STIRLINGS TO COAST FARMERS

2020 TRIALS REVIEW

Growing Agriculture Together

Hi everyone,

Welcome to the 2020 edition of the Stirlings to Coast Farmers Trials Review (SCF) Booklet. I hope you enjoy the second year of the revised layout. 2020 was a strange year, with a terribly dry start, which was finally reprieved with season-saving rains in August. The final yields ended up being surprisingly good for our eastern members, and some excellent grain yields were achieved on the western side.

Canola yields were pleasantly surprising across the region, with most agronomists and researchers putting that down to the cool finish. Last year marked the first season of our twin hyper yielding crops projects, which will be ongoing for another three years. The small plot trials being run by FAR Australia will move from Green Range to Frankland this year, and we look forward to the data produced in this environment.

The wet start to 2021 will be a good test of our sub-soil drainage project hosted by the Preston family at West Cranbrook. The grain yields of this paddock-scale trial will be measured for the next three years to ascertain the economic benefit of installing the sub-soil drains and the payback period. Every paddock situation will be different, but this project will give members some robust numbers to evaluate subsoil drainage as a waterlogging mitigation strategy.

I would like to wholeheartedly thank our farmer trial hosts from 2020 and those that have already put up their hand to host a trial in 2021. Most of the funding to run SCF comes from grants, and most of the grant activities involve running on-farm trials and demonstrations. Without your contribution, SCF would not be able to deliver new and exciting farming concepts.

Our staff, led by Philip Honey, are transforming the way we collect on-farm trial data, significantly reducing the burden on farmer trial hosts. Philip is a precision agriculture expert who can pull the yield data from your harvest computer to measure the trial treatments we have installed. Not only does this provide better data than the weigh trailer, but it also means SCF staff don't have to interrupt your harvest operations. If you are worried about the hassles of hosting a trial, please speak to members who have done it. We would love to broaden the base of members willing to host trial sites.

Finally, a quick thank you to our SCF communications team, who put a lot of effort into this publication. We hope you find the trials review booklet easy to read and full of helpful information. As always, we are happy to take feedback from you, be it positive or negative.

Enjoy the 2020 SCF trials review booklet, and best of luck for the remainder of the 2021 growing season.

Best Regards,

Nathan Dovey
CEO

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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. Lowercase letters above the column (a,b,c etc) denote treatments whose means are statistically the same ie a column with an 'a' will not be statistically different from any other treatment in that graph with the same 'a' letter above the column. On some graphs the treatment mean is also recorded above the column (Figure 1).

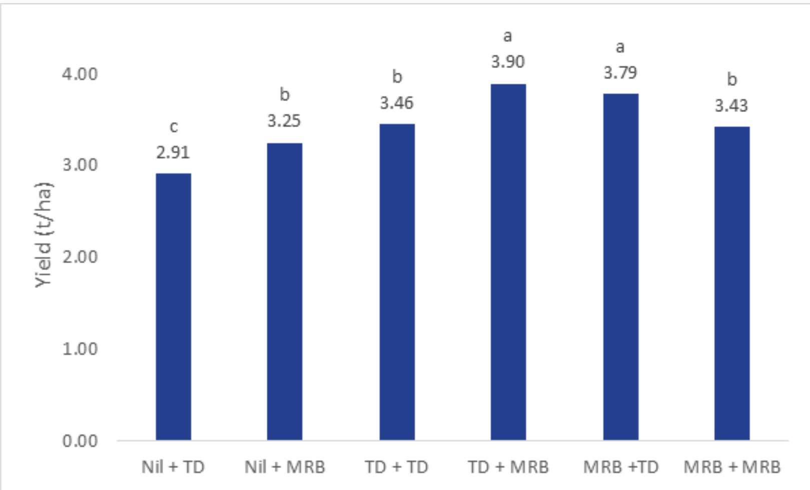
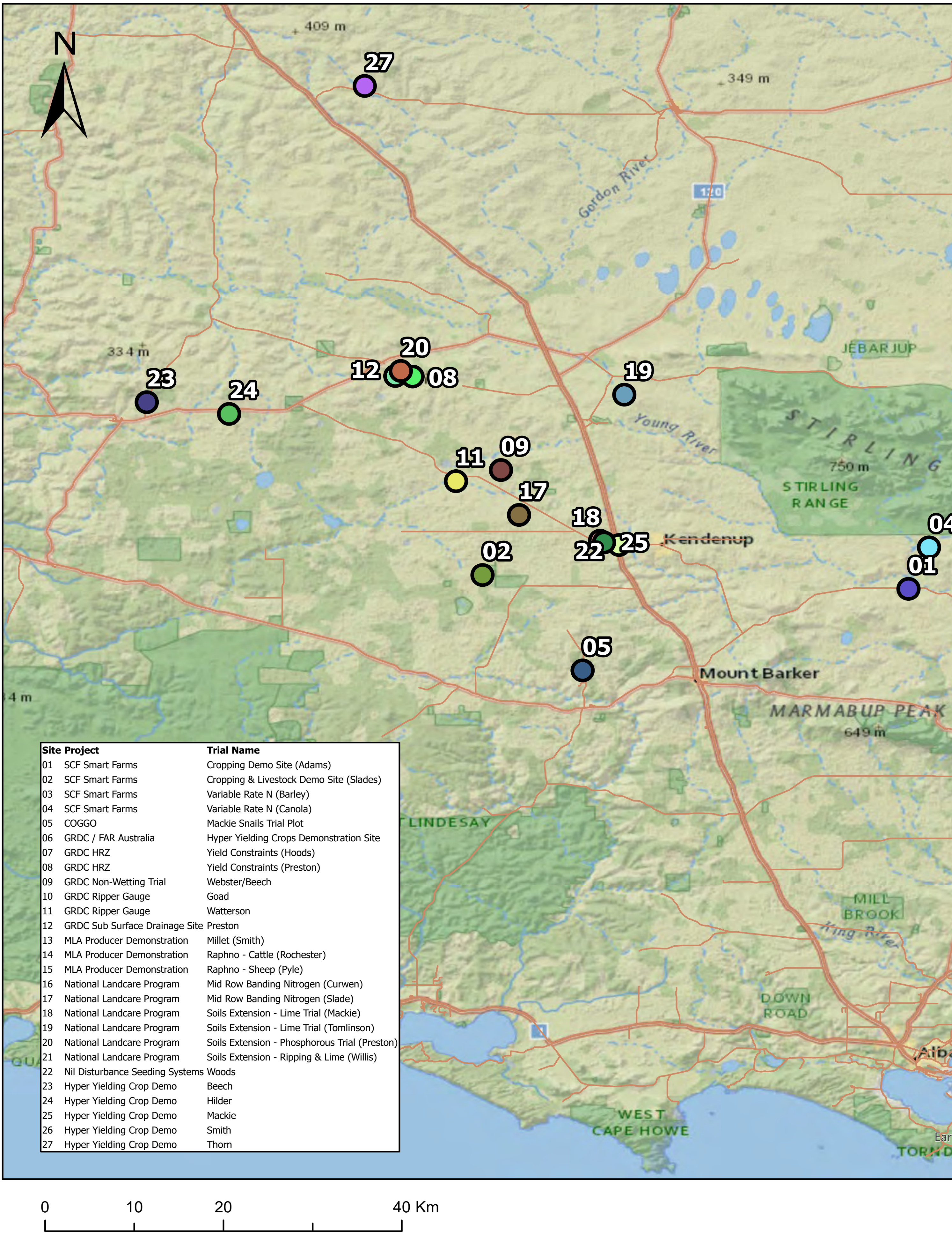


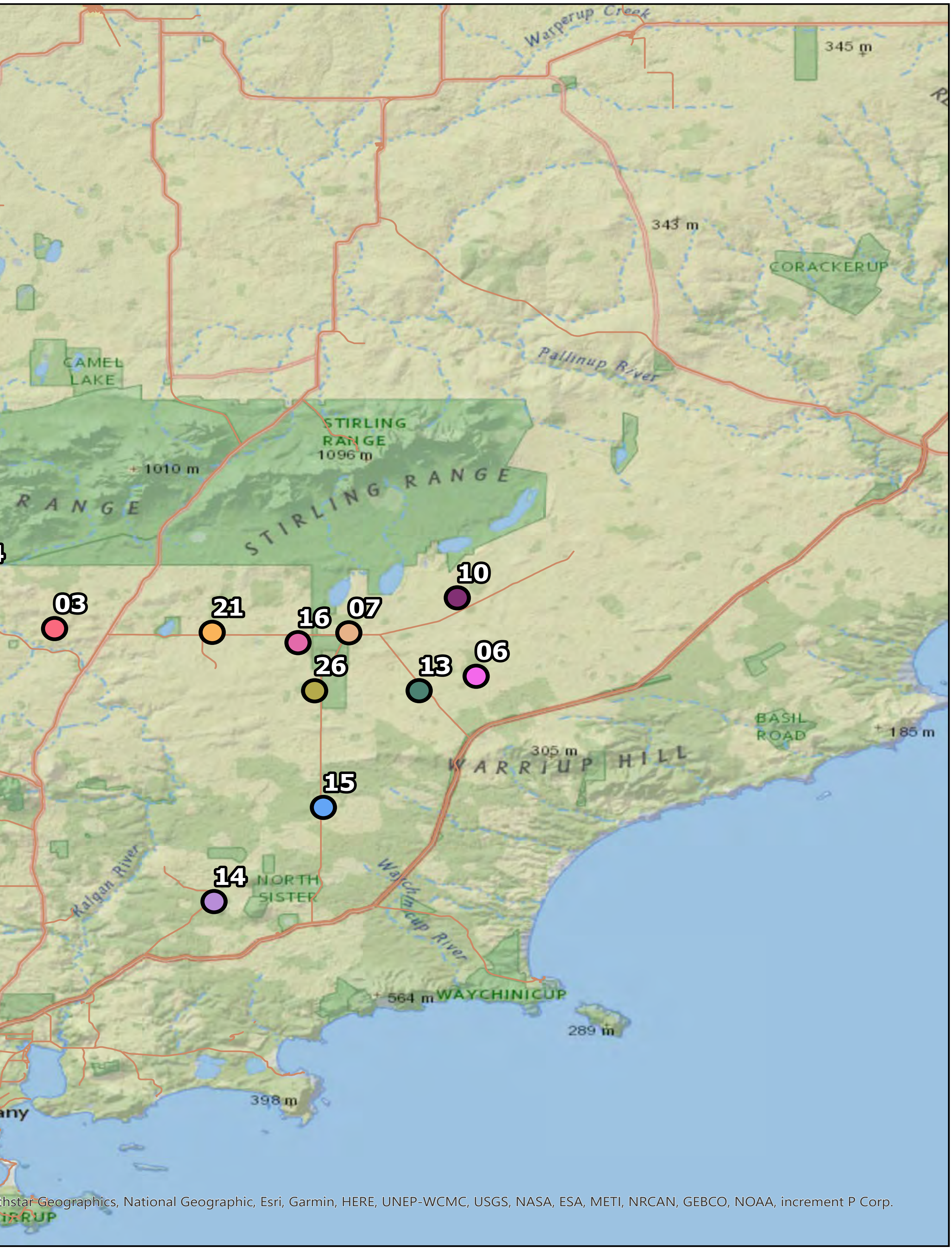
Figure1. Average grain yields for different application methods for Nitrogen (N) for the 2020 season, where TD is top dressed and MRB is mid-row banding. The first N application method was done at seeding and the second was at tillering.

