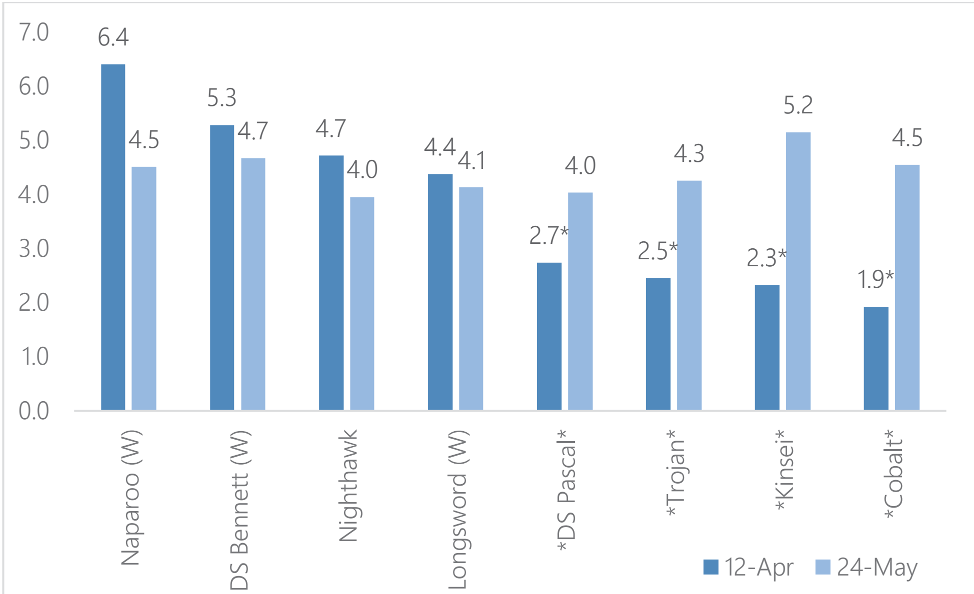

FIGURE 5. Small plot yields for the 2018 long season wheat trial located at Kendenup, WA. The first time of sowing (TOS) was April 12, and required 13mm of irrigation to ensure germination. The second TOS was May 10, 2018. (W) indicates a winter-type maturity. *Variety* Indicates yield reduction due to frost

TABLE 2. Summary of small plot trial data for Stirlings to Coast Farmers long-season wheat project between 2016-18. Displays average yields for the winter and spring type wheats over two different sowing dates.

Year	Variety	TOS 1	TOS 2	Seeding Date	Location
2016	Winter	6.87	5.79	TOS 1- 28 April	Kendenup
2016	Spring	6.97	6.02	TOS 2- 26 May	Kendenup
2017	Winter	5.29	4.86	TOS 1- 20 April	Manypeaks
2017	Spring	5.23	5.46	TOS 2- 10 May	Manypeaks
2018	Winter	5.36	4.44	TOS 1- April 12	Kendenup
2018	Spring	*2.84*	4.39	TOS 2- May 24	Kendenup

Discussion

- Winter wheat yields are comparable or better than spring wheats when sown early (April 12, 20 and 28th) in our research.
- Winter wheat yields were significantly higher than average spring wheat yields when sown on April 12, 2018. This was due to frost events damaging spring wheat yields, whilst not affecting the winter varieties.
- Sowing earlier only resulted in higher yields in 1/3 years for spring varieties. The 'earlier' sowing date was April 28, which is not much earlier than standard grower practice in the southern HRZ of WA.
- Sowing earlier resulted in higher yields for winter wheats in all three seasons (2016-18).
- Our limited data from sowing earlier than April 12 suggests there can be a penalty from seeding winter wheats too early. Critical factors to consider are variety season length and soil moisture.

Conclusion

- Sowing winter wheats early (April 12-28) did not result in yield losses compared to spring wheats sown in their traditional sowing window in Southern WA in 2016-18.
- In 2018 we experienced multiple frost events at the Kendenup plot site and this showed the value of seeding winter wheats early (April 12) compared to spring varieties. Winter wheats have a stable flowering time regardless of sowing date because they require vernalisation (cold period) before they develop beyond tillering.
- SCF research shows winter wheats can be sown earlier without the risk of frost damage yet still yield competitively with spring wheats sown at the normal time. This provides an opportunity to spread the seeding window out which means more hectares will be planted in the ideal sowing window. Planting more hectares in the ideal seeding window will increase whole farm yields and profits.
- Winter wheats are an opportunity crop to take advantage of early soil moisture. Even in perfect conditions winter wheats are not likely to exceed 25% of a grower's total wheat program.

Tips for growing winter wheats

1. Ensure there is adequate soil moisture for even germination. Ideally, moisture to last until the autumn seasonal break.
2. SCF research indicates the ideal sowing time for long-season wheat varieties in southern WA is April 7-21.
3. Sow into a paddock with a low weed burden because ryegrass will germinate too late to be controlled in the knockdown.
4. In paddocks with grass weed pressure, use pre-emergent herbicides that have longer residual control on ryegrass (E.g. Sakura).
5. When planning to graze, growers should seed a minimum of 100kg/ha to maximise early-season biomass for feed.
6. Apply nitrogen after grazing to maximise the re-growth of the crop.
7. Apply nitrogen after grazing to maximise the re-growth of the crop.

TABLE 3. Examples of wheat varieties and sowing windows on the south coast of Western Australia

	Winter wheats	Slow Maturing Spring Wheat	Mid-Maturing Spring Wheats	Fast-Maturing Spring Wheats
Sowing Window	*Mid-March - Mid April*	*Mid-April- Late April*	*Late April- Mid May*	*Mid May onwards*
Variety Examples	Accroc	Beaufort	Kinsei	Corack
	DS Bennett	DS Pascal	Magenta	Mace
	Longsword	Nighthawk	Rockstar	Scepter
	Naparoo		Trojan	
	Revenue		Yitpi	

Growing Noodle Wheat in the High Rainfall Zone of WA

Key points

- Modern noodle wheat varieties Kinsei, Ninja and Zen, yielded more than Calingiri in almost every trial conducted by SCF between 2016-18.
- Southern HRZ noodle wheat growers reduce the risk of downgrades due to falling numbers and germ end staining by sowing noodle wheat later in the program.
- Southern HRZ growers try to avoid planting noodle wheat within 30km of the coast to reduce risks of harvest rain, and quality downgrades.
- Southern growers reduce grain quality risks by prioritizing the harvest of noodle varieties. Noodle wheat should be harvested once the crop is ripe and moisture is below 13.0%. HRZ growers can harvest noodle wheat at >13% moisture and dry the grain when it is economical to do so.
- Kinsei has good physical grain characteristics and provides a general udon quality improvement compared to Calingiri and Ninja.

Introduction

Growing noodle wheat in the high rainfall zone (HRZ) has been regarded as a 'risky' crop to produce for many grain growers. One hazard to producing noodle wheat is the volatile price. Price instability of noodle wheat can be due to market and environmental conditions. The southern climate regularly experiences harvest rain on mature wheat, which can lead to the grain sprouting and germ end staining. The price reduction for missing noodle wheat grades (ANW1 or ANW2) is usually very steep.

The noodle wheat market requires approximately one million tonnes of grain annually to supply Japan and Korean consumers. Southern WA is usually the last region to start harvest and once noodle wheat demands are fulfilled the price falls dramatically. Southern growers are more likely to harvest noodle wheat after the market demands have been met.

Wheat on the south coast has traditionally had lower yields and profit margins compared to barley. Malt barley varieties are high-yielding and well suited to our region. When barley misses malt specification, the high yields and sometimes minimal price difference, maintains profitable gross margins. Noodle wheat is capable of achieving gross margins similar to canola or barley but is often less due to grain quality discounts and low prices.

Stirlings to Coast Farmers investigated if a better agronomic package could simultaneously improve grain yields and reduce the risk of missing noodle grade specifications. If both parameters could be improved, noodle wheat would be a less risky crop for southern HRZ growers to plant. An increase in noodle wheat plantings would likely come as a substitution for barley hectares which is beneficial for crop rotations and economic diversity.

FIGURE 1. Kinsei wheat on the left and Ninja on the right at Frankland on November 8, 2018. Trial was sown on June 4, 2018.

FIGURE 2. Drone image of the Tenterden noodle wheat farm-scale variety trial in 2017.

Table 1. Summary of the noodle wheat yields from Stirlings to Coast Farmers trials in 2016-18. Yields are in (tonnes/hectare). Trials include small plots and farm-scale data sets.

				ANW	ANW	ANW	ANW	APW
Trial type	Location	Year	Sowing date	Kinsei	Ninja	Zen	Calingiri	Trojan
Small Plots	Woogenellup	2016	May-27	N/A	5.91	6.01	5.93	6.03
Farm-scale	Perillup	2016	Jun-02	N/A	N/A	6.31	5.92	6.24
Farm-scale	Gnowellen	2016	May-20	N/A	N/A	6.25	6.04	6.24
Farm-scale	Tenterden	2016	May-30	N/A	N/A	3.03	2.53	2.54
Small Plots 80kg/ha	Kendenup	2017	May-26	6.66	6.68	6.52	5.82	5.92
Small Plots 150kg/ha	Kendenup	2017	May-26	7.19	7.10	7.01	N/A	N/A
Farm-scale	Gnowellen	2017	May-29	N/A	4.91	4.61	4.55	4.49
Farm-scale	Tenterden	2017	May-26	N/A	5.29	5.5	5.26	5.96
Farm-scale	Tambellup	2017	May-30	N/A	2.23	2.28	2.28	2.66
Small Plots 110kg/ha	Tenterden	2018	Jun-16	2.76	2.64	2.57	2.24	2.32
Small Plots 135kg/ha	Tenterden	2018	Jun-16	2.80	2.80	2.49	2.62	2.33
Farm-scale	Kendenup	2018	Jun-11	6.36	5.81	5.70	5.52	5.35
Farm-scale	Frankland	2018	Jun-04	6.07	5.92	5.76	5.44	5.86
SCF Trials Average 2016-18				**4.93**	**4.69**	**4.75**	**4.51**	**4.66**

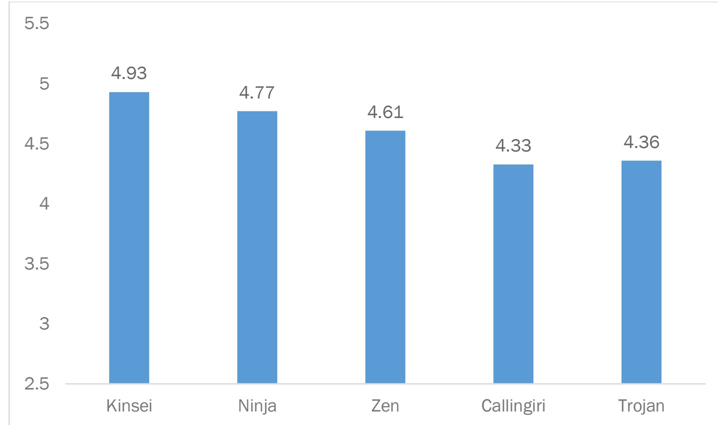

FIGURE 3. Displays the average noodle wheat yield (tonnes/hectare) from five different Stirlings to Coast Farmer trials in 2017-18. Trojan is an APW wheat and is included as the regional standard.

Conclusion

New noodle wheat varieties are higher yielding than Calingiri in the southern HRZ of WA. The high yield potential of Kinsei particularly, acts as a buffer to price drops from market conditions or grain quality challenges. Some growers in the region are regularly achieving high yielding noodle wheat crops that satisfy ANW1 quality parameters.

The basic agronomy package sees growers selecting the modern varieties such as Kinsei, Ninja and Zen, seeding high sowing rates and planting after May 20. Fertiliser is supplied to feed a 6t/ha grain crop and usually two foliar fungicides are applied in addition to a seed dressing.

Harvesting noodle wheat is prioritized where possible, due to the economic penalty of missing noodle grades.

Growers factor in the weather forecast, noodle wheat price and the cost of drying grain when making these decisions. One way to reduce price volatility of noodle wheat is to increase international demand of our product. SCF and the Western Australian Producers Co-operative have made small steps in this area but require ongoing support to continue.

High yielding noodle wheat that achieves ANW classification has similar gross margins to barley and canola crops. The latest varieties are a significant yield and quality improvement on Calingiri which will increase grower profits. Careful consideration of paddock selection, location and grower logistics will reduce the risk of noodle wheat failing to meet specification in the HRZ.

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Thanks to project partners Intergrain for this contributions to this study.

FIGURE 4. Drone image of the Frankland broad-scale noodle wheat variety trial on November 8, 2018. The trial was seeded on June 4, 2018.

Tips for growing Noodle wheat in the Southern HRZ of WA

1. Sow more than 30km from the coast where possible to reduce the risk of harvest rainfall affecting grain quality.
2. Sow noodle wheat later in the seeding program to mitigate risk from late-season rain.
3. Data from SCF trials from 2016-18 indicate noodle wheat maintains excellent yield potential when sown after May 20, on the south coast.
4. SCF trial work in the HRZ showed higher yields from all noodle varieties when planted at heavy sowing rates. SCF data suggests seeding rates should be 100-140kg/ha for Kinsei, Ninja and Zen when sowing after May 20.
5. Calingiri growers should try sowing new variety Kinsei. Yield data across multiple SCF trials and local NVT results indicate a >10% yield improvement.