In the example above we can see that all treatments were different to Nil+TD; that Nil+MRB, MRB+MRB and TD+TD were statistically the same as each other but different to all others and that TD+MRB and MRB+TD were statistically the same as each other but different to all other treatments and were statistically the highest yielding.

SCF 2020 Trial Site Map



Site	Project	Trial Name
01	SCF Smart Farms	Cropping Demo Site (Adams)
02	SCF Smart Farms	Cropping & Livestock Demo Site (Slades)
03	SCF Smart Farms	Variable Rate N (Barley)
04	SCF Smart Farms	Variable Rate N (Canola)
05	COGGO	Mackie Snails Trial Plot
06	GRDC / FAR Australia	Hyper Yielding Crops Demonstration Site
07	GRDC HRZ	Yield Constraints (Hoods)
08	GRDC HRZ	Yield Constraints (Preston)
09	GRDC Non-Wetting Trial	Webster/Beech
10	GRDC Ripper Gauge	Goad
11	GRDC Ripper Gauge	Watterson
12	GRDC Sub Surface Drainage Site	Preston
13	MLA Producer Demonstration	Millet (Smith)
14	MLA Producer Demonstration	Raphno - Cattle (Rochester)
15	MLA Producer Demonstration	Raphno - Sheep (Pyle)
16	National Landcare Program	Mid Row Banding Nitrogen (Curwen)
17	National Landcare Program	Mid Row Banding Nitrogen (Slade)
18	National Landcare Program	Soils Extension - Lime Trial (Mackie)
19	National Landcare Program	Soils Extension - Lime Trial (Tomlinson)
20	National Landcare Program	Soils Extension - Phosphorous Trial (Preston)
21	National Landcare Program	Soils Extension - Ripping & Lime (Willis)
22	Nil Disturbance Seeding Systems	Woods
23	Hyper Yielding Crop Demo	Beech
24	Hyper Yielding Crop Demo	Hilder
25	Hyper Yielding Crop Demo	Mackie
26	Hyper Yielding Crop Demo	Smith
27	Hyper Yielding Crop Demo	Thorn


Warperup Creek
345 m
343 m
CORACKERUP
CAMEL LAKE
Pallinup River
STIRLING RANGE 1096 m
1010 m
RANGE
STIRLING RANGE
10
03
21
16
07
26
13
06
BASIL ROAD
185 m
305 m
WARRIUP HILL
15
14
NORTH SISTER
Kalgan River
Waychinicup River
564 m
WAYCHINICUP
289 m
398 m
thstar Geographics, National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Funded Trials

Mid-row banding of Nitrogen to improve nitrogen use efficiency and reduce fertiliser applications in cropping systems.

Trial Hosts: Slade & Curwen Families

Key Messages

- **Higher wheat yields were achieved for some treatments that included mid-row banding (MRB) of Nitrogen (N) at South Stirlings, but not in the Kendenup trial.**
- **At South Stirlings, the combination of MRB applications of N yielded significantly higher than the other treatments.**
- **MRB of N at both seeding and tillering yielded significantly less at South Stirlings than either combination of MRB and top dressed N applications.**
- **The two highest yielding treatments at South Stirlings, which included MRB and top-dressing of N, had greater N efficiency because they yielded more grain from the same applied N units (109.5).**

Background

Research indicates only 42% of the Nitrogen (N) fertiliser applied is utilised by the crop with the remaining leached, volatilised or washed away. Mid-row banding (MRB) of N at seeding and tillering reduces the contact that N has with the atmosphere leading to reduced volatilisation and a reduced likelihood of rainfall runoff washing it away before it can be utilised. Benefits from MRB include the same or higher yields from less nitrogen being applied, improved nitrogen use efficiency and reduced soil acidification rates.

Method

Two trial sites were setup in 2020, a small plot trial in South Stirlings and a broadacre site at Kendenup. Seeding was completed with the help of Direct Seeding and Harvest and MRB and top-dressing of N was completed with the help of CSBP. Mid-row banding at seeding was completed by using the seeder to place urea in rows then seeding between those rows. Top-dressing at seeding was done by spreading urea over the plots. The MRB at tillering was done with CSBP's trial machine with Flexi-N streamed behind a disc and top-dressing Flexi-N was done with streaming nozzles on a hand boom.

Table 1: Treatments applied at Kendenup

Treatment	At Seeding (8/6/20)
1	Mid-row Banded Urea (125kg/ha)
2	Top Dressed Urea (125kg/ha)

Table 2: Treatments applied at South Stirling

Treatment	At Seeding (8/6/20)	At Tillering (29/7/20)
1	Mid-row Banded Urea (125kg/ha)	Mid-row Banded Flexi-N (100L/ha)
2	Mid-row Banded Urea (125kg/ha)	Top Dressed Flexi-N (100L/ha)
3	Top Dressed Urea (125kg/ha)	Mid-row Banded Flexi-N (100L/ha)
4	Top Dressed Urea (125kg/ha)	Top Dressed Flexi-N (100L/ha)
5	Nil Urea	Mid-row Banded Flexi-N (100L/ha)
6	Nil Urea	Top Dressed Flexi-N (100L/ha)

Results

South Stirlings

All treatments yielded significantly greater than the farmer control of nil urea at seeding and top-dressed flexi-N at tillering. The combinations of a top-dressing (TD) and a mid-row banding (MRB) were statistically equivalent to each other but significantly greater than all other treatments. There was a 340 kg increase from MRB at tillering when nil urea was applied at seeding and a 440kg increase from MRB at tillering when previously top-dressed at seeding. However, there was a 360kg decrease from MRB at tillering when MRB was also done at seeding.

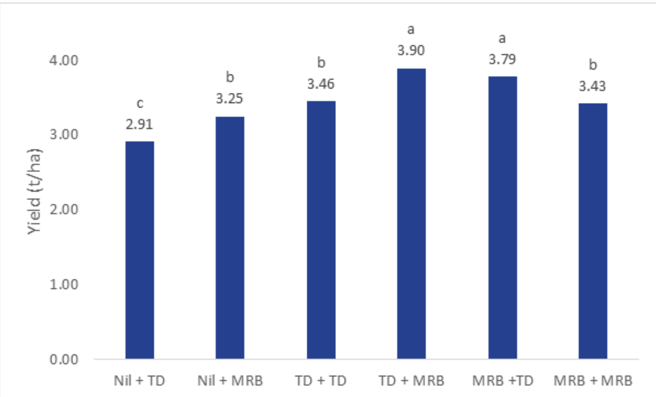


Figure 1. Average grain yields for 2020 at South Stirlings. Columns with different letters on top are significantly different from others.

There were no significant differences in grain protein levels at South Stirlings for the treatments that recieved the same units (109.5) of N. The two treatments that recieved zero urea at seeding had lower protein than the other four treatments. This is expected given they only got a total of 52 N units compared to 109.5.

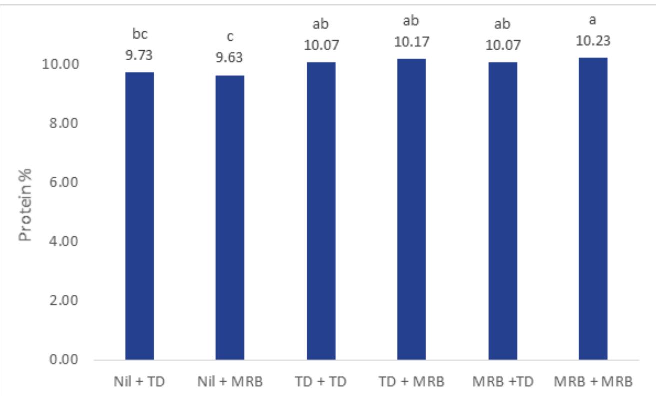


Figure 2. Average Protein % for 2020 at South Stirlings. Columns with different letters on top are significantly different from others.

Kendenup

At the Kendenup site there were no significant differences between MRB or top dressing at seeding time (19/06/20) for grain yield or protein. The late time of sowing likely reduced the yield potential further than expected and N was not a limiting factor.

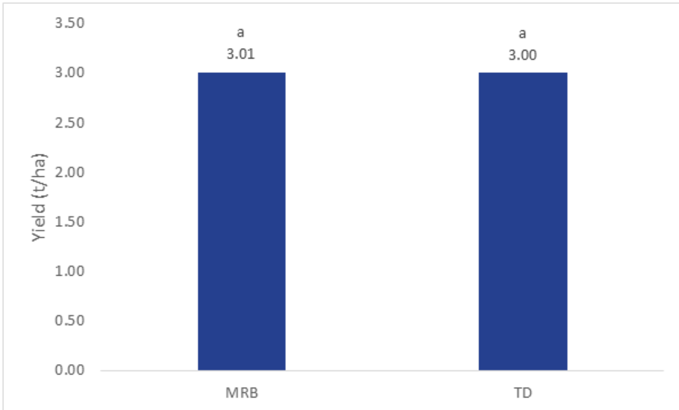


Figure 3. Average grain yield for 2020 at Kendenup. Columns with different letters on top are significantly different from others.

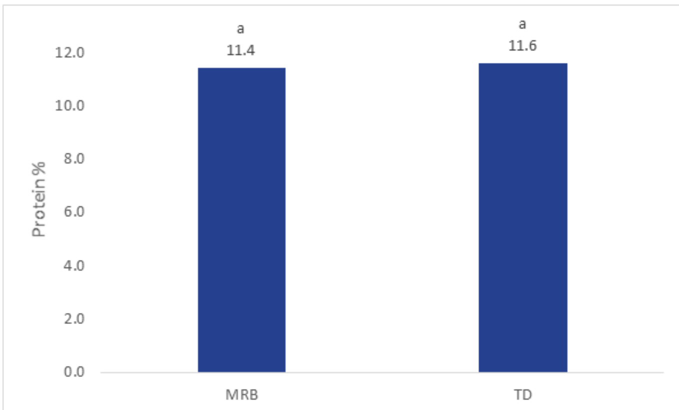


Figure 4. Average protein % for 2020 at Kendenup. Columns with different letters on top are significantly different from others.

Australian Government | National Landcare Programme

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

Trial Host: Michael Webster

Key Messages

- **Placement of soil wetter in the seed contact zone behind the seed boot was most effective for improving germination and early biomass growth.**
- **Seeding on or near last year's furrow significantly increased early biomass growth compared to off-row.**
- **There is high variability in expression of water repellence across paddocks and soil types along with response to soil wetter.**
- **Canola plants can compensate for low plant densities, and significant differences in grain yields are hard to detect.**

Summary

Low summer rainfall and dry growing season starts have compounded the non-wetting soil issue for crop germination. The use of soil wetters as a mitigation method offers the chance to alleviate the issue in years of concern. Through the investigation of 11 different placements and rates in a forest gravel soil, it was found the best placement of SE14 soil wetter was in the seed contact zone with significant improvement over the control in plant germination and early biomass.

- Increasing rates from 2 L/ha to 4 L/ha for each placement resulted in small improvements that were not significantly different.
- There was a significant improvement in early biomass when seed placement was on or near last year's furrow when compared to off-row.
- There were no benefits seen in yields with canola plants compensating for low plant density with increased branching and pod formation.

Background

Over the past few years, grain growers in the Albany port zone have found it more challenging to achieve an even crop germination because early growing season conditions were usually dry. Non-wetting soils are prevelant for growers with forest gravels, which usually rely on late summer and early autumn rains to alleviate the soil's non-wetting properties for plant germination. Growers and advisers are looking at cheaper mitigation options rather than costly soil amelioration to alleviate non-wetting soils effectively.

Conventional methods of managing non-wetting soil involve mechanical disturbance of the soil structure to mix the non-wetting particles with wettable particles. Mechanical disturbance includes claying, deep ripping with inclusion plates, ploughing and spading. These are expensive to implement for farmers; however, they also have long-lasting results. Soil amelioration can be costly with the risk of severe wind erosion.

Possible mitigation options are wetting agents, on-row seeding, furrow seeding and stubble retention. There are a range of wetting agents on the market for growers to use with different placement options whether it be on the seed, down below the seed, in the seed contact zone or on the furrow surface. Previous research by Glenn McDonald (DPIRD) found that wetting agents will help crop germination and water infiltration at the end of the season, which assists in grain filling. Growers are also reporting long term benefits from using soil wetters, although this is hard to measure.

Results

Plant Density

- Placement of SE14 into the seed contact zone behind the seed boot was the only treatment to have a significant increase from the untreated control for crop establishment.
- Increasing the rate from 2 to 4 L/ha, in the behind the seed boot treatments, had no significant increase in plant density.
- Placement of SE14 directly on the seed or behind the press wheel had no significant differences to the control.
- The application of SE14 behind the press wheel reduced the effect of SE14 behind the seed boot when used in combination.
- High rates of SE14 directly on the seed led to them sticking together which lead to lower plants per metre established.

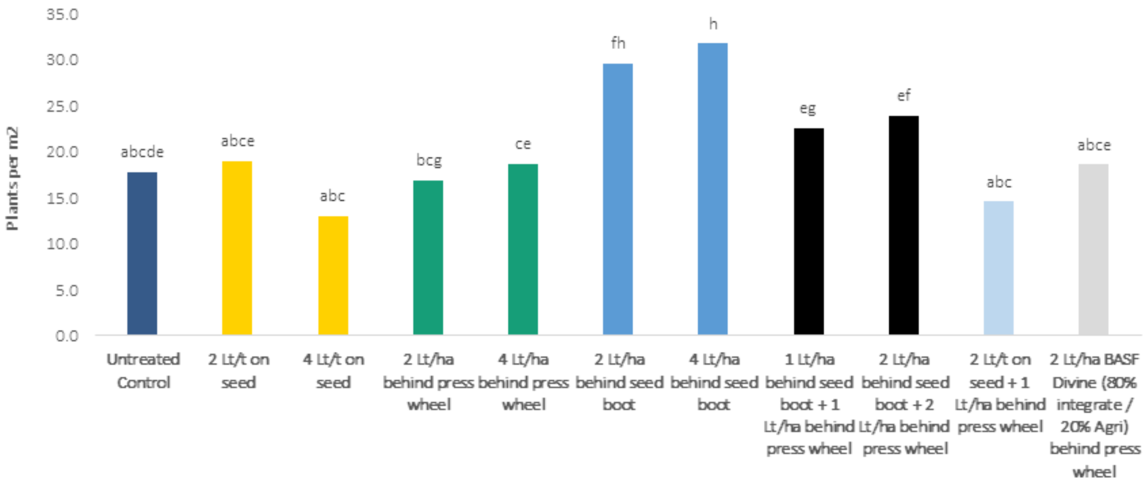
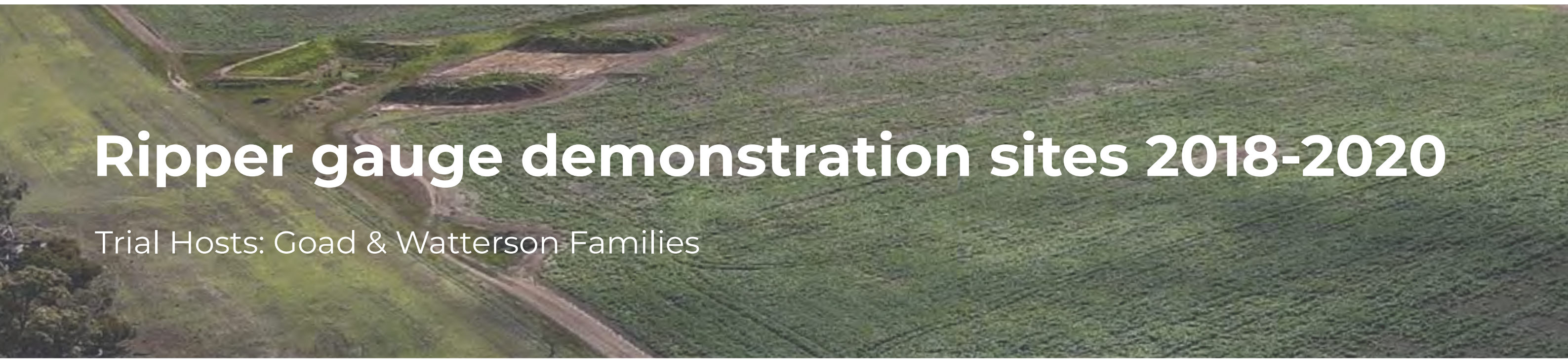


Figure 1: Plant density counts for different placements and rates of the soil wetters, SE14 and BASF Divine in a forest gravel at Tenterden WA.

SCF would like to thank the GRDC for investing in this project and Southern Dirt for inviting SCF to partner with them.



Ripper gauge demonstration sites 2018-2020

Trial Hosts: Goad & Watterson Families

Key Messages

- **TENTERDEN: There were no statistical yield increases from any tillage treatments compared to the untreated control in 2020. The 2020 results are consistent with the 2019 grain yield data.**
- **KOJONEERUP: Significant wind erosion in 2018-19, motivated the Goad family to spread clay over the whole paddock to reduce non-wetting expression and wind erosion. Machinery re-compacted the soils through the claying process and removed the 2018 deep ripping benefits. After clay-spreading and incorporation in 2020, three 50m by 50m quadrants were deep ripped to 50cm using a Tilco ripper. Each quadrant represented a different duplex depth, classified as deep, medium or shallow-duplex. Deep ripping to 50cm averaged a 1.3t/ha yield advantage over the un-ripped soil in 2020.**
- **DARKAN: There were no significant improvements in grain yield from any tillage treatments compared to the nil treatment last year. The 2020 results were consistent with the 2019 grain yield data.**
- **BROOMEHILL: There were no significant improvements in grain yield from any tillage treatments compared to the nil treatment in 2020. Last year was the first time since the treatments were installed (2018) that there were no yield benefits from the soil amelioration over the untreated control.**

Background

This project implemented four deep ripping demonstration sites in the Albany port zone on four different soil types. The trial demonstrations included different ripping machines depending on the subsoil constraints that were prevalent at each site. The main soil constraint for the project was compaction, but others included non-wetting topsoils, waterlogging and acidity. The project ran over three years, with 2020 being the final year. Stirlings to Coast Farmers partnered with Southern Dirt who managed the Darkan and Broomehill sites for this project.

Results and Discussion

Kojaneerup

There was a significant increase in grain yield from deep ripping to 50cm using a Tilco deep ripper. The yield increase ranged from 1.1t/ha in the deep-duplex soil to 1.6t/ha in the medium-duplex soil.

Deep ripping assisted in retaining subsoil moisture from the August rainfall which would have allowed the plants greater access to moisture during grainfill, increasing yields.

The highest yield increase from the deep ripping was on the medium-duplex soil, a 1.6t/ha barley yield increase. Using an on-farm barley price of $270/t and deep ripping costs of $90/ha gave a profit of $342/ha.

In 2018, the treatment yields suffered wind-erosion affecting plants numbers and early growth. Before seeding in 2020, the whole paddock had 250t/ha of clay spread and incorporated into the top 20cm of soil. The yield improvement from ripping + clay compared to unripped + clay was significant. The minimum yield improvement was 1.1 t/ha of barley in 2020. An on-farm barley price of $270/t meant that the deep ripping was $297/ha better than the unripped + clay treatment. Deep-ripping costs have been calculated at $90/ha, which means there was a minimum $207/ha benefit in the first year after deep ripping. Spreading & incorporating clay at 250 t/ha is estimated to cost $1000 per hectare in the Kojaneerup region. Although highly expensive, the soil condition's improvement is permanent, allowing payback to occur over many years.

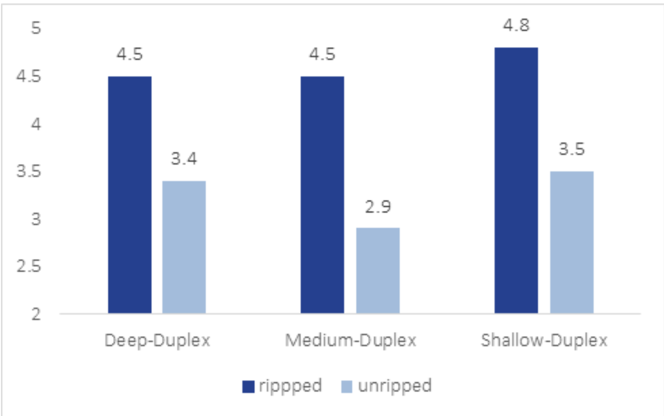


Figure 1. Ripper gauge site located at Kojaneerup, WA. Graph displays 2020 barley yields in (t/ha) comparing deep-ripped quadrants (50m by 50m) to the surrounding un-ripped soil.

Tenterden

There were no significant yield differences between treatments in 2020 at this site. Data from 2019 indicated that the Tenterden trial site was not responsive to deep tillage treatments because there is little soil compaction on gravel soils.

In February 2020, SCF staff tested the severity of the non-wetting soil at the Tenterden site. The topsoil non-wetting ratings, using the Molarity of Ethanol Droplet (MED) test, were low for the control, Horsch Tiger Ripper and Plozza Plough. The shallow disc treatment rated in the moderate range for MED testing. The four treatments' non-wetting severity was not a significant factor at this ripper gauge site based on the MED testing.

Normalized difference Vegetation Index (NDVI) readings were taken at four different times during the growing season. The Plozza Plough treatment had significantly lower biomass on the 20th June only (Data not shown). Every other treatment and timing showed no significant NDVI differences during the 2020 growing season.

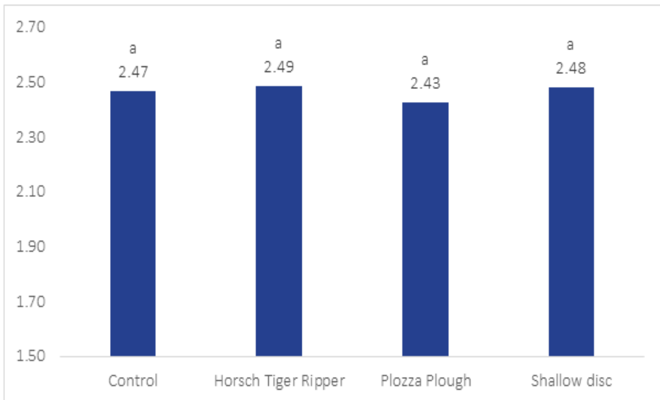


Figure 2: 2020 Canola yields (t/ha) at the Ripper gauge Tenterden site hosted by the Watterson family.

Broomehill

None of the four soil amelioration treatments yielded significantly different to the untreated control (UTC) in 2020.

In 2019, 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 2020 winter growing season was the third crop grown at the Broomehill ripper gauge demonstration site. No significant differences in yields from the soil amelioration treatments may indicate the benefits only last for two years.

Growing season rainfall was marginally less (205mm) in 2020 than in the 2018 and 2019 seasons of 217mm and 226mm, respectively. All three years from 2018-20 received less growing season and total rainfall than average.