FIGURE 5. Noodle wheat plot trial at Woogenellup in 2016.

Noodle Wheat Facts

- WA is the only external source of wheat grain for Udon Noodle markets in Japan and Korea.
- Intergrain has the only noodle wheat-breeding program in the world outside of Japan.
- Noodle wheat is one of the few differentiated grains produced by WA growers creating a buffer between price drops compared to more common wheat grades.
- Kinsei, meaning 'balance' in Japanese, was named by a Great Southern Grammar student as part of a collaborative naming project between the Albany-based school and Intergrain.

		NVT trial year					
Variety	**Grade**	**2015**	**2016**	**2017**	**2018**	**2019**	**Average**
Kinsei	**ANW**	*NA*	*NA*	111	113	108	**110.7**
Ninja	**ANW**	108	107	110	107	105	**107.4**
Zen	**ANW**	104	97	104	113	107	**105**
Calingiri	**ANW**	94	100	97	94	97	**96.4**
Trojan	**APW**	95	97	100	93	96	**96.2**
Sceptre	**H1**	110	109	111	114	114	**111.6**

Table 2. GRDC funded National Variety Trial data from Kendenup, Kojonup and South Stirlings from 2015-2019. Numbers represents the average percentage above or below the trial mean achieved that year.

Future farmers student connect pilot program

SCF has partnered with the WA College of Agriculture Denmark, Great Southern Grammar and Mount Barker Community College for the Future Famers Student Connect program with support from the Federal Government's National Landcare Program Smart Farms Small Grants.

SCF is proud to support the youth and the future of our industry by providing better links between farmers, industry and agricultural students. The program aims to better equip students by connecting them to farmers and industry professionals, helping to enlighten them to the wide range of industry employment the Ag sector provides. This was achieved through sustainable farming innovation demonstrations, lectures and mentoring throughout the year.

The program was launched with students receiving a welcome pack that contained information material, SCF prospectus, SCF 2018 trials review booklet, newsletter, pre-program survey and a program outline. It was encouraging to see that students were keen to gain greater knowledge and experience and build connections for future employment with the program providing them with information on the range of employment opportunities within the Agricultural sector.

Lectures presented to students were tailored to tie in and compliment current curriculum term themes. In term 1, Mt Barker concentrated on careers in Agriculture with a focus on technology, its implications, applications and benefits to farmers. SCF invited Stratus imaging and CSBP out to Mt Barker to talk about careers in Ag and technology use. Students were introduced to Decipher, a precision agriculture platform that enables farmers to make better decisions on fertiliser application for improved efficiency. While Stratus Imaging introduced the students to their UAV's (drones) that collect data which can assist in critical crop management decisions. Great Southern Grammar students studied breeding and nutrition in term 2 and to complement that SCF invited AI Technician Allison Watson to present a talk on artificial insemination in cattle. Topics discussed included methods of AI and the advantages of utilising AI over traditional breeding methods along with nutrition related to breeding cattle.

SCF members also engaged with students through demonstration sites and sharing of their knowledge. SCF R&D Coordinator at the time, Nathan Dovey, and member, Jarrad Beech, travelled out to the Western Australian College of Agriculture Denmark where Jarrad shared his experience of grazing crops and familiarised the students with practices used to determine time of grazing. Great Southern Grammar students visited a pasture and grazing fodder demonstration site located in Kalgan. Here students observed the trials, some clear treatment effects of different fertilisers on different pastures and were able to use the Green Seeker to collect NDVI readings on the different treatments.

The opportunity for work experience either on farm or in the industry was also offered to interested students. Students interested in on-farm work experience were placed with volunteer SCF members while SCF itself hosted three students from Denmark early in the program, and one student from GSG later. All students found their work experience time very valuable and gave them an insight in to the types of opportunities a career in Agriculture can offer.

To conclude the final term SCF hosted two successful careers information sessions, one at Denmark and the other at GSG. During these sessions students learned of new career opportunities in the Agriculture industry that they previously had not considered. Students were exposed to a wide range of industry professionals from farm managers to DPIRD research officers, consultants, bankers and agronomists. Each presenter offered their own experiences and often unique pathway leading to their current role in the Agricultural industry. These events contributed to more young people considering a career in the Agricultural industry.

Students participating in the program were encouraged to apply for a Scholarship valued at $1000 to be held by the school and go towards their Agriculture or NRM education. One scholarship was offered to each school. Students in year 11 were asked to complete a 500-1000 word essay on what role they saw technology, data management and the internet of things (IoT) playing in the future of the Agricultural Industry. Students had to be in year 11 and intending to study an Agriculture course or subject in year 12 the following year. All students who submitted an essay should be commended on their efforts; a high calibre of essays was received making the selection process considerably hard.

Congratulations to the winning applicants Ruby Millard, Grace Hourston and Holly Pearce who were awarded the scholarship during their graduation ceremonies.

SCF would like to thank project ambassador Clare Webster for her support of the project along with all the farmers and industry professionals that volunteered to lecture and mentor students throughout the year. Without you this program would not be possible. SCF will be continuing the program in to 2020 and has already held a Drone Demonstration Day with Great Southern Grammar and Mount Barker Community College on the grounds at GSG.

Optimising the profitability of high rainfall zone Farming Systems

The GRDC investment "Optimising the profitability of high rainfall zone (HRZ) farming systems – survey, farmer scale demonstration trials and field days" aims to reduce the gap between current and potential yield in the HRZ, focussing on wheat and canola production.

The high rainfall zone (HRZ) of Southern Western Australia is the arable area where annual rainfall is between 450-800mm. This area represents approximately 1.2 million Ha in WA. As annual rainfall has decreased over the last four decades, the amount of area in the HRZ sown to crops has increased. This is due to less frequent and less severe waterlogging events, which can reduce yields by 37% in wheat alone. Current research suggests that growers in the high rainfall zone are potentially missing out on an extra 1-3 t/ha of wheat and 0.5-1.5 t/ha of canola, depending on the decile year.

Twenty growers were recently surveyed to ascertain an understanding of current farming performance and system practices in the HRZ regions of the Albany Port Zone. This survey was also completed by 20 growers in the Esperance region managed by SEPWA. The survey covered farm profiles, crop rotations, yields, agronomic strategies, technology and production constraints, answering 56 questions in total! Thanks again to those members who gave their time to complete such a comprehensive survey.

The survey results found non wetting soils to be one of the main physical characteristics impacting yield potential, along with waterlogging. Soil type, free draining soils, and favourable seasons were the main characteristics that defined our growers 'best yielding paddock's. 40% of growers surveyed indicated they would like to do more soil amelioration to increase production over the next five years, since 50% of growers believe they can only achieve higher yields once soil amelioration has taken place. Soil amelioration is soil type dependant, and doesn't necessarily mean growers need to do something for every paddock they manage.

Only three of the twenty growers surveyed did not grow wheat. Most growers current cropping rotation have 20 – 50% barley and the same with canola. Scepter was the main wheat variety grown by the respondents with 55% having it in their cropping program. Nuseed GT 53 was the main variety of canola grown with 21% of respondents growing it. The surveys showed five-year wheat yields ranged from 2.5t – 5.5t/ha, with an average of 4t/ha. Canola yield ranged from 1.5 – 2.4t/ha, with an average of 1.9t/ha.

Twelve of the survey respondents currently have yield mapping abilities, with six not currently or under utilising the technology. Protein mapping is not currently being used by any of the survey respondents and VRT is being utilised by six of the surveyed growers. Seven of the respondents are using CTF, however most of the growers are looking at implementing it in the next five years to help increase production.

The growers final question was 'what resources and technology do you need to help achieve an increase in production': six indicated they would like more resources on precision agriculture, four indicated they need access to specialised machinery, and others stated they would like to see more research around legumes.

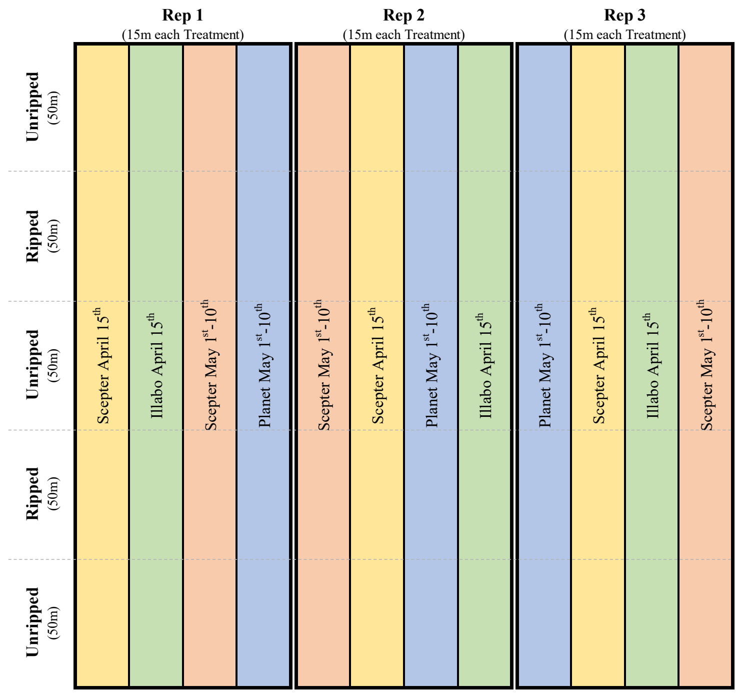


FIGURE 1. Diagram of the farm-scale demonstration trial to be conducted by Stirlings to Coast Farmers (SCF) in 2020. One trial site will be in the western SCF region and one in the east.

Sister project to the SCF surveys and farm-scale demonstrations in 2020-2022

Alongside this project, the SCF and SEPWA grower groups will be working with partners from the Foundation for Arable Research (FAR), DPIRD and CSIRO, who with GRDC investment will be conducting small-plot trials looking at aspects of pushing for higher productivity in cereals and canola in the HRZ. Within these small plot trials, researchers will investigate how to optimise production through variety selection and appropriate management, particularly given the unique constraints present in the HRZ. SCF will be assisting with the extension of the small plot trial results as well as attending and promoting in-season field days. SCF and SEPWA will also apply some of the 'best-bet' practices to broad-scale farm trial demonstrations throughout the duration of the project for validation and extension purposes.

What research is being done in 2020 and beyond by SCF and SEPWA?

As part of this project SCF and SEPWA will be conducting two farm-scale trials each, looking at aspects of high yielding crops in the high rainfall zone. In 2020 both groups will be looking at the differences between long-season wheat genetics, in conjunction with deep ripping compared to not deep ripping. In the following seasons, each group will be taking aspects of the plot trial research and applying to our large-scale farm demonstrations. The trial protocol for the 2020 season is listed above and SCF have a site at South Stirlings and a site in the western SCF region near Tenterden.

Acknowledgments

SCF would like to acknowledge the support from:

FARMER TRIALS

Amelioration of subsoil compaction and subsoil acidity - South Stirlings

Key points

- Deep ripping with inclusion plates gave a yield response of over 1 tonne a hectare on the sandy deep duplex soil (gravel clay layer at 50+cm with an acidic subsoil) and a sandy medium depth duplex soil (gravel/clay layer at 30-50cm). These two soil types are typical of the South Stirlings sand plain.
- The deeper sandy duplex soils have a lower yield potential overall but gave similar grain yield response (and greater % yield response) as this profile had higher soil compaction to a greater depth.
- There was a reduction in soil resistance at depth (improved root growth at depth) however there was also an effect of improved incorporation of the clay in the topsoil applied previously contributing to the yield increase by adding inclusion plates.

Aim

To test amelioration of subsoil compaction and sub soil acidity within Controlled Traffic Farming (CTF).

Method

Treatments

1. Deep Rip
2. Deep Rip + Inclusion plates
3. Nil treatment.

Note: This paddock and the trial have been setup under a Controlled Traffic system.

Deep ripping was to 60cm in deeper sandy duplex but 35-50cm in more medium duplex soils gravel over clay at 30-55cm. Soil tests have confirmed subsoil acidity (pH 4.2 to 4.4 at 10-20cm soil depth) and compaction (to 50 cm+) especially in the deeper duplex soil zone.

The paddock sandy duplex zone was clayed in 2010 and the paddock has had 4t/Ha lime over last 3 years top-dressed on the surface. Previous year (2018) was pasture. The site was deep ripped in March 2019 and sown to Scepter Wheat in May 2019.

The Control plots with no ripping were evident with lower growth throughout the growing season. To the left of each control plot (UTC) is a deep ripped plot and to the right of each control plot is a deep rip plus inclusion plates. The higher crop biomass (from drone and satellite imagery plus NDVI -Green-seeker measurements) in the treated plots resulted in higher grain yields.