There were no statistical differences in the treatments for any of the NDVI data sets in 2020 (Data not shown).

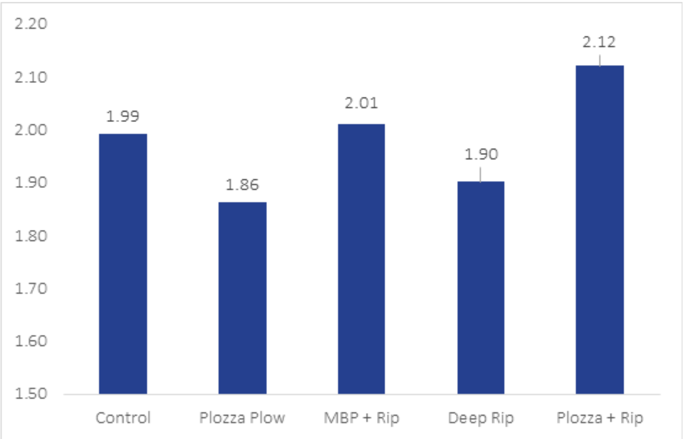


Figure 3. Ripper gauge site located on the Bignell's Farm in Broomehill, WA. This graph displays the average 2020 Canola yields in (t/ha).

Darkan

There were no significant yield differences in the canola crop grown in 2020.

In 2019, there were also no significant yield differences between the treatments at this trial site. However, all tillage treatments yielded less than the untreated control indicating that tillage treatments were detrimental to grain yields. The 2020 data set supports the hypothesis that the Darkan site is not responsive to deep tillage treatments.

NDVI data showed no significant differences between any of the trial treatments at three different growing season dates (Data not shown).

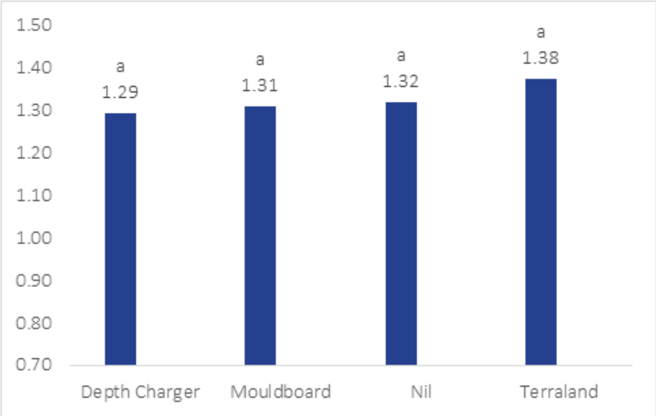


Figure 5: 2020 Canola yields (t/ha) at the Ripper gauge Darkan site hosted by the Duffield family.

SCF would like to thank GRDC for investing in this project and Southern Dirt for partnering with us.

SCF TRIALS REVIEW VIDEOS

This year we have created a series of videos, covering our SCF projects. Please like and subscribe to the Stirlings to Coast Farmers YouTube channel.

Search Stirlings to Coast Farmers in YouTube or head to bit.ly/SCFvideo

Optimising profitability of high rainfall zone farming systems

Trial Hosts: Preston Family and Ashton Hood

Key Messages

- **Matching a wheat variety maturity to the growing season length was critical to maximising yields at West Cranbrook and South Stirlings**
- **Long-season wheats (winter-types) sown mid-April can yield equivalently to Scepter wheat sown in mid-May in the high rainfall zone of WA.**
- **Deep ripping on South Stirlings sand plain showed a yield increase of 370kg/ha which closed the gap between the harvested yield and the water-limited yield potential (WLYP) by 8%.**
- **Barley yielded more than wheat at both trial sites and was closer to the WLYP. Barley was more profitable at the South Stirlings trial but not the West Cranbrook site.**

Background

The High Rainfall Zone Systems project is a sister project to the Hyper Yielding Crops and focuses on expanding research results from the Hyper Yielding Crop Focus Centre into broadacre farm trials. Without results from the Focus Centre in the first season of the project, a trial design was created in consultation with SEPWA and DPIRD that included treatments of deep ripping, sowing time and variety. There were two sites installed – one in South Stirlings and the other in West Cranbrook.

Summary

At Cranbrook, Illabo (winter) wheat sown on the 20th of April yielded statistically equivalent to Scepter (spring) wheat sown on 13th May. Both of these treatments yielded significantly higher than Scepter wheat sown on the 20th April. Planet barley, planted on 13th May, yielded 470kg more than Scepter seeded on the same day. Deep ripping at this site showed no yield benefits, typical for forest gravel soils where compaction is not a constraint.

At South Stirlings, there was no significant yield difference between either time of sowing for Scepter wheat. The mid-short maturity of Scepter meant that the 9th June sowing date, which had better soil moisture conditions, caught up to 16th May sown Scepter. Illabo was only planted on 16th May because of the late seasonal break. Illabo wheat yields were not significantly different to Scepter wheat treatment in the challenging 2020 season. Planet barley yielded significantly higher than the wheat at South Stirlings and had a higher gross margin.

The deep ripping across this site achieved a 370kg yield advantage over the un-ripped soil. Deep ripping closed the gap between the WLYP and the harvested yields. The ripped wheat yields only averaged 78% of the WLYP, whereas the ripped barley was >100% using the French & Shulz model. Crop biomass data collected by drone on 29th July showed a significant increase from the ripped plots compared to the unripped plots. The dry finish to the season meant the 29th July biomass differences did not translate to the final yields.

Although the South Stirlings site yielded much less than the Cranbrook trial in 2020, both data sets showed the highest yielding varieties were the ones whose maturity best matched the growing season length. For example, long season winter wheat (Illabo) yielded competitively with Scepter in the long growing season at Cranbrook. The short-mid maturity of the Scepter was advantageous at South Stirlings in 2020 because of the shorter growing season.

Results

Cranbrook

The later sown Scepter wheat and early sown Illabo wheat yielded significantly higher, average of 880kg/ha, than 20th April planted Scepter. The data indicates that early sowing of long-season wheat can pay off in the region. However, it is critical to seed a longer maturing variety earlier to maximise yields. Longer season varieties can also drive other benefits for growers, such as grazing and utilising early subsoil water to reduce peak season waterlogging. There were no significant differences in yields for any varieties or sowing times after being ripped, indicating that soil compaction was not a constraint that limited yield at this site.

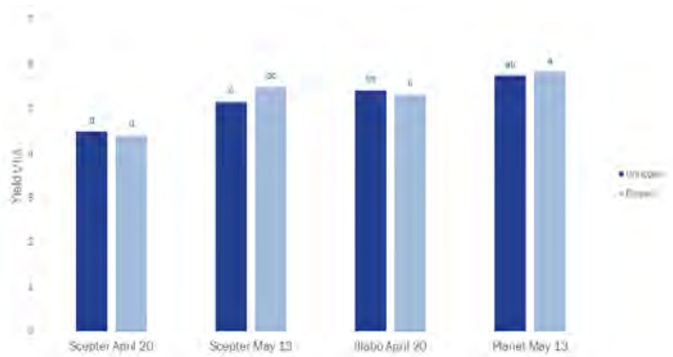


Figure 1: Grain yields (t/ha) for April 20 and May 13 sown, Scepter wheat, Illabo wheat and Planet barley over ripped and unripped treatments for the West Cranbrook site in the 2020 season.

Table one indicates that the West Cranbrook (Preston) trial site yielded close to its water-limited yield potential and even exceeded the original French and Schultz equation of:

(Attainable Yield) = (April to October rainfall – 110mm) * 20 kg/ha/mm

The GRDC publication, '*Water use efficiency of grain crops in Australia: principles, benchmarks and management*' (Sandras & McDonald 2012), suggests that modern wheat varieties can achieve 25 kg/ha/mm of grain. The paper also talks about other factors that can affect the evaporation figure of 110mm including, vapour pressure, nitrogen availability, previous crop and rainfall intensity. For simplicity, we decided to use the original 110mm evaporation figure to analyse our two trial sites in 2020.

Table 1: Summary of the harvested grain yields (t/ha) of the West Cranbrook trial in 2020 in comparison to the water-limited yield potential (WLYP) calculated using the French & Schultz (1984) method using either 20 kg grain/ha/mm or 25 kg grain/ha/mm.

Treatment		Yield		% WLYP	% WLYP
		t/ha		t/ha (20mm)	t/ha (25mm)
Scepter wheat April 20	Ripped	4.40	d	83.3	66.7
Scepter wheat April 20	Unripped	4.48	d	84.8	67.9
Illabo wheat April 20	Ripped	5.32	c	100.8	80.6
Illabo wheat April 20	Unripped	5.41	bc	102.5	82.0
Scepter wheat May 13	Ripped	5.48	bc	103.8	83.0
Scepter wheat May 13	Unripped	5.15	c	97.5	78.0
Planet barley May 13	Ripped	5.83	a	110.4	88.3
Planet barley May 13	Unripped	5.74	ab	108.7	87.0
Water Limited Yield Potential (t/ha)		5.28t/ha		(374mm-110mm) * 20kg/ha/mm	
Water Limited Yield Potential (t/ha)		6.60t/ha		(374mm-110mm) * 25kg/ha/mm	
Average % WLYP Ripped treatments				99.6%	79.7%
Average % WLYP Unripped treatments				98.4%	78.7%

The most water-efficient treatment in the trial was the ripped Planet barley sown on 13th May at 88% of WLYP. The best wheat treatment (Scepter 13th May) was 5% lower in water use efficiency than the ripped Planet barley. The growers applied 110kg/ha of nitrogen (N) fertiliser over the growing season and, combined with the soil stored N, should have been enough to grow the maximum WLYP of 6.60t/ha.

One of the known limitations of French and Schultz's model is that it does not account for rainfall intensity over the growing season (Sandras & McDonald, 2012). The growing season rainfall displayed in table two shows an even spread of rain from April to October, and the site had no observable signs of

waterlogging in 2020. The most likely reason for not reaching the WLYP was the dry October (17.2mm) and dry April (20.5mm).

The ripping resulted in a slight decrease in all protein levels than the unripped treatments; however, it was only significant in the late sown Scepter. The lower protein levels in the ripped 13th May Scepter wheat could be because of the slightly higher yields diluting the protein levels.

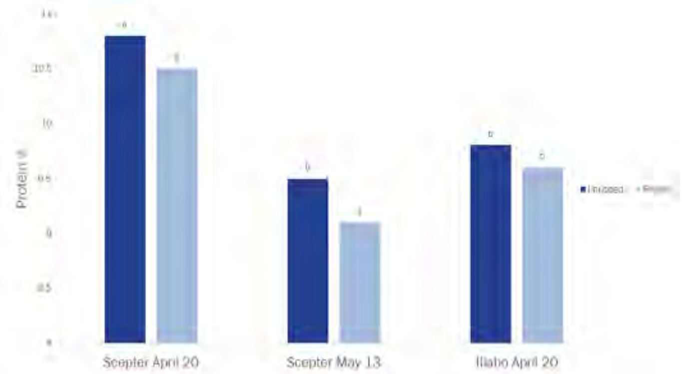


Figure 2: Grain protein (%) for April 20 and May 13 sown, Scepter and Illabo wheat varieties over ripped and unripped treatments for the West Cranbrook site in the 2020 season.

Table 2: The estimated growing season rainfall at the West Cranbrook trial site (34.316955, 117.373124) based on the Doppler radar service provided by the Bureau of Meteorology under licence to DPIRD.

Month	Growing Season
	Rainfall (mm)
Apr	20.5
May	97.8
Jun	43.3
Jul	41.5
Aug	94.6
Sep	59.1
Oct	17.2
Total	374

There was a significant increase in plant density for the May sown Scepter wheat over the 20th April sown Scepter. In May, the higher plant establishment was due to better soil moisture from 34mm of rain received before the second TOS. The higher plant counts were not seen in the later sown Planet barley because it was only seeded at 100kg/ha compared to the wheat at 120kg/ha. There was a decrease in plant density in the ripping treatments for all varieties and sowing times, although this was only statistically significant for the Illabo wheat.

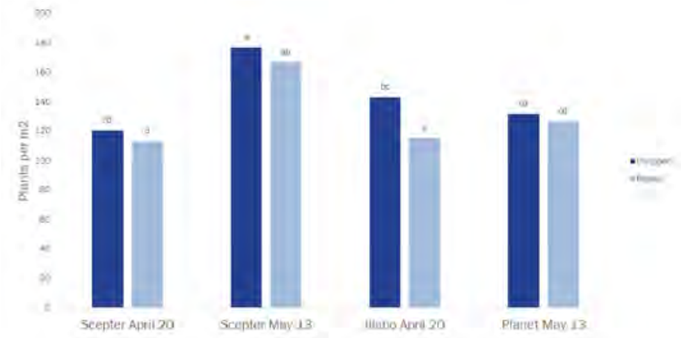


Figure 3: Plant density counts (plants/m2) for April 20 and May 13 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the West Cranbrook site in the 2020 season.

South Stirlings

There was a significant difference when comparing the barley yields to the wheat yields. This is consistent with local farmers' experience where barley consistently yields higher than wheat. There was a significant yield increase of 380kg/Ha, from deep ripping , for the late Scepter and early Illabo treatments.

There were no significant differences in yield at the South Stirling site when comparing wheat varieties or time of sowing (TOS). The lack of yield difference between sowing dates could be attributed to the growing season rainfall and timing of rainfall events. With the dry start to the season, the first TOS did not receive a significant rainfall event until 9.6mm fell on the 6th May. A further 12.6mm fell on 30th May, which assisted plant establishment.

The second TOS germinated off stored soil moisture and benefited from the 11.2mm of rain received three days after planting. It was very dry from 11th June onwards, and there was no single rainfall event over 10mm until 3rd August. Over this time, most crops in the region, including at the trial site, were significantly water-stressed.

There was a 31mm rain event on the 3rd November that may have benefited the later sown Scepter and long season Illabo. The early sown Scepter had reached maturity by this date and therefore not benefited from the late rainfall.

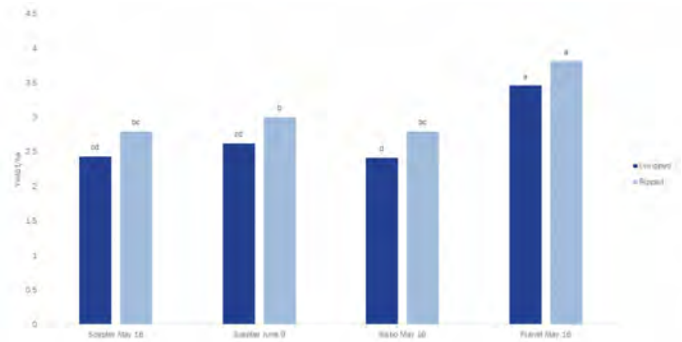


Figure 4: Grain yields (t/ha) for May 16 and June 9 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the South Stirling site in the 2020 season.

Table 3: Summary of the harvested grain yields (t/ha) of the Kojaneerup trial in 2020 compared to the water-limited yield potential calculated using the French & Schultz (1984) method with either 20 kg grain /ha/mm or 25 kg grain /ha/

Treatment		Yield t/ha		% WLYP t/ha (20mm)	% WLYP t/ha (25mm)
Scepter May 16	Ripped	3.00	b	81	65.2
Scepter May 16	Unripped	2.62	cd	71	57.0
Illabo May 16	Ripped	2.79	bc	75	60.7
Illabo May 16	Unripped	2.41	d	65	52.4
Scepter June 9	Ripped	2.79	bc	75	60.7
Scepter June 9	Unripped	2.43	cd	66	52.8
Planet May 16	Ripped	3.81	a	103	82.8
Planet May 16	Unripped	3.46	a	94	75.2
Water Limited Yield Potential (t/ha)		3.68t/ha		(294mm-110mm)* 20kg/ha/mm	
Water Limited Yield Potential (t/ha)		4.60 t/ha		(294mm-110mm)* 25kg/ha/mm	
Average % WLYP Ripped treatments				84.2%	67.3%
Average % WLYP Unripped treatments				74.2%	59.3%

Using the 25 kg grain /ha/mm figure in the French & Schultz equation showed the Kojaneerup trial site was only 67.3% of the WLYP in the ripped plots and 59.3% in the unripped plots. Unlike the west Cranbrook trial, ripping at this site has closed the margin between the actual yields and Water-limited yield potential (WLYP), indicating that compaction was yield constraining. However, there is still a large gap between the real yields and the WLYP.

The poorer water use efficiency at this site can be attributed to a couple of factors. Firstly, the rainfall distribution was not ideal with a very dry June and July period. August had 134.6 mm of rain, which effectively saved crops in the area from becoming droughted. Septembers 52.0mm was adequate before the season finished early, with only 12.0 mm recorded in October. (See table four for full details).

According to *'Water use efficiency of grain crops in Australia: principles, benchmarks and management'* (Sandras & McDonald 2012), dry conditions at the start of the growing season will significantly increase the crop's evaporation. For example, high frequency of small rainfall events and leaf area reduction increase the proportion of rain lost as soil evaporation. Sandras & McDonald (2012) display a graph suggesting evaporation at -34 latitude could range from 90 mm to 160 mm in the best to worst conditions. Given the sandplain soil and exceptionally dry start to the growing season, we suspect the Kojaneerup trial site may have experienced high evaporative conditions in 2020.

If we use the highest evaporation figure of 160mm, the French and Schultz model shows an estimated WLYP of 3.35t/ha, which the Planet barley was able to exceed in both the ripped and unripped plots. The highest yielding wheat treatment (3.00t/ha), ripped Scepter, seeded on the 16th May, was able to get within 90% of its WLYP. We suspect the 2020 evaporation conditions were closer to the 160 mm figure than the 90 mm number, which would explain why the yields were so far off the WLYP calculated from the original French & Schultz model.

There were significant differences in the protein levels when comparing late and early Scepter wheat and Illabo wheat. The early Scepter had the highest protein, followed by early Illabo and then late Scepter. The protein yield difference was only minor and is explained mainly by the variation across the trial. This would indicate that the protein percentage difference is most likely due to the yield difference of the treatments and some variation within the trial site.

There was also a significant benefit to early biomass growth from deep ripping measured via drone imagery on July 29. For all varieties and TOS, ripping improved ground cover percentage on average by 15.5%. As expected, the Planet barley had significantly higher ground cover over the wheat treatments due to its tillering structure.

Table 4: The growing season rainfall at Ashton Hood's 2020 Kojaneerup trial site based on the DPIRD Kojaneerup South (K0002) weather station data. (3.5km from the trial site).

Month	Growing Season
	Rainfall (mm)
Apr	6.2
May	46.8
Jun	20.6
Jul	21.8
Aug	134.6
Sep	52
Oct	12
Total	294

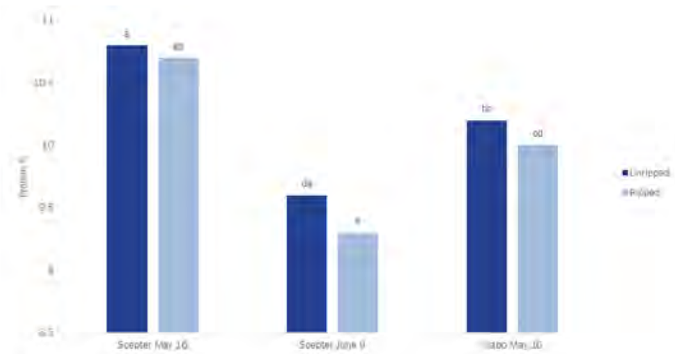


Figure 5: Grain protein levels (%) for May 16 and June 9 sown, Scepter wheat, Illabo wheat and Planet barley over ripped and unripped treatments for the South Stirling site in the 2020 season.

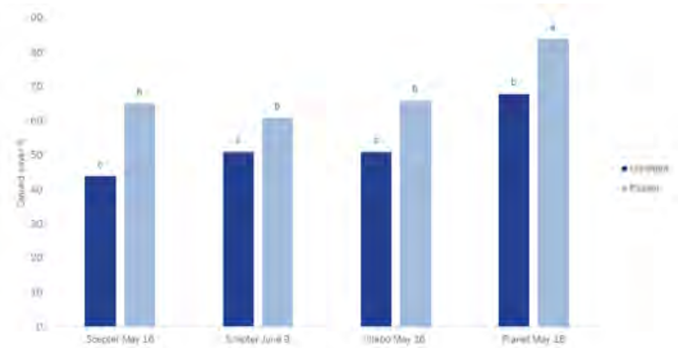


Figure 7: Ground cover calculations (%) from a drone flight on July 29 for May 16 and June 9 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the South Stirling site in the 2020 season.

SCF would like to thank project partners GRDC for investing in this project.

MLA PDS: Alternate forage crops for Southern WA

Introduction

Summer rainfall in the southwest of WA is happening more frequently. In 2021 over 90ml of rainfall was received for (Manypeaks) from 1 January to 10 March. There is an opportunity for producers in the south west high rainfall zone (HRZ) to take advantage of summer rainfall events with summer forage crops, but this begs the questions as to what a summer forage can contribute to the farming systems and what species are best suited. Stirlings to Coast Farmers (SCF) set out to explore these questions with a project specifically looking at Pallaton Raphno, millet, Hyola 970 canola, cowpea and sorghum. In the 2020 season producer demonstration paddocks were sown to Raphno and millet and the findings are presented below.

Benefits from 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. 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.

For the first year of the project the three trial sites were:

- Pyle- North Manypeaks, lambs grazing Pallaton Raphno versus ryegrass re-growth
- Smith- Green Range, lambs grazing millet versus barley stubble
- Rochester- Manypeaks, yearling cattle grazing Pallaton Raphno and Optiweigh system

This project will continue for another two years.

Aim

To demonstrate the feed value of alternate high biomass summer forage crops in increasing stocking rates and live weight gain of prime lamb or beef cattle relative to current systems in the HRZ of Western Australia.