TABLE 1. Average scepter wheat yields for each soil type and for the whole trial (combined). Within each of the three results all treatments were significantly different P = 0.05. *Means followed by different letter indicates there was no significant difference.*

Treatment	East & West Combined	West- Medium duplex soil	East-Deeper sandy duplex
Control-Nil	3.13 c	3.58c	2.68c
Deep rip	3.71 b	4.15b	3.28b
Deep Rip + Inc. Plates	4.25 a	4.62a	3.88a

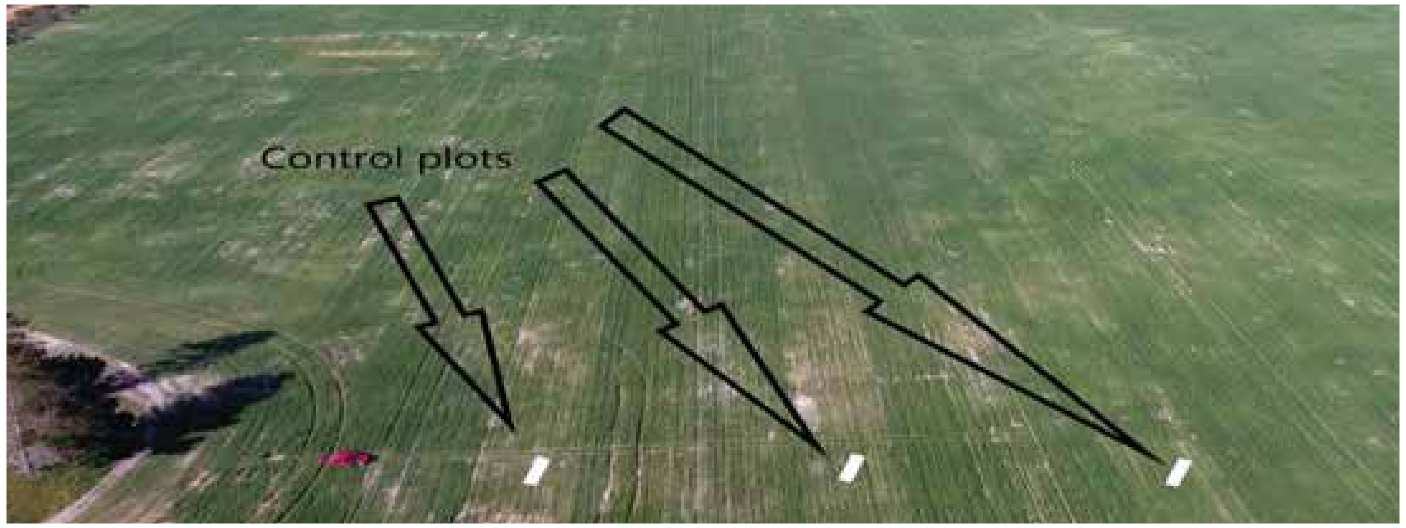


FIGURE 1. Drone view from August 2019 shows layout - treatments ran the full length of the paddock and different soil zones as reps were harvested separately along the trial.

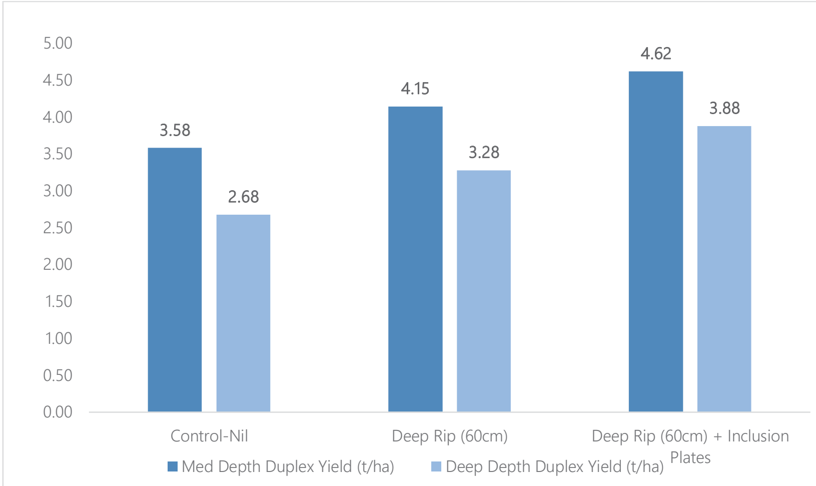


FIGURE 2. Average wheat yields at the Curwen deep ripping trial site in 2019. The data is split into each soil type and medium depth duplex and deep depth duplex in t/ha.

Discussion

Both soil types, the deeper sandy duplex with lower sub soil pH and the sandy medium duplex soil gave a yield response of over 1t/Ha to deep ripping with inclusion plates. The deeper sandy duplex had a lower yield potential overall but gave similar yield response as this profile had higher soil compaction.

Reece and Guy Curwen observed there was a reduction in soil resistance at depth (improved root growth at depth), however, both also considered there was also an effect of improved incorporation of the clay into the topsoil applied previously. This is indicated by the virtual doubling of the yield response with addition of inclusion plates. The effect on sub soil pH and clay mixing can be further studied through the crop rotation in an extension program.

Acknowledgements

SCF would like to thank the Curwen Family who managed the trial as part of their on-farm experimentation.

Amelioration of subsoil compaction – Gnowellen

Key points

- The Growing Season Rainfall (GSR) for 2019 was 218mm of rainfall at Wellstead and SE Gnowellen had well below decile 1 rainfall in 2019 (and through to April 2020).
- The large (>90%) grain yield response in canola to deep ripping reflects the low growing season rainfall at SE Gnowellen. The average yield gain of 650 kg (or 96%) indicated there was extra available soil water in the ripped plots. There was a reduction in soil resistance at depth (improved root growth) after deep ripping and higher Water Use Efficiency (WUE) was reflected in the improved grain yield.
- There are two typical soil types of the Stirlings sandplain; 1) a sandy deeper duplex soil (gravel/clay layer at 50+ cm) with low sub soil pH, 2) a sandy medium depth duplex soil (gravel/clay layer at 30-50cm). Each soil type was represented in the paddock transect at Diprose Gnowellen site.

Aim

To test amelioration of subsoil compaction from deep ripping with simple replicated paddock test strips

Method

The two treatments consisted of a deep ripped (March 2019) and a nil ripped control that were applied in test strips across a paddock which was then sown to canola in April 2019. The southern part of the paddock will be clayed in 2020.

Deep ripping was to 60cm in deeper sandy duplex but 35-50cm, in more medium duplex soils gravel over clay at 30-55cm. Soil tests confirmed compaction to 50 cm+ especially in the deeper duplex soils along the paddock cross-section.

The paddock was direct harvested 22 Nov 2019 and results for grain yield determined via analysis of the yield map from the harvester.

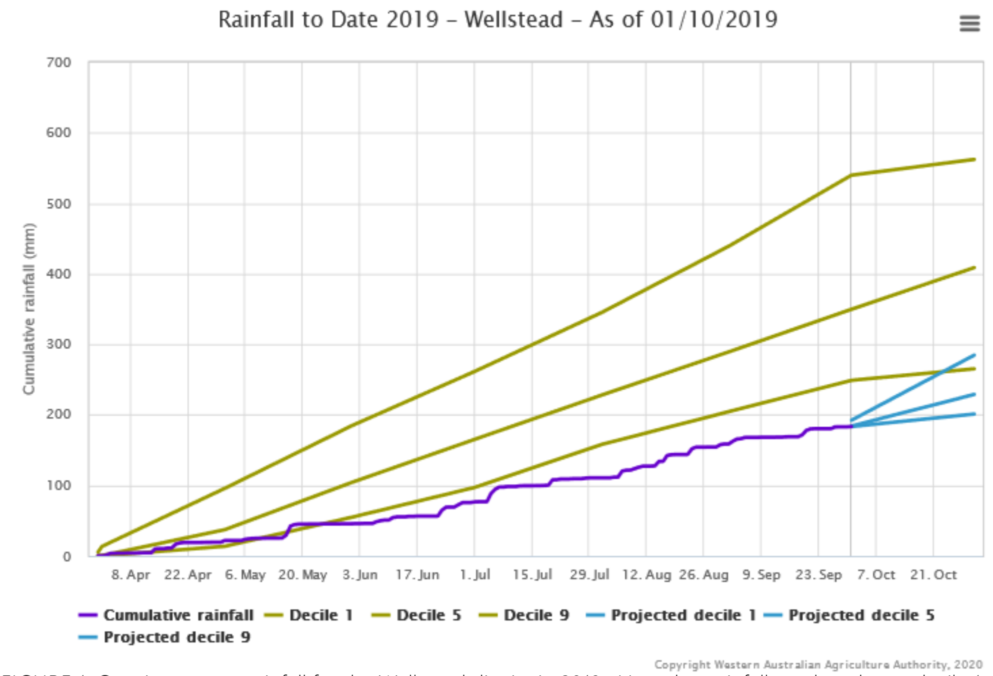


FIGURE 1. Growing season rainfall for the Wellstead district in 2019. Note that rainfall was less than a decile 1 season for some areas.

Results and Discussion

The control plots with no ripping were evident with lower biomass throughout the growing season. The higher crop biomass (from drone and satellite imagery plus NDVI -Green-seeker measurements) in the treated plots resulted in higher grain yields.

There is almost twice the yield recorded in the ripped treatments, compared with that of the un-ripped treatments for the two replicates. See yield map Analysis below with control strips harvested to west of each deep ripped strips and Murdoch university analysis Fig 3.

Both soil types, the deeper sandy duplex (gravel/clay layer at 50+ cm) with lower sub soil pH and the sandy medium duplex soil (gravel/clay layer at 30-50cm) gave a yield response to deep ripping. Peter and John observed there was a reduction in soil resistance at depth (improved root growth at depth) and the virtual doubling of the canola yield response.

FIGURE 2. Aerial view captured via Drone on 6 Nov 2019 shows crop biomass response in an adverse season to diagonal deep ripping strips implemented March 2019.

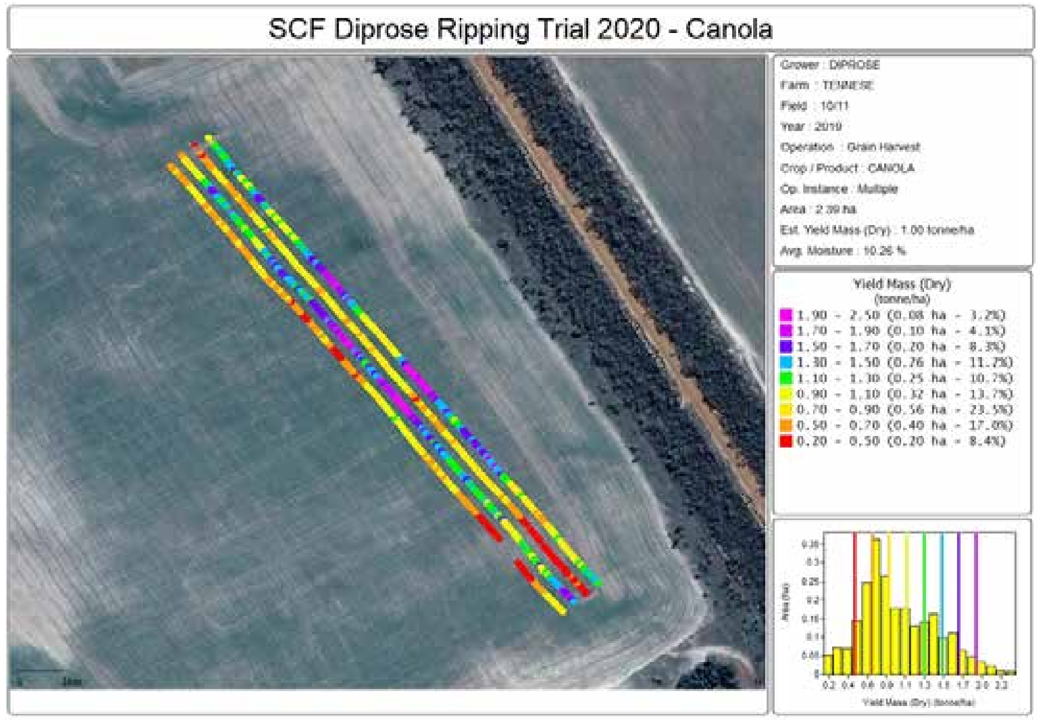


FIGURE 3. Yield map for the trial as extracted by grower John Diprose and interpreted by Phil Honey (SCF).

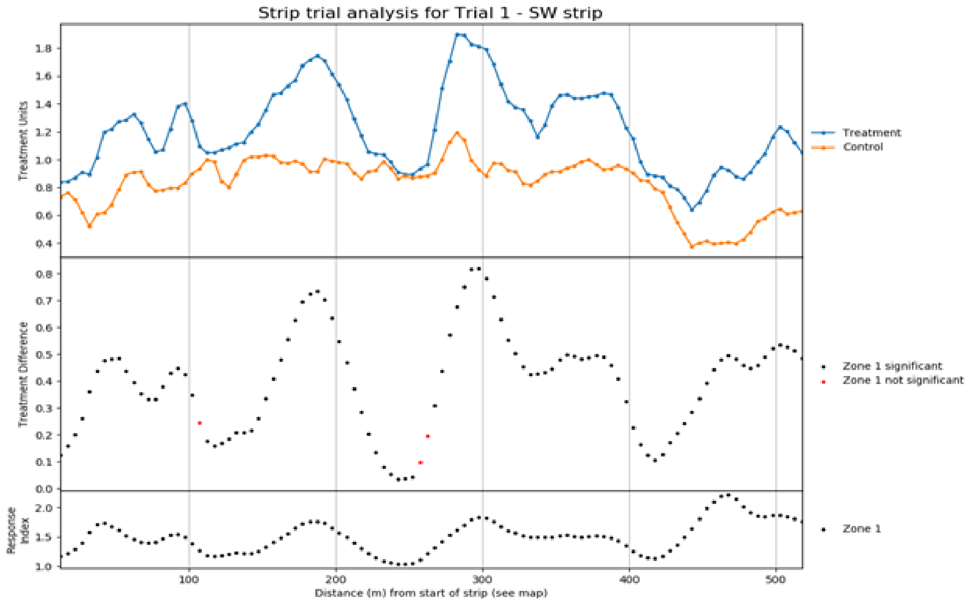


FIGURE 4. The Response Yield Index (treated yield divided by control yield) ranges from 1.1 to 2.2 along the strips and indicates some zones where other limiting factors may be involved. The original analysis (J. Diprose and P. Honey) gave an average Response Yield Index overall of 1.96 and this related well to the Biomass results.

FIGURE 5. Improved root growth in canola plants from Deep Ripped strips (LHS) compared with un-ripped control (RHS)

TABLE 1. Average canola yield data extracted from yield map.

Treatment	Plot	Min Yield t/Ha	Max Yield t/Ha	Average Yield t/Ha
Control	2	0.20	1.15	0.68
	4	0.14	1.15	0.66
	Average	*0.17*	*1.15*	*0.68*
Ripped	1	0.54	2.47	1.27
	3	0.58	2.34	1.39
	Average	*0.56*	*2.40*	*1.33*

Moving 't' test – further analysis of yield response variation by soil zone along the strips is being undertaken within the Murdoch and Curtin Universities' GRDC project, 'On-Farm Experimentation'. Stanley Sochacki, Research Fellow with Murdoch University is assisting.

Acknowledgements

Peter and John Diprose who initiated the trial as part of their own on-farm experimentation.

Stanley Sochacki, Research Fellow with Murdoch University for assistance in yield map analysis.

SCF lime efficiency trial – East Tenterden

KEY MESSAGES

- Significant lime responses occurred in the third (2016) and sixth (2019) years of the initial six years of the trial. Lime responses occurred in seasons with a dry spring and not in seasons with a wet spring.
- Sub soil acidity can be addressed with lime incorporation to depth.

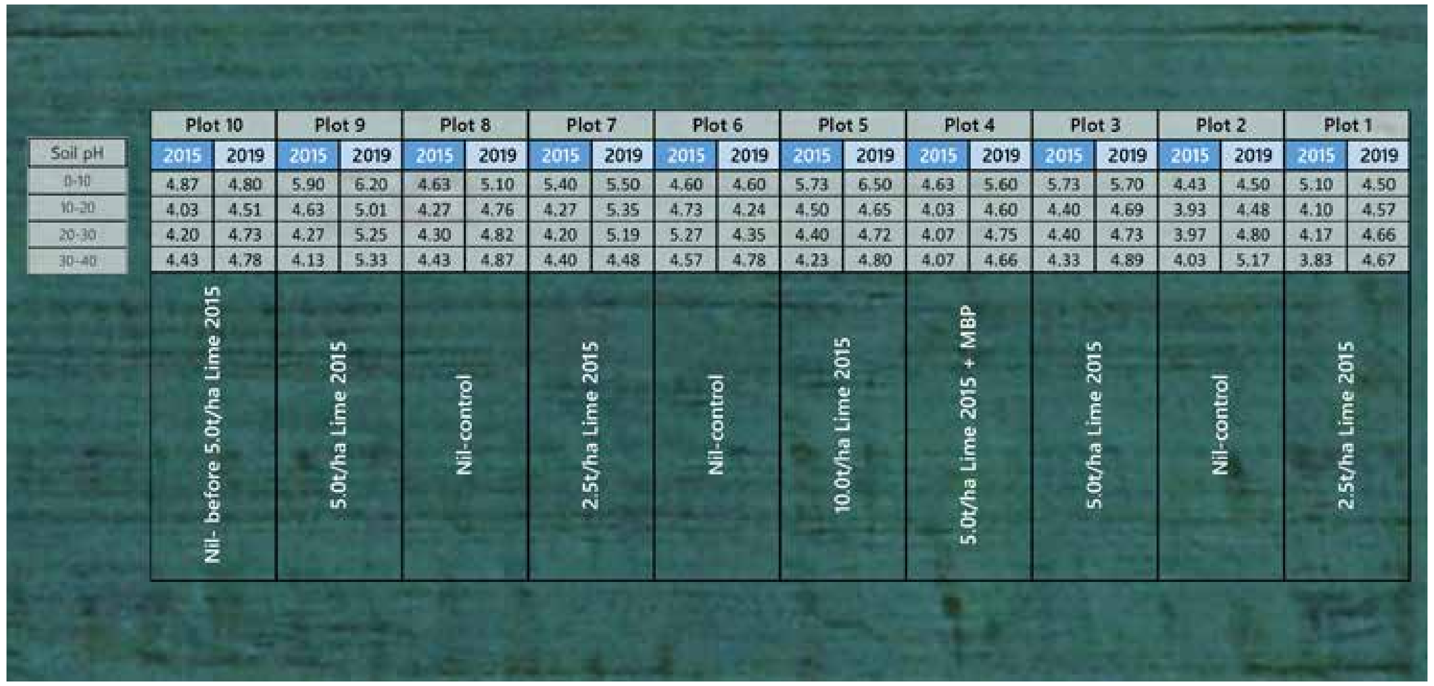
Introduction

The site had severe sub soil acidity and soil tests by SCF and Precision Soil Tech (PST) have confirmed that the trial area was relatively uniform in sub soil acidity. The purpose of the trial is to determine how best to ameliorate subsoil acidity.

Trial Results

This is a longer-term trial and the initial benchmark soil testing from 2014/15 was critical for interpreting the harvest results through 6 seasons. Testing by PST in 2014 confirmed the same pH values as site testing done in Feb 2013 by Greg Mengler and SCF. Sub soil pH's were all in low 4's from the different testing laboratories.

Further soil testing with SCF and Map IQ was undertaken in 2017 + 2019 and showed that the sub soil acidification in control plots was continuing. In the lime top-dressed treatment plots there is only limited movement of lime down the profile (even at high rates of surface applied lime). (Fig 2)



	Plot 10		Plot 9		Plot 8		Plot 7		Plot 6		Plot 5		Plot 4		Plot 3		Plot 2		Plot 1	
Soil pH	2015	2019	2015	2019	2015	2019	2015	2019	2015	2019	2015	2019	2015	2019	2015	2019	2015	2019	2015	2019
0-10	4.87	4.80	5.90	6.20	4.63	5.10	5.40	5.50	4.60	4.60	5.73	6.50	4.63	5.60	5.73	5.70	4.43	4.50	5.10	4.50
10-20	4.03	4.51	4.63	5.01	4.27	4.76	4.27	5.35	4.73	4.24	4.50	4.65	4.03	4.60	4.40	4.69	3.93	4.48	4.10	4.57
20-30	4.20	4.73	4.27	5.25	4.30	4.82	4.20	5.19	5.27	4.35	4.40	4.72	4.07	4.75	4.40	4.73	3.97	4.80	4.17	4.66
30-40	4.43	4.78	4.13	5.33	4.43	4.87	4.40	4.48	4.57	4.78	4.23	4.80	4.07	4.66	4.33	4.89	4.03	5.17	3.83	4.67
	Nil- before 5.0t/ha Lime 2015		5.0t/ha Lime 2015		Nil-control		2.5t/ha Lime 2015		Nil-control		10.0t/ha Lime 2015		5.0t/ha Lime 2015 + MBP		5.0t/ha Lime 2015		Nil-control		2.5t/ha Lime 2015	

FIGURE 1. The average soil pH (CaCl²) for each plot tested in 2015 and 2019. Each plot was tested at three seperate locations (not shown).

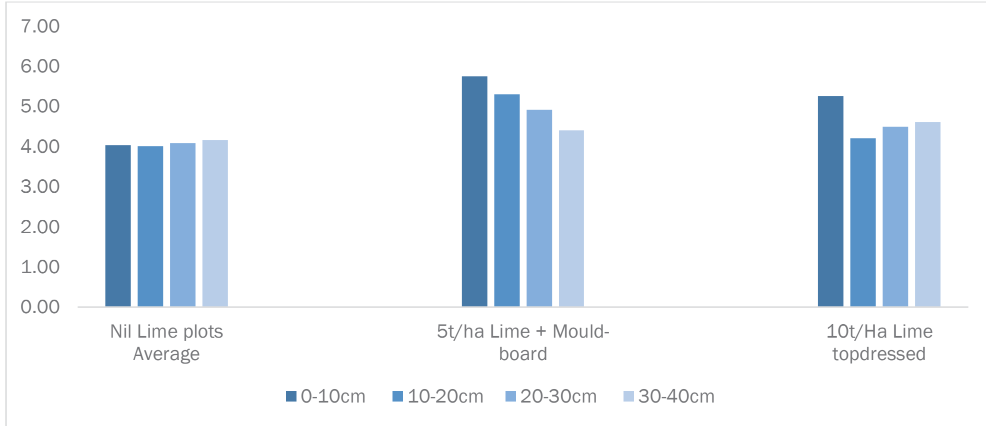


FIGURE 2. Soil pH profiles at the East Tenterden lime trial two and three years after lime application.
*Main lime treatments applied March 2014 and Lime plus Mould-board applied March 2015.
Lime incorporation was measured to a depth of 40cm (depth of Mould-boarding) but surface application of lime only still show limited downward movement after four years. Further monitoring is required.

2019 Canola Harvest results

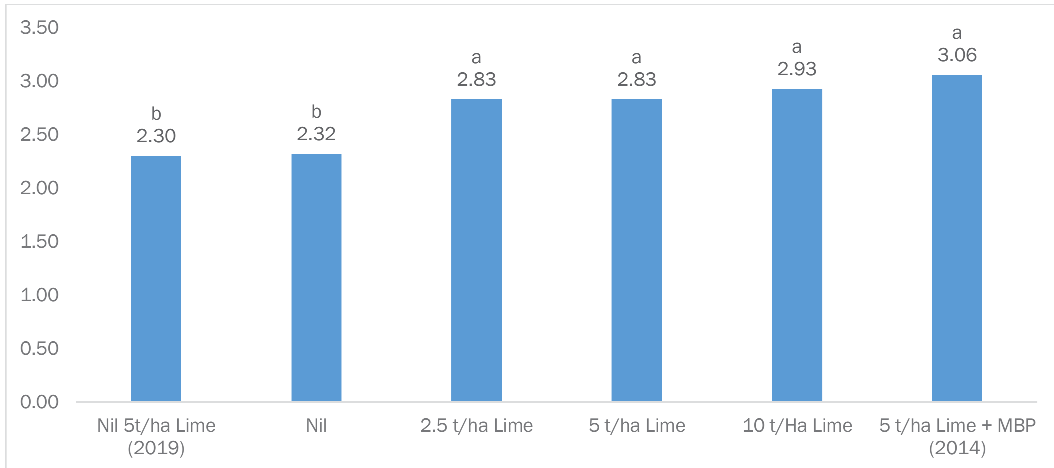


FIGURE 3. Canola yields (tonnes/hectare) in 2019 season. Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
NB: The first bar treatment was an untreated control untill the 2019 season. In march 2019, 5t/ha lime was applied on the surface before sowing.

All lime treatments gave significant responses in canola in 2019 season apart from the former Nil treatment that had 5t/Ha applied in March 2019. Differences between 5t/Ha Lime with and without incorporation were not significantly different (0.25 t/Ha canola).

The 2019 average yield increase of 0.6 t/Ha of canola for all lime treatments represents a 26% increase over controls (the 2016 response was 25% in increased wheat yields). However, in wet springs the lime treatments have given nil response (see discussion below).

TABLE 1:. Growing season effects on lime response. Note the lack of response to lime in the highlighted wet springs (dark blue).