This Producer Demonstration Site is funded by Meat & Livestock Australia

PYLE SITE: PALLATON RAPHNO VS RYEGRASS REGROWTH

Key Messages

- **Pallaton Raphno had a higher nutritional value (NV) than the ryegrass control, with a higher crude protein, digestibility and metabolisable energy.**
- **Raphno and ryegrass had similar biomass of 3t/ha and 3.8t/ha respectively.**
- **Excellent weight gain was achieved on the Raphno with 62.5g/head/day more than the ryegrass regrowth.**
- **The ability of Raphno to grow under grazing pressure and produce leaf material allowed a much higher stocking density with 1400 lambs on 45ha (31 lambs/ha), compared to 360 lambs on 30 hectares (12 lambs /ha).**
- **Lamb live weight gain measured in kg/ha/day was a staggering 5.35kg/ha/day for the Raphno compared to 1.31kg/ha/day achieved on the ryegrass.**

Background

On September 2 2020, brothers Tim and David Pyle planted a 45ha paddock of new forage brassica, Pallaton Raphno, after seeing it trialled in the region. The control comparison was 30ha of ryegrass regrowth from a 2020 silage crop cut on October 15 2020. After sowing, the Raphno was sprayed for diamond back moth (DBM) on November 2 with Affirm and 100L/ha of Flexi-N was applied a day later. Despite the insecticide application, there were still signs of damage from DBM on December 3. Biomass cuts were taken on December 3 with soil and plant tissue samples collected on December 7. Lambs were introduced on December 3 and removed to be weighed on January 4 when the ryegrass regrowth ran out. In comparison there was plenty of feed remaining in the Raphno paddock. A considerable benefit of this crop is its ability to grow under grazing pressure. It can be grazed multiple times over summer and throughout the year depending on rainfall, grazing pressure, and pest management.

Method

The Pyle's site investigated lamb growth rates on Pallaton Raphno compared to ryegrass regrowth. The control of ryegrass regrowth was selected because it is a common feed source available at this time of year in the Pyle's operation.

Prior to grazing, soil samples were collected for each paddock from 0 - 10cm depth. Four quadrant cuts were collected from each paddock to determine biomass prior to grazing. The samples were dried at 65°C for 48 hours before being weighed. Plant samples were also collected for nutritive value (NV) analysis. NV samples were analysed by Feedtest, 260 Princes Highway, Werribee, VIC.

A proportion of the lambs were weighed from each group selected to go onto the Raphno and Ryegrass. The same proportion was then weighed coming off the respective forages one month later.

Site results

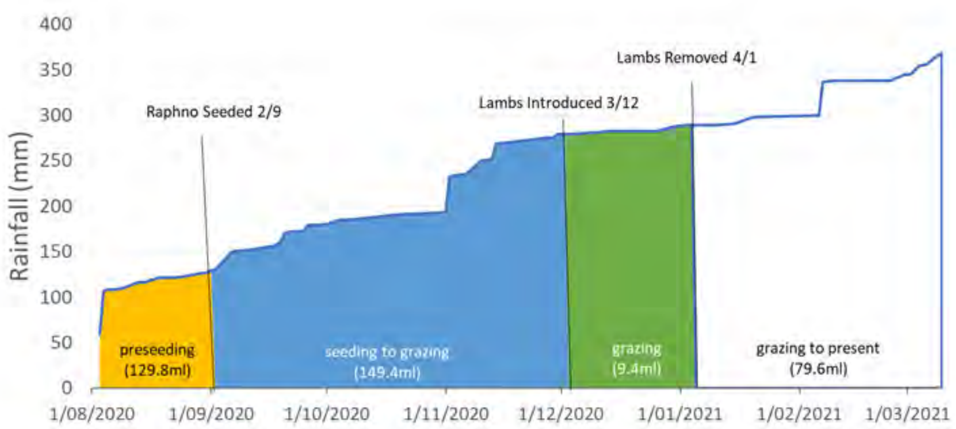


Figure 2. Summary of cumulative rainfall on the Pyle's property from August 1 2020 to March 10 2021 at a nearby GoannaAg digital rain gauge located at the Drawbin and Pfeiffer road intersection.

Table 1. Pyle soil sample results taken December 7 2020.

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Raphno	0-10	5.6	0.1	22	32	Sand	98.0	1.0
Rye	0-10	4.5	1.2	20	19	Sand	97.0	1.0

Table 2. Pyle dry matter (DM) cuts prior to grazing

Forage	g of 0.1m^2 quad	t/Ha
Rye grass	30.10	3.01
Pallaton raphno	38.30	3.83

Table 3. Pyle nutritional value (NV) analysis of forages

NV Analysis	Ryegrass regrowth	Pallaton Raphno
Dry matter (DM)	30.3%	13.9%
Moisture	69.7%	86.1%
Crude protein	7.9% of DM	16.4% of DM
Acid detergent fiber	38.6% of DM	13% of DM
Neutral detergent fiber	71.5% of DM	19.3% of DM
Digestibility (DMD)	51.2% of DM	88.3% of DM
Digestibility (DOMD)	50.2% of DM	81.6% of DM
Estimated metabolisable energy	7.2MJ/kg DM	13.6MJ/kg DM
Fat	2.4% of DM	3.8% of DM
Ash	6.9% of DM	10.9% of DM

Animal results and discussion

Table 4. Stocking rate and weight gain for lambs grazing Pallaton Raphno and ryegrass regrowth at the Pyles'.

Forage	**Head**	**Area (ha)**	**Stocking rate (lambs/ha)**
Ryegrass	360	30	12
Raphno	1400	45	31.11
Forage	**Weigh In (average kg)**	**Weigh Out (average kg)**	**Weight gain (average kg)**
Ryegrass	49	52.5	3.5
Raphno	42.5	48	5.5

Table 5. Average weight gain for lambs grazing forages for one month

Forage	**Avg weight gain (g/hd/day)**	**Avg weight gain (kg/ha/day)**
Ryegrass	109.38	1.31
Raphno	171.88	5.35

Figure 3. Left, photo of the Pyles' 30ha Ryegrass control on December 7 2020. Right, the same crop on January 15 2021 after the lambs had been removed.

Figure 4. Left, photo of the Pyles' 45ha Pallaton Raphno crop on December 7 2020. Right, the same crop on January 15 2021 after the lambs had been removed.

The Pallaton Raphno had a higher nutritional value than the ryegrass control, with a higher crude protein, digestibility and metabolisable energy. Interestingly the Raphno and ryegrass had similar biomass of 3t/ha and 3.8t/ha, respectively. Excellent weight gain was achieved on the Raphno with 62.5g/head/day more than the ryegrass regrowth. This was a great result and when it is calculated at kg/ha/day, the Raphno significantly outperformed the ryegrass.

The ability of Raphno to grow under grazing pressure and produce leaf material allowed a much higher stocking density with 1400 lambs on 45ha (31 lambs/ha), compared to 360 lambs on 30 hectares (12 lambs/ha). The lamb live weight gain measured in kg/ha/day was a staggering 5.35kg/ha/day for the Raphno compared to 1.31kg/ha/day achieved on the ryegrass. Once the sheep were removed due to the ryegrass being depleted, the Raphno paddock still had excess biomass, which indicated it could have supported a higher stocking rate than 31 lambs per hectare.

SMITH SITE: MILLET VS BARLEY STUBBLE

Key Messages

- **The summer crop (millet) had a higher NV than the barley stubble, with a higher crude protein, digestibility and metabolisable energy.**
- **There was a much greater biomass in the control barley stubble 3.5t/ha than the 1.2t/ha of millet.**
- **Millet growth was highly variable and showed signs of heat and moisture stress before grazing.**
- **Despite the environmental stress the millet had an average daily gain (ADG) of 253g/head, which was over double the 120g/hd/day achieved by the barley stubble.**

Background

In 2020, the Smith's decided to do some soil amelioration by claying a paddock in September. To ensure erosion was kept to a minimum, 90ha of millet was sown on October 18 and proceeded to germinate with the first rains in November. Other than being sprayed with Estercide and Garlon to kill the melons, no additional crop protection or fertiliser was applied. The Smith's site grazing control was a barley stubble harvested on December 16 2020. This paddock was also clayed seven years ago. The barley crop received a small amount of hail damage with Ryan Smith estimating there was approximately 100kg/ha of barley grain on the ground.

Ploughing to incorporate the clay dried the soil profile out artificially. The millet paddock received 36mm before sowing and another 107mm before December 16 when the lambs were first introduced. Despite rainfall being above average for November to December, the millet was heat and moisture stressed on December 16. Biomass cuts were taken on December 16 with soil and plant tissue samples collected on December 15.

Method

Smith's site investigated lamb growth rates on millet compared to barley stubbles. The control of barley stubbles was selected because it is a traditional feed source available at this time of year.

Prior to grazing, soil samples were collected for each paddock from 0-10cm depth. Four quadrant cuts were collected from the barley paddock while six were collected from the millet to determine biomass prior to grazing. More quadrants were cut from the millet paddock to account for the higher variability in plant density compared to the barley paddock which was more even. The samples were dried at 65°C for 48 hours before being weighed. Plant samples were also collected for nutritive value (NV) analysis. NV samples were analysed by Feedtest, 260 Princes Highway, Werribee, VIC.

100 lambs were weighed and marked from each group selected to go onto the millet and barley. The same marked lambs were then weighed coming off the respective forages one month later.

Figure 3. Images of the millet taken on the December 16 2020 showing the variation in plant density and health across the paddock.

Site results

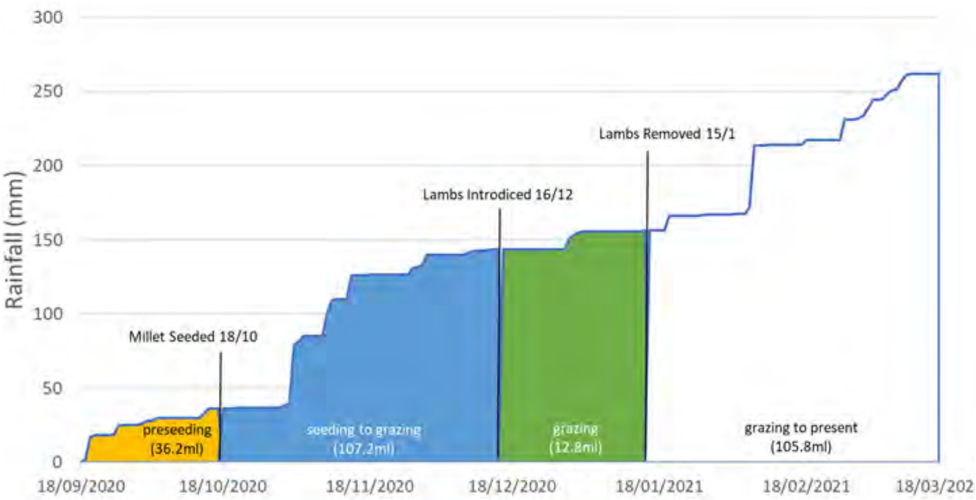


Figure 1. Summary of cumulative rainfall from September 18 2020 to March 18 2021 at the Smiths' Metos weather station, located on Kojaneerup West road close to the demonstration site.

Table 1. Smith soil sample results taken December 15 2020.

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Millet	0-10	5.8	0.1	42	22	Sand	94.0	2.8
Barley Stubble	0-10	5.9	0.1	19	14	Sand	95.0	2.5

Figure 2. Millet, Satellite NDVI image captured on December 19 2020, showing the variation in plant density and health across the paddock.

Table 2. Smith Dry matter (DM) cuts taken prior to grazing

Forage	g of 0.1m² quad	t/ha
Smith barley stubble	35.53	3.55
Smith millet	12.02	1.20

Table 3. Smith nutritive value (NV) analysis of forages.

NV Analysis	Barley stubble	Millet
Dry matter (DM)	87.0 %	18.7 %
Moisture	13.0 %	81.3 %
Crude protein	2.7 % of DM	21.0 % of DM
Acid detergent fiber	47 % of DM	23.7 % of DM
Neutral detergent fiber	81.7 % of DM	40.2 % of DM
Digestibility (DMD)	43.4 % of DM	81.3 % of DM
Digestibility (DOMD)	43.6 % of DM	75.7 % of DM
Estimated metabolisable energy	5.9 MJ/kg DM	12.4 MJ/kg DM
Fat	2.0 % of DM	4.1 % of DM
Ash	5.1 % of DM	8.6 % of DM

Animal results and discussion

Figure 5. Left, photo of the Smiths' 90ha millet crop on December 16 2020. Right, the same crop on January 15 2021 after the lambs had been removed.