Year	Crop type	Autumn Winter rainfall	Spring Rainfall (mm)*			Yield potential and biomass at start of Spring	Lime Response
			Sept	Oct			
2014	Wheat	Average	44	83*	Wet Spring	Good Yield potential -high Biomass	NS
2015	Canola	Below Average	42	28	Dry Spring	Below average yield potential -lower biomass	not harvested
2016	Wheat	Above Average	42	34	Dry Spring	Wettest day in Sept only 7mm - but higher biomass	25%
2017	Canola	Below Average	82*	23	Wet Spring	Below average yield potential -lower biomass	NS
2018	Wheat	Below Average	20	21	Dry Spring	Below average yield potential -lower biomass	NS
2019	Canola	Average	29	26	Dry Spring	Good Yield potential but dry spring and higher Biomass	26%

Discussion

SEASONAL ANALYSIS

Over the six years of the trial, the seasons that have recorded a yield response to lime application are when good biomass has been produced early but the crop subsequently suffers a dry finish. This would be consistent with having better root growth in the subsoil in limed plots with incorporation to depth compared to lime just top-dressed on the surface. A deeper root system will result in an improved ability to access moisture and nutrients from deeper in the soil profile when the topsoil dries out due to the dry finish. In this broadscale trial the differences between methods of lime application are not significant (at P .05 level) but more intensive small plot trials in other regions have been more able to show this.

Conclusions

The trial gave an average of a 0.6 t/ha yield response (26%) to lime in the 2019 canola crop. Because only two years in five seasons gave a measurable response, a long-term benefit over the range of seasons could be assumed to be about a 10% average.

There was a significant lime response in third year and sixth after application of lime. Lime responses could continue to be seasonally dependent, and crop type dependent and the trial will be continued to monitor lime value for each phase of the rotation.

Subsoil acidity can be addressed with lime incorporation, but mould-board ploughing may not be the most cost-effective and practical treatment. This requires further seasons of testing. Other methods of lime incorporation may also be tested at the SCF lime sources trial at another site (Red Gum Farm, Iain Mackie).

Acknowledgements

The Lime Efficiency trial was initiated with Greg Mengler at Tenterden East in 2014 with initial NLP funding from South Coast NRM. The trial is now hosted by Chris Tomlinson. The growers have ensured high quality management of this long-term trial.

PROUDLY SUPPORTING OUR GRAIN GROWING COMMUNITIES

Investing in the health, wellbeing and sustainability of our growers and their communities.

The CBH Community Investment Fund provides grants and support to schools, community groups, grower groups, sporting organisations and community programs in regional communities across Western Australia.

We invest more than $1.5 million each year in our communities through the fund.

Giggle Pots Day Care in Corrigin received a Grass Roots grant to install solar power at the centre.

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Nil disturbance seeding systems trial - Kendenup 2019

KEY MESSAGES

- Over the full 4 years of the crop rotation the NDS (disc-seeder) and the Tyne No-Till based system have performed equally well, although both systems have shown different advantages in different crops and seasons.
- In 2019 the full Tillage system incorporated maximum tillage to 40cm soil depth using the Horsch Tiger Deep Ripper. The yield response was significant in 2019 with deep ripping achieving 1.01t/ha more than the disc seeding.
- SCF researchers are interested in measuring the longevity of the deep ripping treatment under controlled traffic farming (CTF)

Purpose

To test alternative seeding systems on non-wetting forest gravel soils. This trial has been ongoing for four seasons between 2016-19.

Treatment 1: Disc-seeder (Slot)

Treatment 2: Tyne Seeder

Treatment 3: Full disturbance prior to tyne seeding.

For 2016-18 the full disturbance treatment was completed with a scarifier. Prior to seeding in 2019, a Horsch Tiger Deep ripper was utilised which ripped and mixed the soil to 40cm.

The Nil disturbance system vs maximum disturbance

Deep ripping compared to slot seeding measures the maximum difference between seeding systems. The aim is to test the impact on soil wettability from damaging soil bio-pores based on the research from Margaret Roper's and Doc Featherstonhaugh study at Munglinup.

The tyne seeder vs disc seeder

Comparisons with farm-scale equipment are difficult because of the inevitable difference in machine set up. In this trial there are row spacing and seed placement differences. Previous studies showed an average yield advantage in narrowing the row spacing was approximately 1% per cm of row narrowing. This means an almost 15% discount alone for the wider spaced disc seeder used in this comparison. The different row spacings can be accounted for when assessing yields but other variables could have similar impacts.

The summary of the NDS trial results to date confirm that there is not an ongoing net 15% discount in yield using the wider spaced disc seeder vs the narrow tyne seeder. Unpacking the various components of each treatment's yield however is difficult without more measurements.

Results

The 2019 Harvest results showed:

a.The average yields for the NDS Disc seeded plots and the Tyne seeded were not significantly different.

b.The "Maximum-Tillage" plots (Deep Ripped to 40cm with Horsch Tiger) gave a significant response of 1.01 t/Ha of Rosalind Barley.

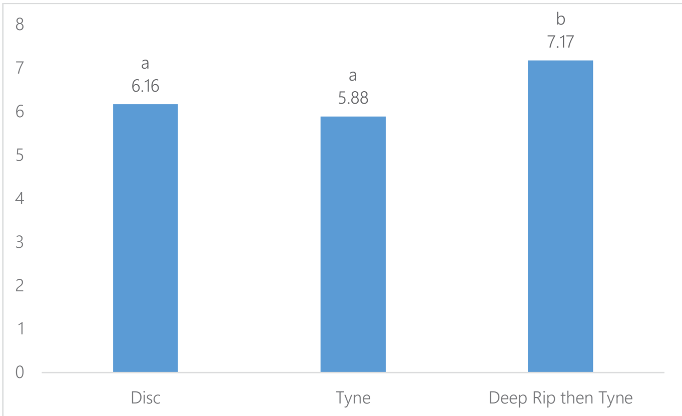

FIGURE 1. Barley grain yields in 2019 at the Wood family Nil disturbance seeding systems trial at Kendenup. Means followed by the same letter or symbol do not significantly differ (P=0.5, LSD)

Crop observations

- 2016: Canola- In a Decile 10 wet season more tillage gave transient waterlogging in topsoil but no significant difference in grain yields.
- 2017: Field Peas- The dry start gave full expression of the non-wetting issue with the extra tillage exacerbating the non-wetting. There was a significant response in plant establishment and biomass with the nil disturbance system (not shown). Although the disc-seeder had a higher yield the difference was not statistically significant.
- 2018: Wheat- In both the wheat and the barley phase there was no significant difference in crop establishment rates and plant densities. The winter of 2018 had a lower radiation sum resulting in canopy cover being significant in relative growth rates. The tyne seeder with narrow row spacing had a higher biomass at the start of Spring, but grain yield was not significantly different.
- 2019: Barley- In 2019, the "maximum tillage" treatment was deep ripped in March to 40cm using the Horsch Tiger ripper.

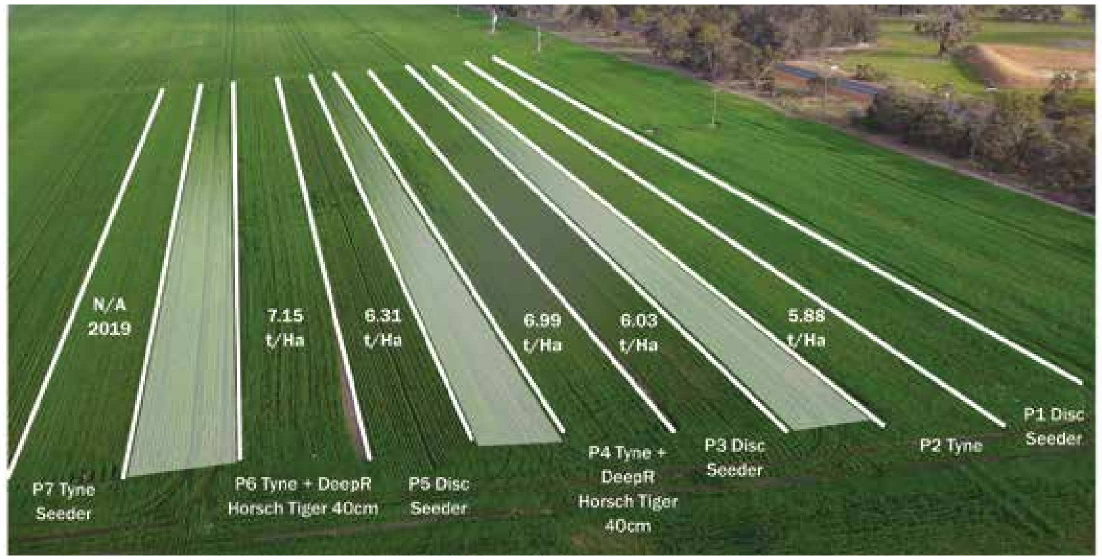

FIGURE 2. Grain yields from 2019 overlaid on a drone image of the Nil Disturbance Systems demonstration site in Kendenup taken August 2019. The Western reps (closest to Albany Highway) are shown in this image.

Conclusions

Over the four years of the crop rotation, the Nil Disturbance System (NDS) and the Tyne No-Till based system have performed equally well, although both systems have shown different advantages in different crops.

In 2019 the full Tillage system incorporated maximum tillage to 40cm soil depth generating a significant response in the first year. The research question extending from this result is how long will the deep tillage effect last under CTF?

Industry is currently divided on the best systems for mitigating non-wetting forest gravel soils in the high rainfall zone (HRZ). Multiple options are available depending on actual soil limitations. These range from physical treatments of the soil profiles, e.g. claying with deep ripping, mould boarding, near row sowing (precision seeding), soil wetting agents and alternative seeding systems to retain bio-porosity and improve soil wettability.

Nil disturbance seeding systems in combination with CTF and precision near row seeding has some potential to mitigate a non-wetting soil, but the question from 2019 is will the deep tillage response measured continue in future years, and for how long?

Acknowledgements

Brad and Jeremy Wood for ongoing management of the long-term trial.

Michael Webster – For same day sowing of the Tyne seeder treatments

AFGRI John Deere Albany: Thankyou to Max Kerkmans for providing the Horsch Tiger Ripper.

NLP/ SCNRM – for initial funding to start up the trial

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Recent on-farm research

GRDC tour of New Zealand

NATHAN DOVEY, CEO, SCF

On the 9th of February myself, Ken & Karen Drummond and Emma Russell (my better half) joined a week-long GRDC tour of the New Zealand South Island. The tour group consisted mostly of growers and advisors from the Geraldton zone who had been through a pretty nasty 2019 season, where some growers only received 140mm for the year. In total we had 21 people on the tour including our tour leader Julianne Hill.

We flew into Christchurch and made our way south towards Queenstown over the course of the 7 days. Being a GRDC tour we had a grain focus, but we also visited dairy farms, a deer farm, as well as taking in a field day in Waimumu (like Newdegate) and catching up with some very knowledgeable consultants.

My highlight was visiting the world record yield holders for wheat and barley at Ashburton and Timaru respectively. The world record wheat yield is 16.79t/ha and Eric Watson achieved this in 2017 on his 490ha property. Eric's farm is fully irrigated, which allows him to be confident with high spending on cropping inputs. Having said that, Eric attributes both his world record wheat crop and other cropping successes to having high attention to detail. The example that stuck in my mind was that Eric often delivered plant tissue tests directly to the laboratory in Christchurch (1.5 hours away) to ensure they arrived in optimal condition. I am not saying that is the reason he grows high yields, but it does show his mindset.

Eric also applies variable rate P and K (but not N) through liquid applications. His reason for using liquid was because of the accuracy achieved through spraying, compared to spreading granules. N applications are done through regular applications of liquid urea. Eric only applies 55L/ha at a time, otherwise the leaf damage from scorch is too high. Eric applies about 300 units of N on every wheat crop and it gets two plant growth regulators at growth stage 29 and 31, which is only two weeks apart (label minimum). Growth regulators are required to prevent lodging. Wheat crops are generally sown in early April and harvested in February.

The irrigation schedule is 45mm every 12 days on the heavy soils and 45mm every six days on the 'lighter' soils. The water itself is free, but they do have restrictions on pumping volumes and the electricity required to pump water and irrigate is very expensive. Still, imagine having the ability to apply 45mm every 12 days when required! Eric's suggested his break-even yield for the wheat crop we were looking at (see photo) would be 7-8t/ha and he thought it would yield 15t/ha.

The world record barley yield is 13.8t/ha and was grown by Warren and Joy Darling on their 570ha farm, on the outskirts of Timaru in 2015. Warren suspects he will own the record for a while yet, since NZ barley growers are having problems with Ramularia (fungus) that is proving difficult to control with multiple fungicides. The annual rainfall at Timaru is 600mm but the world record barley crop was grown under pivot irrigation. Before Ramularia became a problem, Warren grew 10-12 tonne barley crops regularly, but is now in the range of 7-10 tonnes. This year Warren was getting about $370/tonne on farm for barley.

Warren generally harvests cereals at 17% moisture and then he dries them down to 14% with his recently purchased grain drier. The grain drier can do about 200t/day and is busy for three months of the year. They are lucky not to have snails in NZ, but Warren does have slugs to contend with and they apply two applications of baits on every crop.

Warren and his family have been using variable rate inputs for the last four years. They grid soil-sample each hectare every four years and use yield data to create prescription maps. Variable rate fertilizer applications in NZ are the opposite to Western Australian farming. Warren and another farmer we visited (David Fisher) apply more nutrients to their 'poorer' soils, because they leach more, and the better soils get less inputs but still produce top end results. Warren said that in the four years since they have been employing VR, he has already seen less variation in his paddock yields.

The Darlings grow wheat-barley-sunflowers-hemp-canola and grass-seed in a six-year rotation. *Wouldn't we love to have six profitable crops to grow in a rotation?*

I found it amazing that farms were so small in New Zealand. It should not be surprising that expansion is hard when land costs $40-50,000/ha. But the small size seems to drive the attention to detail which allows them to push yields closer to their maximum potential.

We noted that just the Aussie farmers on our tour probably planted more wheat than the entire nation of NZ. Hard to yield 9t/ha when you only get 140mm of growing season rainfall though!

There are many more things I could say about what I learnt on this GRDC supported trip to New Zealand. It was amazing to discover that Agriculture and its impact on the environment is under a brighter spotlight than what we are seeing in Australia right now. The 'social license' to farm in the dairy industry seems to be collecting the greatest amount of attention currently. New Zealand farmers mentioned that the rural/urban divide is large, and the lack of understanding from North Island city dwellers was mentioned more than once.

The tour finished in Queenstown, which is a hugely popular tourist destination for those that have not been. Being there in the height of summer was about the equivalent of a nice sunny winter's day here in Albany. The group were free to fit as many adventure sports as they and their wallets dared. I enjoyed some of the tamer activities like jetboating on the river and cruising up the gondola to take in the magnificent view. Other people got their kicks from Bungy jumping (Ken) or the canyon swing (Emma and Karen) or mountain biking, paragliding etc. etc. *It's amazing what you can get through in a day and a half.*

To finish, I thought I'd remind members that doing a tour like this would not be impossible to organize for SCF members in the future. I remain interested in learning more about the NZ red-meat industry (possible MLA funding), which we didn't cover on this trip, as well visiting the north island to understand their agriculture systems. The GRDC have funding available on a dollar for dollar basis for international, as well as interstate trips, for growers to utilise. The beauty about New Zealand is that it is so close to Australia (we are the west island apparently) and it is such a small country you can cover a lot of area in only one week. Given the usual time constraints that members have, it is feasible to put an excellent itinerary together for only 7-8 days away from the farm.

If you have strong interest in this idea, please get in touch with me or any SCF staff member. Just a simple text message would do in the short term, so we can gauge member interest levels.

SCF Growers Esperance tour

NATHAN DOVEY, CEO, SCF

In September last year, myself and 8 SCF members visited some Esperance grain growers to learn about farming in their region. The three-day tour was an excellent forum to hear from fellow growers, and the informal environment meant the conversation flowed back and forth. I'll be sending a copy of this article to each of the grower hosts, so I'll take this opportunity to thank them for giving up their time to see us.

The Esperance growers displayed a strong culture for sharing and learning. Although there was friendly banter between neighbours, I detected genuine respect for other growers and how they did things differently. Some growers were unable to see us because they were away etc. however, each gave me the contact details of other exciting growers to visit. It certainly made organising the tour very easy.

Day 1: Stott Redman- Hopetoun- 100% cropping (canola and wheat)

Our first tour stop was with Stott Redman at Hopetoun. Stott and his family initially farmed at Munglinup but saw an opportunity to buy in Hopetoun 15 years ago which allowed them to expand their farming operation. Hopetoun is prone to waterlogging (MAR- 487mm), but innovative drainage solutions have alleviated much of the risk. Stott used his RTK mapping to drain his high, and low spots with scraper drains. Water from the scraper drains empty into excavator drains which drain the paddocks. Stott estimates that they reclaim up to 5% of their land in wet years.

The Redman's have also started to deep rip to 450mm, which is alleviating waterlogging and increasing the size of the soil bucket. Although, Stott acknowledged they have not experienced a really wet season since they have been ripping. A wet year after summer ripping could be problematic. The downside to ripping is the amount of rocks being dug up, and Stott's solution has been to purchase the new H4 Hydraulic Reefinator.

Given their proximity to the coast, the Redman's have troubles with high grain moisture at harvest time. They have purchased their own grain drier which is mobile if needed. The machine is capable of drying 40t/hr of wheat by 2% and 24t/hr of canola. One person can manage the drier, which is often loaded directly into their truck.

Day 2: Mark Wandel- Scaddan

On the second day, we headed to Mark Wandel's property. The Wandels manage 10,500 ha's in a continuous cropping system. They have been controlled traffic farming for 14 years to avoid compaction which, amongst many other benefits, helps crops cope better when water-logged. It was amazing to see a large farming business managed with such high attention to detail.

The visit started with a chat in the main workshop where we learned how they manage the repairs and maintenance of their machinery. Mark gave us a rundown of the crops they grow, with their typical rotation being Faba beans-Wheat-Canola-Barley-Faba beans. The Wandel's use a specialist seeder to sow Faba beans at 750mm row spacings. The wide row spacings allow for shielded spraying which certainly keeps the Faba beans clean from weeds.

After plenty of tyre-kicking in the workshop, we ventured out into the paddock to look at the crops. It was only 1-2 weeks after the frosts in early September, and we saw the damage starting to appear. The crop that caught my eye was the Faba beans. They looked incredible (see photo), weed-free with excellent yield potential. The frost damage was already evident, but it was apparent that the beans were a staple part of their farming system. Mark mentioned that Faba beans sometimes achieved their best financial returns.

Brad Egan- Scaddan

From Wandels, we travelled east to visit Brad Egan. Brad farms with his parents Gavin and Elaine, who many of you would know from their farming days at South Stirlings. We spent a lot of time at Brad's talking about soil amelioration in their area. The Egan's utilise EM38 maps to determine clay depth. Depth of clay determines which country can be delved, to bring clay to the soil surface, and which areas will need clay spread using a carry grader because the clay is deeper.

In some cases, the Egan's would use a combination of the two to get sufficient clay on the paddock. The significant difference between our claying strategies and those of Esperance growers was the amount of clay they apply on their land. Brad was spreading up to 700t/ha where many of our growers are only spreading 200-250t/ha. Note: Mark Wandel mentioned spreading a similar clay rate.

The main reasons for such massive rates of clay were because they incorporate it much deeper, often to 30-40cm. Once claying or delving was completed, the paddock was deep ripped and then spaded before moving into a full controlled traffic farming system. All of this is an expensive exercise, but the results speak for themselves.

Dave Cox- Neridup

Dave Cox's home farm is in Neridup about 30km north-east of Esperance, and he grows a roughly 30% pasture mix with 70% cropping on his 5500ha property. Dave also has 5500ha of land in Hyden, which is 400km from Neridup.

Dave's primary livestock system is finishing yearling cattle for Coles through Harvey beef. He buys in young cattle each year and fattens them to sell in October-November to Harvey beef. He has stringent specifications that he must meet to deliver his 290kg carcass weights. He achieves the fattening and delivery of these cattle through strong management and monitoring of livestock weights. Dave embraces his ability to grow Wimmera ryegrass, rather than fighting it, and applies high rates of N to drive productive pastures.

Dave's overall philosophy seemed to be that extra management was able to give him incredible gains in his livestock system. Most people would baulk at grazing crops; moving hotwires and moving troughs and water supplies. Dave completes all of this seemingly without much fuss, although I suspect the system has evolved over the years into the efficient operation it is now. Dave lamented the ongoing machinery price hikes for equipment like self-propelled boom-sprays, harvesters and air-seeders. His livestock system appeared to make similar margins to cropping with less cost and risk for the business.

As an interesting side note, Dave pioneered the N-rich system that has now been adopted by Summit Fertilisers. In previous years Dave's theory and fieldwork have determined that a blanket rate of N will give similar returns to the poor country as the good areas.

Day 3: Mic Fels - Wittenoom Hills

Our last visit for the tour was Mic Fels place at Wittenoom hills. Mic farms approximately 6,300 ha's and grows wheat, barley, and canola in a double rotation. That is Canola-Canola-Wheat-Wheat-Barley-Barley. His theory is that with 4 years gap between crops, the disease in the soil and stubbles have dissipated enough that he can grow the same crop two years in a row with limited pressure. The theory makes a lot of sense, and I am surprised that further research has not been carried out to validate Mic's system.

Mic is a self-professed tight arse and explained very simply his philosophy with farming. Mic reasoned that average farming margins are 7%, so if he could cut costs by 2% (as an example) and increase productivity by 1.5% (as an example) he could be 50% more profitable than average. It sounds unbelievable, but similar thinking was presented at the GRDC business updates late in 2019 by a farmer named Peter Kuhlmann from South Australia. For those interested in reading the presentation input the following link: ***https://t.co/oSs79Uq2ie?amp=1***

Another unique philosophy of Mic's was his management of grain logistics at harvest time. Mic does not like to double handle his grain, which by his reckoning costs at least $5/tonne every time you move it—for example, moving from the chaser bin to sheds. Mic has perfected a system of stacking grain in the paddock.

It sounds risky to some, due to the inevitability of harvest rain. Mic explained that an undisturbed cone of grain would allow the water to run off the stack. When water can drain freely at the bottom, the grain has no problems getting wet. Mic initially had 400 tonnes stacks in his paddocks, but now with a larger conveyer, he can make 1000t stacks of grain. The stacks are picked up with his custom-designed and manufactured 'unstacker' and loads trucks directly. Mic estimates his losses from his grain stacks are less than 1%. At $250 (on-farm value) / 1000 tonne = $2.50 / tonne in storage costs.

Summary

The trip was an excellent way to view other farming systems and take ideas away from different growers. The Esperance environment is not dissimilar to our sandplain soils, and they face many of the same issues like compaction, non-wetting soils, water-logging, harvest rainfall and moisture.

Esperance grower's adoption of controlled traffic farming, digital agriculture and soil amelioration is much more widespread than the Albany port zone. The reasoning for this is difficult to pinpoint, I'm sure some would say it is because the region has enjoyed some prosperous years in recent times. Therefore, they can afford to reinvest in their farming businesses. I think that would be a shallow assessment and not pay enough credit to the grower's innovation and willingness to embrace new ideas. Perhaps there is a critical mass of high performing farmers, and their skills and knowledge lift the entire community? Whatever it is, I feel like our group learned a great deal about growing crops and farming in general. I am sure most of our participants picked up many ideas to challenge their method or way of thinking. It is cliched to say, but if each of our tour participants took away one idea that caused a change in how they manage their businesses, it was a successful trip.

As I have mentioned previously, SCF is willing and able to organise more of these tours within Australia or even internationally. The GRDC recognises the value in the learning opportunities from travel, and we are welcome to apply for 50:50 funding at any time. If you have ideas for future tours or would just like to register your interest in going, please contact Nathan via email or text.

Your Soil's Peak Performance is Our Passion

Our Field Research Team & Area Managers work closely together to gain regional insights and empower local growers with the most up to date information.

Our 2019 trials in the region included: NxK in Wheat and the GRDC NPK Project - P rates project.

Get in touch with Andrew or Mark to find out how our field research can benefit you.

Andrew Wallace
Albany East
0427 083 820

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Albany West
0498 223 421

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SUMMIT FERTILIZERS

Looking ahead for snails - COGGO

Small conical snails are still a growing issue in the cropping programs of the Great Southern and with tightening grain receival standards Stirlings to Coast Farmers (SCF) are continuing to look at all parts of an integrated snail management system. A component of the integrated system commonly used in South Australia is managing stubble so that snail refuges are disturbed, exposing them to the hot ground in summer which leads to mortality. The issue of using these control techniques in the South West WA is the need for 35+ degree days to kill the snails, there is also an erosion risk on lighter soil types that could lead to other problems.

For the next two years, SCF have received funding from COGGO for research into the impact of stubble management on the mortality of the small conical snail populations in the South West of WA. For this project SCF are looking at a heavily snail populated paddock west of Mt Barker and applying stubble crunching, speed tilling and cabling which will be compared against a control using four replicates over 15ha.

To determine the effectiveness of the treatments, counts of snails will be done before and after the treatments, during the season and in the grain sample at harvest. During harvest, we will use John Moore's (DPIRD) snail detecting GrainCam to create snail distribution maps. In the second season only half of the plots will be treated again to determine the implications of two consecutive applications on snail populations and mortality compared to a once only effect.

SCF aim to determine if these stubble management techniques can be used effectively in the South West of WA to control populations of conical snails with a high enough mortality rate to be effective in an integrated snail management system. The new tactics will be used in conjunction with established methods of controlling snails such as baiting, burning, rolling and cleaning to provide more options to minimise snail numbers.

SCF will partner with DPIRD researcher John Moore, to further demonstrate and test the GrainCam system developed by DPIRD. The aim of GrainCam is to map the snail populations in the paddock so that growers' applications can be more targeted. Variable rate snail bait applications would be possible in the future as well as targeted stubble management or burning.