Figure 6. Left, photo of the Smiths' 160ha barley stubble on December 16 2020. Right, the same stubble on January 15 2021 after the lambs had been removed.

Table 4. Smith stocking rates and average weight gain of lambs grazing millet and barley stubble.

Forage	Head	Area (Ha)	Stocking Rate (lambs/ha)
Barley	588	160	3.68
Millet	500	90	5.55
Forage	**Weigh In (Avg kg)**	**Weigh Out (Avg kg)**	**Weight gain (Avg kg)**
Barley	42.4	46.0	3.6
Millet	41.7	49.3	7.6

Table 5. Average weight gain of lambs on forages for one month

Forage	Avg weight gain (g/hd/day)	Weight gain (kg/ha/day)
Barley stubble	120.00	0.44
Millet	253.33	1.41

The 2020 season was not kind to the Smith's millet as paddock soil amelioration (ploughing) caused the soil profile to dry out, leading to heat and moisture stress before grazing. This also resulted in variable plant health and biomass, as seen in Figure 3. Pasture cuts revealed a much larger biomass available prior to grazing in the control barley stubble with 3.5t/ha compared to 1.2t/ha of millet. Despite the environmental stress the millet had an average daily gain (ADG) of 253g/head, which was over double the 120g/hd/day achieved by the barley stubble. The summer crop (millet) had a higher NV than the barley stubble, with higher crude protein, digestibility and metabolisable energy. At the conclusion of grazing there was still some grain amongst the barley stubble available suggesting that it was not stocked to capacity over the grazing period. Therefore, the barley stubble weight gain kg/ha/day will be underestimated.

ROCHESTER SITE: RAPHNO AND OPTIWEIGH SYSTEM

Key Messages

- **Successful cattle induction to Raphno was challenging to achieve. Best results were attained when weaner cattle were moved off Raphno onto pasture each day over the first week, slowly introducing them to longer grazing periods on the Raphno.**
- **Poor induction for the first grazing event saw steers reduce their Average Daily Gain (ADG) from 2kg/day on rye clover pasture down to 0.08kg/day on Raphno.**
- **Second grazing event by growing weaner cattle received a better induction and Heifers slowly built up to and maxed out at 1kg ADG.**
- **The Optiweigh system is a game changer to better understand different forages and how different grazing systems influence weight gain and pasture utilisation.**

Background

After observing a local trial of Pallaton Raphno in 2018, Kent Rochester decided to try some on his own farm. The Raphno was sown in September 2019 into eight 5ha grazing cells. The cells were to be grazed in rotation. Following seeding, 300kg of super copper zinc moly was applied over the eight 5ha cells. No other fertiliser or crop protection was applied. Plant samples were collected in the second week of November and sent off for nutritive value (NV) analysis. Optiweigh is an automatic in paddock weigh system that Kent purchased in 2019.

"We gave Optiweigh a go to better understand what happens to weight gain in paddock on different feeds and with different supplements. Mainly to maximise weight gain per hectare"

A huge benefit to the Optiweigh system is the ease at which it can be moved. Even if moving cattle on a daily basis there is no trouble following the grazing group. Another large benefit is being able to track heifer ADG leading into AI programs. It also helps to ensure the pasture available is allocated to the most profitable stock class i.e. cows and calves to lower weight gain pasture and trade cattle to highest weight gain paddocks.

Method

The Rochester site investigated steer and heifer growth rates on Pallaton Raphno compared to a clover rye mix at the end of spring. The comparison to clover and ryegrass mix was selected because it was the pasture grazed immediately prior to steers grazing the Raphno with weight data collected.

Plant samples were also collected for nutritive value (NV) analysis. NV samples were analysed by Feedtest, 260 Princes Highway, Werribee, VIC. Two hundred and fifty steers and 120 heifers had their weight gain tracked using the Optiweigh system. Tracking of the steer weights were abandoned after ten days due to poor weight gain, while heifers were recorded for six weeks.

Results and discussion

Table 1. Rochester NV analysis of Pallaton Raphno

NV Analysis	Pallaton Raphno
Dry matter (DM)	18.9 %
Moisture	81.1 %
Crude protein	18.6 % of DM
Acid detergent fiber	14.2 % of DM
Neutral detergent fiber	23.4 % of DM
Digestibility (DMD)	93.1 % of DM
Digestibility (DOMD)	85.7 % of DM
Estimated metabolisable energy	14.4 MJ/kg DM
Fat	4.2 % of DM
Ash	3.5 % of DM

Table 2. Average daily weight gain of weaner cattle on Pallaton Raphno and clover/ryegrass pasture for the Rochester site.

Date	Forage	Class of stock	Head	Area (ha)	Weigh In (Avg kg)	Weight gain
Late October 2019	Raphno	Green tag steers	250	5	325	0.08
September 2019	Clover rye mix	Green tag steers	250	5	305	2.00
November/ December 2019	Raphno	Green tag heifers	120	40	300	1.00

In late October 250 steers commenced grazing the Raphno with a 325kg average weight and ad-lib hay available. Steers visually looked poorer after ten days grazing. After a cross section of the group were yard weighed it revealed an average daily gain (ADG) of only 0.08 kg was being achieved on the Raphno compared to approximately 2kg per day on a previous ryegrass and clover pasture. Based on this data Kent abandoned tracking that group and returned the steers to conventional spring grass.

After consultation with an agronomist, an agriculture supplies specialist and a local vet, it appears the cattle were ill adjusted to graze the Raphno crop. Kent received many suggestions on induction strategies to Raphno brassicas for cattle. The remainder of the cells were grazed by dry cows, but no data was collected.

The second attempt to graze growing weaner cattle was with 120 approximately 300kg heifers. After a better induction process and added supplements, an average daily weight gain of roughly 1kg was achieved. Moving the heifers on and off the Raphno each day for the first week was the main practice change to the induction period. There was also ad-lib straw and silage rather than hay with Beachport minerals added to the water troughs. By the time 1kg ADG had been achieved, heat, diamond back moth and moisture stress were affecting the forage. Kent believed this was probably affecting palatability and feed quality.

In April 2020, Kent grazed the remaining plants quite hard because there were too few plant numbers to continue the monoculture. Cereals were then sown into the Raphno paddocks to experiment with having two fodder species.

The last graze occurred on June 20 2020 and was with cow-calf units at a density of 56 pairs per hectare. The cows overgrazed the grasses and other paddock plants and had to be pushed to eat Raphno plants. Kent commented that again, this was not an ideal induction to the crop for the stock. Kent concluded that to get the induction process correct each time he grazed the Raphno would not fit in with his management system.

Kent's concluding remark on the trial was that Raphno was an amazing plant, with a great ability to survive and grow in harsh conditions and with good feed test data. He just needs to find a way to fit it into the grazing system and create good induction protocols to achieve a good result.

The Optiweigh system is instrumental in knowing when ADG has dropped or picked up after adding supplements or changing grazing duration. This knowledge of understanding what happens in the paddock better is key to making quick and timely decisions before they become visually apparent. It has not all been smooth sailing though, with the main issue of ensuring cattle participation rates are high enough to get an accurate representation of the mob. Over the summer a block of minerals was found to be sufficient to encourage cattle through the Optiweigh system, however in spring when cattle are quite content more encouragement is required such as a molasses roller or molasses base block.

Figure 1. Optiweigh system on site at Kent Rochester's.

Conclusion

Successful cattle induction to Raphno was challenging to achieve. Due to poor induction the first grazing event saw steers reduce their ADG from 2kg/day on rye clover pasture down to just 0.08kg/day on Raphno. The second grazing event by growing weaner cattle received a better induction that involved moving the heifers off Raphno onto pasture each day over the first week, slowly introducing them to longer grazing periods. Heifers slowly built up to and maxed out at 1kg ADG. Until proven induction protocols are available Raphno as a monoculture will not be pursued by Kent in his system.

This Producer Demonstration Site is funded by Meat & Livestock Australia

Stubble Management for Snail Control

Trial Host: Mackie Family

Key Messages

- **There was no statistical difference between cabling, stubble crunching and the nil control early in the season, however, there was an increase in snail numbers in the cabling and stubble crunching plots after treatments were applied.**
- **Snail counts suggest that speed tilling was the most effective method of stubble treatments for snail mortality.**
- **Cabling, crunching and speed tillering treatments had no significant effects on the number of snails that contaminated the grain at harvest.**
- **The GrainCam and artificial intelligence programs showed high potential for measuring snail contamination but require further development of the training algorithms to increase accuracy and reduce the number of false positives.**

Background

Stirlings to Coast Farmers (SCF) are investigating if summer stubble treatments could lead to a reduction of small conical snails at a paddock level. This project is based on South Australian (SA) practices where snails on stubbles are knocked onto the ground surface on hot (+35°C) days, where they dehydrate and die. Stubble treatments in SA are mainly for the control of the larger round snails, but farmers have speculated that stubble treatments could reduce small conical snail numbers. We aimed to determine if stubble treatments could reduce small conical snail numbers in Western Australia where very little research like this has been completed before.

Methodology

The treatments investigated in the trial were cabling, stubble crunching and speed tilling. Cabling was done with an inch-thick cable towed between two utes driving at 20km/hr. For stubble crunching, a 12m wide machine was used that cut the stubble into 25cm lengths. A three-metre-wide speed tiller was hired to mix topsoil to a 10cm depth. The speed tiller caused the most aggressive soil and stubble disturbance.

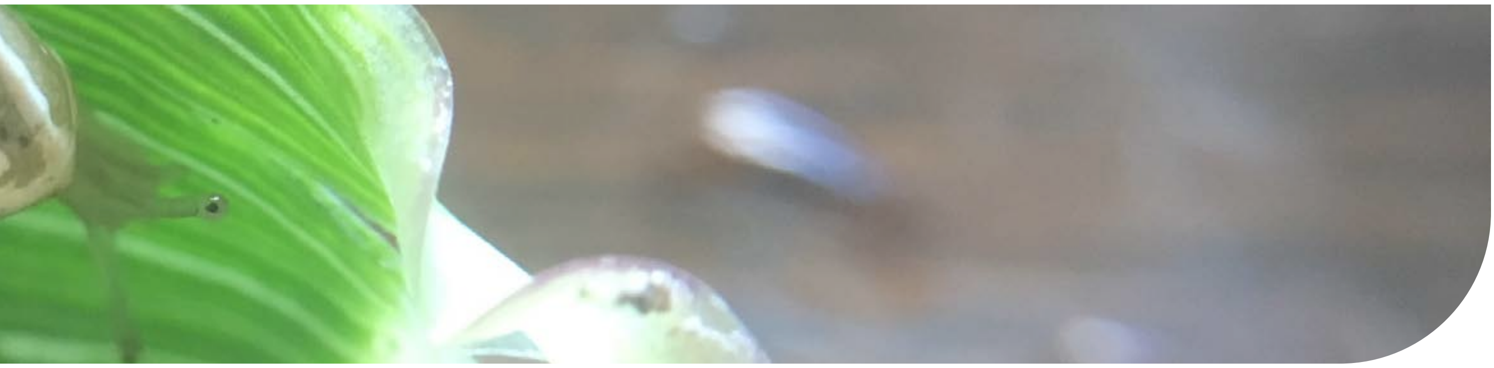
Snail density counts were completed before and after treatments by counting the number of snails in 20 (10 on-row and 10 off-row) $0.1m^2$x$0.1m^2$ quadrats in each plot.