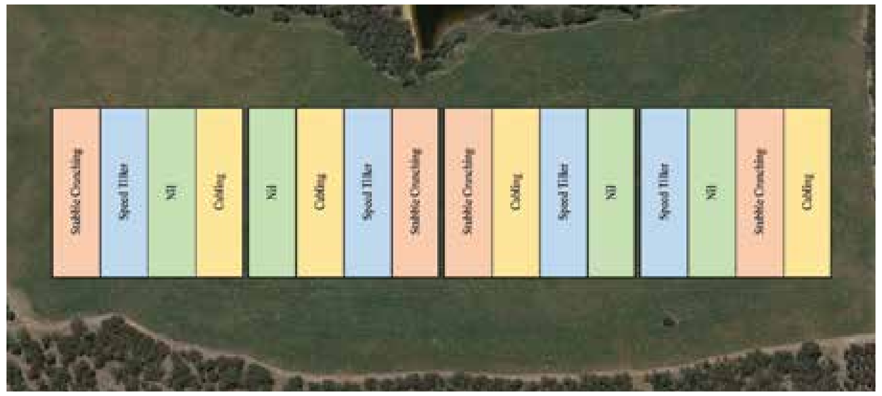

FIGURE 1. Trial layout of the 2020 COGGO small conical snail project west of Mt Barker, WA.

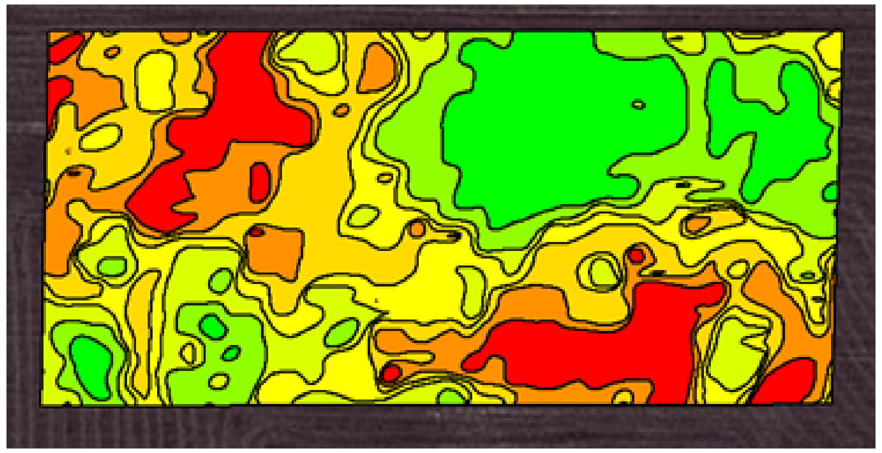

FIGURE 2. Example of contoured snail density map produced by Moore et al. (2018) using 'GrainCam' a camera mounted on the bubble auger in the grain tank of a harvester, where regular pictures are taken with a smart phone. Red indicates the areas with the highest snail densities and green areas the with the lowest snail densities.

COGGO

On the go pH sensing

Stirlings to Coast Farmers is excited to announce that we have been successful in our National Landcare Program – Smart Farms Small Grants (Round 3) Soil Acidity Mapping project application.

Project Background:

Soil acidity is becoming an ever-increasing soil constraint in the Great Southern region of Western Australia, with approximately 90% of sampled sites evaluated receiving pH values below the suggested topsoil pH target level of 5.5 (soilquality.org.au, 2019). Low soil pH levels lead to low fertility, poor crop vigour & nutrient availability, and reduced production levels.

Currently, the majority of Western Australian farmers irregularly soil test their paddocks. If they do, the soil sampling strategy is often based off previous sampling sites which may or may not be reflective of the level of soil pH variation typically seen within a paddock. However, there are two alternative sampling strategies that allow growers to gain a better understanding of their soil acidity variation. Grid sampling is one alternative available, and allows a better paddock representation of soil acidity, but is heavily labour intensive and requires a laboratory soil test for each point tested. On-the-go sensors is the second alternative, and these systems take measurements more often (4+ samples/ha) and are less labour intensive.

Project Methodology:

SCF will be establishing a Soil Acidity Management demonstration site in our Great Southern region, hosted over an 18-month period. The soil acidity demonstration site allows the opportunity to explore the use of digital technology in rapidly assessing acidic soils and quantifying the areas that need effective remediation, at a greater resolution (measurement count) than currently assessed. The project will utilise a range of soil pH sampling strategies, tools and technologies to demonstrate best practice in the management and measurement of soil acidity.

Soil pH sampling strategies held under this project include utilising the traditional farmer/advisor scattered paddock samples, 1-hectare grid sampling and utilising a Veris "on-the-go pH" sampler as pictured to the right.

Soil pH levels will be analysed across all three sampling techniques, and a soil pH map will be created from each strategies' result.

FIGURE 1. Veris On-the-go soil pH sensor (Source: Stock Journal, 2018)

An economic analysis and comparison scenario will be designed that compares the differences between traditional uniform treatment methodologies, against modern variable rate methodologies based on gridded and on-the-go sampling methods. The site will also have a variable rate lime application in 2021, and the soil pH levels will be re-assessed in 2022 at designated sampling points.

Project Aims:

- Demonstrate digital technologies that could be utilised for mapping & monitoring soil pH levels.
- Demonstrate the levels of which soil pH can vary, and how sampling strategy can ultimately affect how a Variable Rate treatment map would be created.
- Determine the potential savings (or additional coverage) gained by utilising variable rate technology based on appropriate treatment rates, if any.
- Increase adoption of best practice sustainable agriculture & the capacity of our land managers to adopt best practice sustainable agriculture.
- Improve our overall soil quality to improve soil structure and on-farm productivity.
- Increase the digital literacy of our members and nearby landholders, researchers, advisors and NRM officers.

Australian Government

National Landcare Program

MLA producer demonstration sites: Alternate summer forage crops for Southern WA

Climate analysis for the SCF region shows that rainfall outside the conventional May to October growing season is increasing. SCF members want to explore ways of managing the high variability in rainfall distribution to optimize the year in year out feed base. The producers most likely to grow summer crops successfully are in the high rainfall zone (HRZ) with a means annual rainfall (MAR) of 450mm and over. Growing summer crops successfully produces a cost-effective feed which will be available to livestock during the summer and autumn period when feed usually is scarce. More feed availability during the autumn feed gap will improve profitability in one of two ways. Firstly, by carrying more livestock and secondly, by having animals ready for the market outside of peak supply times.

This project funded by Meat and Livestock Australia aims to demonstrate the feed value of alternate high biomass summer forage crops in increasing stocking rates and live weight gain of prime lambs or beef cattle relative to current systems in the HRZ of Western Australia. Summer crops allow deferred grazing on annual pastures, giving them more time to establish and reach critical biomass before stock graze them, which means more productive annual pastures with more biomass. Typically, whole-farm stocking rates are calculated based on the ability to carry the stock over the autumn period. If producers have more confidence in their feed base over the summer/autumn period, they would be able to increase flock or herd numbers and produce more meat and wool consistently.

In 2018-19, a grazing demonstration on Pallaton Raphano had been carried out by PG Wrightson Seeds and Elders at Manypeaks. Producers and demonstration hosts witnessed multiple cattle grazing events on the paddock at large carrying capacity. As a result of this, many SCF members have ordered the limited seed to plant this upcoming spring. SCF Producers are also interested in winter canola, sorghum, millet and cowpea crops as potential livestock feed sources.

SCF researchers want to demonstrate which crops are the most productive in our region out of millet, Pallaton Raphano, winter-canola, cowpea and sorghum. The productive capacity of the summer forage crops will be measured in live weight gain on three different producers properties over the next three years. SCF is looking for interested members to either host a site or be involved in a core producer group.

Important data hosts need to collect.

Before grazing:

- Stock number
- Stock class
- Stock weights
- Plant samples from summer crop and control pasture or barley stubble

Post grazing:

- Stock weights

SCF staff will help with all critical data collection. It will provide livestock scales if required for the weighing of the animals and taking biomass cuts, plant sampling (for nutritional testing, etc.). If weighing the whole mob is not practical a subsample of sheep or cattle can be tagged so we can determine pre and post grazing average weights.

If this project interests you, or you would like to be involved, please contact Samantha Lubcke on 0417 605 784.

Understanding return on investment of sub-surface water management options for waterlogged areas in the Great Southern Western Region

Project aim:

This investment aims to assist growers in making informed decisions around the installation of drainage to reduce the impacts of waterlogging on crop production areas and overall farm profitability. This will be achieved through grower participation in the planning, development, monitoring and maintenance of the drainage installation trial sites. Data, such as cost of implementation, water movement, plant establishment, biomass and yield will be collected from within the drainage zone of influence and compared to outside of this zone. Measurements will be collected over multiple years to give growers a better understanding of the improvements in yield and time to return on investment.

Many SCF members are well-acquainted with waterlogging in the high rainfall zone (HRZ) and the impact it has on grain yields. Under waterlogged conditions, the excess water within the root-zone creates anaerobic conditions (conditions without free oxygen) and prevents the plant from taking up nutrients and surviving. Left unmanaged, waterlogging can lead to soil structural decline and has the potential to create nutrient deficiencies & toxicities, create root death/reduced plant growth, or result in the death of the plant.

There are a range of methods available that we can utilise to minimise and mitigate against the effects of waterlogging, including the use of either surface water management or subsurface water management methods.

Surface drainage options available to growers include raised beds, evaporation basins, & interceptor drains, while subsurface options include slotted pipe, mole drains & pumping options.

From 2020 for four years SCF will focus on the use of subsurface drainage with the Preston family installing 5km of subsurface slotted pipe with a limestone caprock backfill over a range of areas. Excess water that reaches the subsurface, after the water holding capacity of the soil is achieved, will be drained away from the plant roots allowing them to grow optimally.

Summary

Subsoil drainage is a waterlogging solution that requires substantial upfront investment from growers. Previously the cost versus benefit of subsoil drainage has been too expensive to warrant employing this solution. With investment from the GRDC and host farmers, SCF will monitor installation costs, and yield benefits over multiple years to ascertain the value of subsoil drainage. SCF is hopeful of having a field day during the installation process so we can all see the subsoil drains being installed.

Can cultivation reduce root lesion nematodes?

CARLA MILAZZO, JEREMY LEMON - DPIRD

Background

Root lesion nematode (RLN) is a significant pathogen of cereal crops. RLN of the Genus Pratylenchus (such as P. neglectus and P. quasitereoides – formerly known as P. teres) feed on plant roots thus reducing the ability of crops to uptake water and nutrients. As such, above-ground symptoms often resemble nutrient deficiencies and can cause yield penalties of up to 40%. RLN populations build up rapidly in the soil when host crops, including cereals and canola, are grown in consecutive seasons.

In the southern region, the extent of RLN-affected paddocks and the spread of populations warrants investigation. Data gathered through the PREDICTA B service has been mapped over time, which suggests P. neglectus populations have rapidly spread and increased in density in recent years . As such, the typical cereal-canola rotation, which lacks a break for RLN, is concerning.

The best way to reduce RLN populations to below economically-damaging levels is through rotation with resistant break crops. Resistance ratings or crops and varieties differ between species of RLN so it is important to know what species of RLN is present. Canola appears tolerant to RLN but is not resistant, meaning populations are sustained and can be damaging to the following susceptible crop.

Aside from planting non-host break crops for one or two years, there is some indication that cultivation may disrupt RLN, along with other root diseases like Rhizoctona bare patch (Rhizoctonia solani).

Aim

To investigate the effect of cultivation (30-40cm depth) on the population of RLN (P. neglectus) and the level of Rhizoctonia bare patch (Rhizoctonia solani AG8) in the soil.

Ripper Gauge demonstration

To complement trial work at several locations across the state (including Darkan and Yerecoin) by DPIRD's nematology group, PREDICTA B sampling and root examination has been undertaken at Stirling to Coast Farmers' Ripper Gauge demonstration site at West Kendenup. The site has a loamy forest gravel soil type with moderate non-wetting challenges.
Pre-cultivation PREDICTA B testing revealed average levels of 15 nematodes (P. neglectus) per gram of soil. This is considered to present a medium risk for wheat yield loss. P. quasitereoides was not detected. The test returned a low risk of yield loss from Rhizoctonia bare patch (0.76 log pgDNA/g soil) while other soil pathogen levels were below detection. The paddock was sown to canola in 2018 and wheat in 2017, and therefore has not had a RLN break crop for several years. Barley, also a susceptible host, was sown in 2019.

Soil sampling

PREDICTA B sampling was conducted at selected locations in the trial at early tillering (June 2019). Samples were taken from seven points at boundaries between cultivated and uncultivated treatment strips. These locations were at least 50m apart and were considered as 'reps'. Locations were marked by GPS point to ensure soil sampling could be repeated after harvest at the same locations to see how populations changed over the season. Post-harvest samples were collected in January 2020.

RLN

RLN populations significantly increased over the season under barley, a susceptible host, as seen in Figure 1 ($p<0.001$). Average numbers in June (all samples) were 4 nematodes/g soil, increasing to 18 nematodes/g soil by January. Levels are considered a medium risk level for wheat yield loss between 6-25 nematodes/g soil while a high-risk level is over 25. Cultivation did not appear to significantly reduce nematode levels from post-harvest data ($p=0.307$).

Rhizoctonia

Rhizoctonia levels were highly variable across the site (Figure 2). In June most samples had undetectable levels of Rhizoctonia, however levels rapidly and significantly increased over the season ($p<0.001$) ranging from low to high risk levels. Due to the high variability across the site no significant differences were found in relation to cultivation ($p=0.683$).

Root health

Twenty plants were collected from the same soil sampling locations at flowering. Roots were washed and scored for symptoms of disease; spear-tipping (on both crown and seminal roots), lesions, and lateral root stunting. Roots were scored on a scale from 0 (healthy) to 2 (50% of roots affected). Figure 3 shows roots that scored 2 for spear tipping, lesions and root pruning.

Symptoms of Rhizoctonia were not statistically different between treatments (crown roots $p=0.394$, seminal roots $p=0.639$). However symptoms of RLN were statistically different between treatments. Root lesions and root stunting was scored significantly more severe in roots collected from uncultivated soil than those collected from cultivated soil (lesions $p=0.004$, stunting $p=0.016$).

Yield

Trial strips 190m long were harvested with a weigh trailer and average yields calculated. Uncultivated strips yielded on average 5.45t/ha and cultivated strips yielded 5.22t/ha. These yields were not statistically significant ($p=0.649$). Grain quality was assessed from protein, screenings, hectolitre weight, moisture and colour. No quality parameters differed significantly in terms of cultivation treatment.

Conclusion

The RLN population and Rhizoctonia levels increased significantly over the season under barley. Barley is a host to both pathogens. The PREDICTA B data did not reveal any significant difference in RLN or Rhizoctonia levels in terms of cultivation. Some root health symptoms pertaining to RLN damage were scored as significantly more severe in roots from uncultivated soil. Despite this, there was no significant difference in barley yield or grain quality in relation to cultivation. Therefore soil cultivation to 30-40cm does not appear beneficial for this soil type.

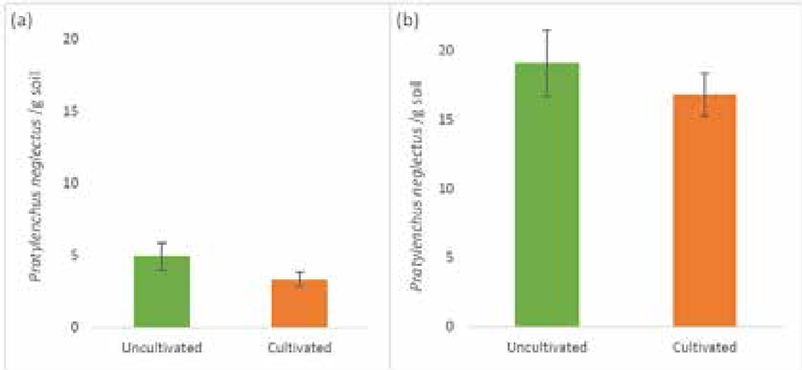

Figure 1. Average number of *Pratylenchus neglectus* nematodes per gram of soil collected from uncultivated soil and soil ripped with a Horsch Tiger and a Plozza Plough at **(a)** early tillering (June 2019) and **(b)** post-harvest (Jan 2020). Error bars show one standard error of the treatment mean.

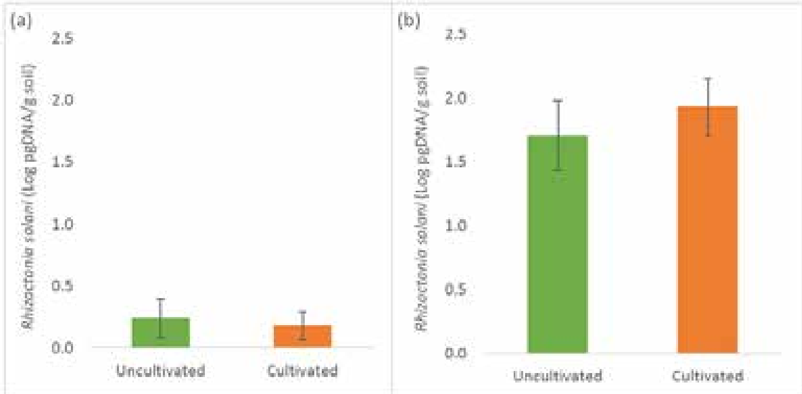

Figure 2. Rhizoctonia (*Rhizoctonia solani* AG8) levels (Log pgDNA) per gram of soil collected from uncultivated soil and soil ripped with a Horsch Tiger and a Plozza Plough at **(a)** early tillering (June 2019) and **(b)** post-harvest (Jan 2020). Error bars show one standard error of the treatment mean.

FIGURE 3. Barley roots collected from the trial site were affected by Rhizoctonia and root lesion nematodes (Pratylenchus neglectus).

Controlling small pointed snails before they lay eggs

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KEY MESSAGES

- Snails will actively feed in summer if there is sufficient green plant material, but they will not start to lay eggs until autumn. The albumen gland generally starts to develop in size from March to April indicating that snails are becoming sexually mature and need to be controlled at this time.
- Control measures using baiting alone need to be carefully considered. Small pointed snails feed on baits all year round however, the mortality rate caused by these baits is variable.
- Before baiting entire paddocks, check that baits are effective by 'patch baiting' and then observing dead snails after 24 hours.

Aims

- Predict when small pointed snails will start to lay eggs based on the size of the albumen gland.
- Determine if small pointed snails consume metaldehyde baits differently throughout the year with associated responses in mortality.

Introduction

Before snails lay eggs, the albumen gland starts to increase in size. The role of the albumen gland is to secrete a nutritive secretion onto the fertilised egg. Until this gland is developed, snails are not sexually mature and will not lay eggs. If the timing the gland development is known, then control measures such as baiting can be implemented before egg laying occurs. If control measures are put in place before eggs are laid then there will be a reduction in the overall snail population.

The most commonly applied control measure for snails is baiting. Some growers have indicated that they would like to bait after a rain event during summer. Anecdotal reports of the success of baiting after summer rain have been mixed. Some growers report getting good kills with at least one dead snail observed per bait on the ground, whereas other growers have reported no dead snails observed in the vicinity of baits. To address these varied reports, a trial was done to determine if there was a time of year when snails are more likely to feed on baits.

Method

Albumen gland size

Snails were collected monthly for about three years. Each month at least 20 snails were collected from a single paddock from each location. In 2017-18 paddocks were located at Woogenellup, Condingup and Munglinup; in 2019 paddocks were located at Mt Barker, Gibson, Scadden and Dalyup. Snails were placed into a jar filled with water and drowned and kept in the water for 24 hours. The water was then drained and the jars filled with 70% ethanol to preserve snails. Using a dissecting microscope, the albumen gland from each snail was removed and its length measured.

Feeding trial

Small pointed snails were collected monthly for 13 months from Woogenellup. At each collection all snails were placed onto damp paper towel and 7-21 actively moving snails placed into 500mL round tubs with mesh lids. Each tub had a 10cm diameter of dampened cotton material placed in the bottom with eight pellets of known weight on top. Tubs had pellets with 50g/kg of metaldehyde or placebo pellets and there were six replicates of each. The cotton material was re-dampened daily with water. After three days, pellets were removed, placed into a 40oC oven for four days and then weighed. After pellets were removed, snails were placed into the centre of each cotton disc in the tubs. After 48 hours, snails that had moved were scored as alive and those that had not were scored as dead. The humidity and ambient temperatures remained constant in the lab. ANOVA in Genstat was used for analysis.

Results and discussion

Time of egg lay based on albumen gland size

Gland size in snails generally increased the most in March or April regardless of whether there was a summer rainfall event (Figures 1-3). While snails fed on green plant material in summer, their albumen glands were not increasing in size and consequently they were not laying eggs during January to March. The albumen gland reached peak size from May at most sites, indicating that at this time most snails were laying eggs. Therefore, snail control needs to occur before May (ideally from March to April) to ensure eggs have not been laid.

Generally, by October the albumen gland had decreased in size indicating that the gland was no longer functioning and that snails were not laying eggs (Figures 1-3). However, at this time of year snails were still observed to be feeding.

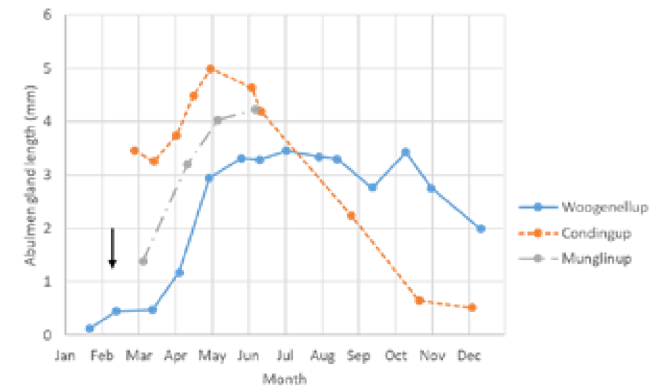

FIGURE 1. Albumen gland size of snails collected in 2017. *Note: arrow indicates monthly total of summer rainfall (mm) >50mm for all sites.*

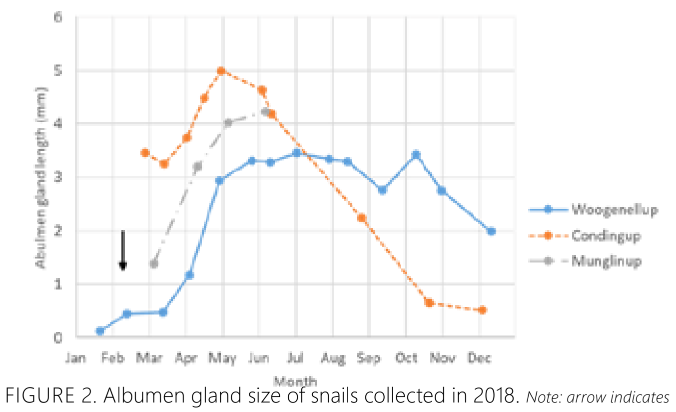

FIGURE 2. Albumen gland size of snails collected in 2018. *Note: arrow indicates total summer monthly rainfall (mm) >50mm; for Munglinup and Condingup only. Woogenellup did not have monthly summer rainfall >50mm.*

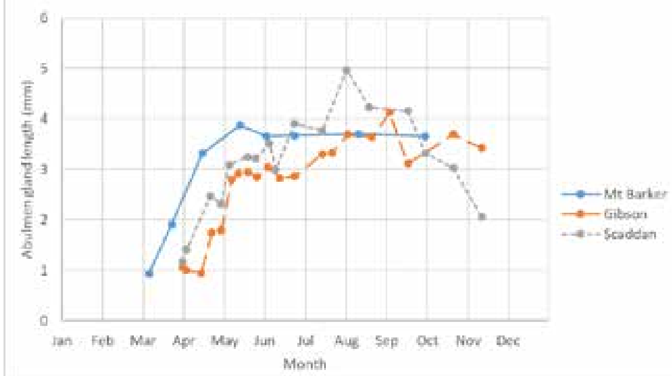

FIGURE 3. Albumen gland size of snails collected in 2019. *Note: no site had monthly summer rainfall >50mm.*

Time of feeding

Snails fed throughout the year. Mortality with placebo was low overall with fewer than 4% deaths except in June when mortality was 12%. Snails feeding on placebo baits between July to October 2018 and in February 2019 consumed almost all the baits, while in February and March 2018 about half were consumed.

While the amount of metaldehyde bait consumed by snails did not significantly differ from month to month (except for a lower amount consumed in March 2018), the mortality caused by the baiting differed from 20-90% between months. For instance, mortalities in February 2019 were more than four times those recorded for February 2018 (Figure 4). More research is required to determine the cause of the deaths, as it cannot simply be the time of the year.

Conclusion

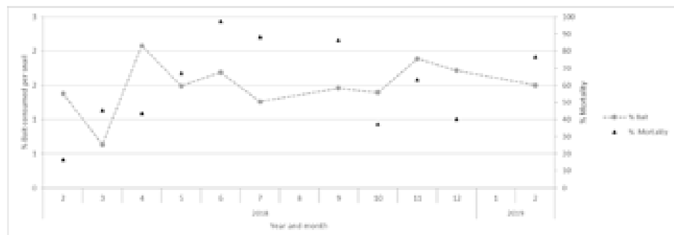

FIGURE 4. Percentage of baits consumed per snail and mortality. Least significant differences (LSDs) are 0.6% for baits consumed per snail and 16% for mortality.

Snails begin to actively lay eggs about May regardless of whether there has been a rainfall event in summer. To stop snails breeding, control measures such as baiting need to be done between March and April when the albumen gland in snails is beginning to develop.

In the absence of any other food source, snails will feed on baits at any time of year. However, the mortality arising from baiting varies. The increase in placebo bait consumption in April highlights the importance of ensuring that the timing of baiting occurs when snails are more likely to be actively feeding as this will increase the likelihood of snail mortality. Therefore, it is recommended that small test areas are baited, and the number of dead snails after 24 hours observed before baiting the whole paddock.

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