At harvest, the GrainCam was set up on the harvester so that images were taken as grain came out the bubble auger. These images were later downloaded and run through an Artificial Intelligence Inferencing program to detect snails in the grain. Grain samples were also collected from across the site so that snails could be manually counted to test the accuracy of the GrainCam system.

Results and Discussion

Initial and post-treatment snail counts

Large numbers of snails were found in all plots across the paddock. Snail density in the speed tiller plots was 58% lower compared to the nil. There was no statistical difference between cabling, stubble crunching and the nil control early in the season however there was an increase in snail numbers in the cabling and stubble crunching plots after treatments were applied (Figure 1). The confusing result could be due to the extreme variability of snail populations within the paddock and the plots themselves. We were hopeful that measurements of snail numbers in the grain sample at harvest would provide greater clarity on the treatment effects.



Our snail counts suggest that speed tilling was most effective; however, this could be due to the machine mixing the snails thoroughly into the soil, making them hard to find and therefore count. However, if snails are buried and subsequently die, this would be an effective control method.

Researcher observations suggest that cabling and stubble crunching would cause less snail mortality because they were not aggressive enough to move or disrupt the harvest row compared to the speed tiller. Small conical snails were easily found within the seeding furrows after the cabling and stubble crunching treatments were completed. The speed tiller mostly removed last year's seeding furrows which would have caused more considerable disruption to the snails and their habitat.

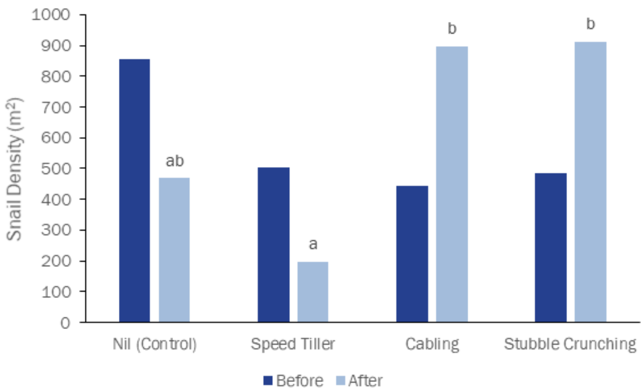


Figure 1: Snail numbers counted in the paddock before and after stubble treatments.

Harvest Results (courtesy of John Moore, DPIRD)

Plots were harvested on December 23, 2020.

The snail infestations were determined by counting snails in 166 grain samples of approximately 266g/sample and analysis of 3486 GrainCam images.

The number of snails per half litre of grain for the four treatments are shown in table 1.

Table 1: The number of snails per half litre of grain following various treatments.

Treatment	Snails per half litre
Cabling	2.93
Stubble Crunching	3.88
Speed Tiller	4.50
Nil (Control)	3.55

The data was analysed in GENSTAT initially as a one-way Analysis of Variance (ANOVA) using the four replicates and then re-analysed using a spatial analysis taking account of the replicate position as well as the distance down the treatment plot. This improved the probability of treatment effects from $p=0.063$ to $p=0.060$. Based on the l.s.d. the speed tiller had greater snail infestation then the cabling treatments and all treatments were not significantly different to the control.

GENSTAT was used to create a map of the density of snails across the whole site (Figure 2). This shows that the snails occurred in patches over the site but were not significantly influenced by the treatments applied.

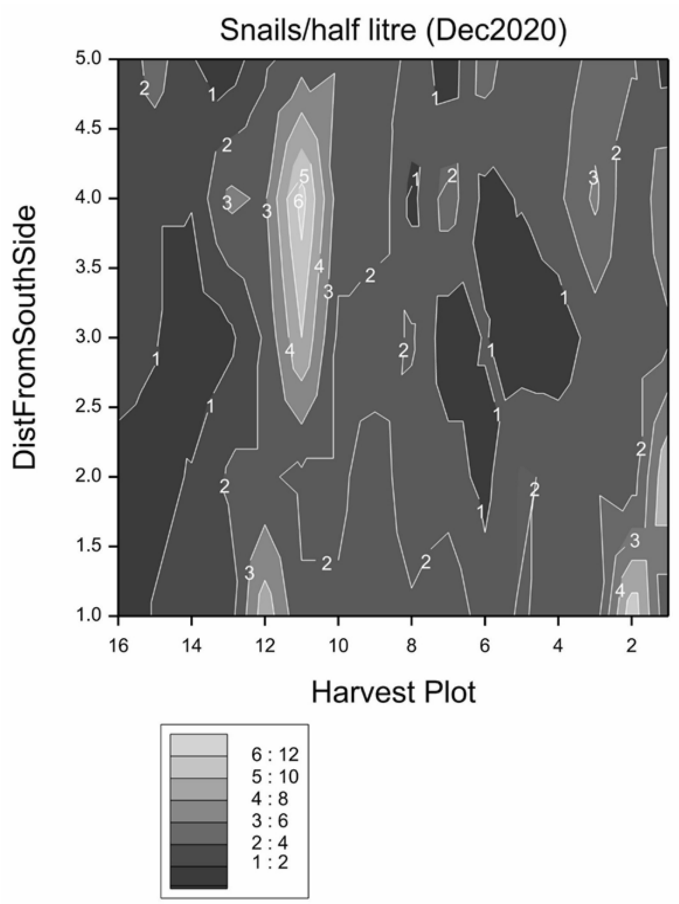


Figure 2: The numbers of snails present in the grain samples taken from the trial site.

GrainCam image analysis

The GrainCam is a device that is attached to the bubble auger on a harvester so that images of the grain may be taken during harvest. Images are then downloaded and passed through an artificial intelligence inference program. This scans the images and detects snails or snail like objects and records them.

The inference program is made by using images that have snails mapped in images of grain and these are passed through a neural network training program. In this case, YOLO3 was used as the training network. Training takes a long time and requires a large number of labelled images and significant computing power. Much of the data for training was taken from a previous DPIRD R4R project supervised by Svetlana Micic and John Moore in collaboration with UWA. The inference program produced is quite small and runs very fast and the final goal is to have this running on a mobile phone on the GrainCam so snail detections may be made in real time.

The snails harvested in this project in 2020 were much smaller than snails in previous years and this resulted in some loss of accuracy. Some retraining with the small snails would improve the accuracy.

A typical image which detected snails is shown in Figure 3 together with a false positive in Figure 4. The numbers indicate the probability that the detection was really a snail. The fact that the false positive was 0.96 whereas the actual snail was 1.00 indicates that with further training of the model these can be eliminated. Increasing the threshold to 0.95 resulted in missing too many snails (e.g. those that were small, misshapen or partially covered).

The grain at the site also had staining that resulted in some false positives as shown in Figure 4.

The correlation between the snails actually counted in samples compared to snails detected by AI was 0.55 which is actually significant at $p<0.05$. Retraining would improve this.

Table 2 versus Table 3 shows the numbers of snails counted compared to the number detected by artificial intelligence.

Figure 3: Typical snail detection and false positive with associated probabilities.

In Table 3 the high number in Rep3 resulted from more grain staining in these plots which was misinterpreted as snails. The overall larger numbers come from snails being counted more than once as the same snail may occur in an image and also in the subsequent image if the grain flow is slow.

There were no significant differences between treatments in the number of "snails" detected.

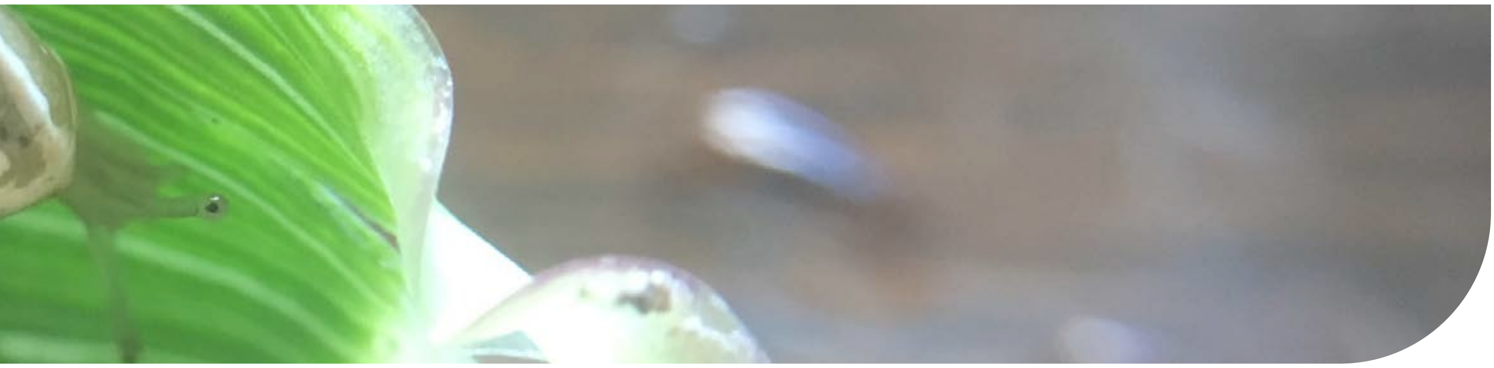


Figure 4: Grain defects that were misclassified as snails.

Table 2: The number of snails per half litre counted in samples.

Treatment	Rep1	Rep2	Rep3	Rep4	Average
Cabling	2.71	2.57	4.43	2.00	2.93
Crunching	4.93	3.29	4.71	2.57	3.88
Nil	4.07	2.71	5.43	2.00	3.55
Tiller	4.71	3.00	7.14	3.14	4.50
Average	4.11	2.89	5.43	2.43	3.71

Table 3: The number of "snails" detected by artificial intelligence and the GrainCam

Treatment	Rep1	Rep2	Rep3	Rep4	Average
Cabling	0.80	9.60	13.40	4.60	7.10
Crunching	5.08	13.80	12.90	4.80	9.15
Nil	0.82	0.20	18.20	8.50	6.93
Tiller	1.38	9.70	17.60	1.80	7.62
Average	2.02	8.33	15.53	4.93	7.70

Conclusions.

Cabling, crunching and speed tiller treatments had no significant effects on the number of snails that contaminated the grain at harvest. This season the snails were very small compared to last season indicating that they were younger and possibly less affected by treatments applied in autumn.

The GrainCam and artificial intelligence programs showed high potential for measuring snail contamination but require further development of the training algorithms to increase accuracy and reduce the number of false positives. These methods are much faster than counting snails in samples if large numbers of samples need or be processed or maps of contamination are required.

Smart Farms Initiative Updates

Introduction:

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.

Established in 2019, SCF currently has two fully established smart farms (Woogenellup & West Kendenup), with a third demonstration site located in South Stirlings being installed now. Key learnings will continue to be extended to members, with additional trials and installations completed on other members properties.

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 inefficient chemical 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 using IoT equipment and decision support platforms.

2020 Smart Farm Practice Precision Ag Technology/Practice Trials:

A range of precision agriculture practices have been employed on the SCF Grains Smart Farm located in Woogenellup, looking at increasing data collection, utilising production data and analysing responses from the PA implementation trials. In 2020, SCF implemented variable rate trials across two separate paddocks, utilising the following practices:

Yield Mapping

Analysing, cleaning and assessing yield data collected from harvester data since 1996.

Multi-Year Standardised Yield Analysis

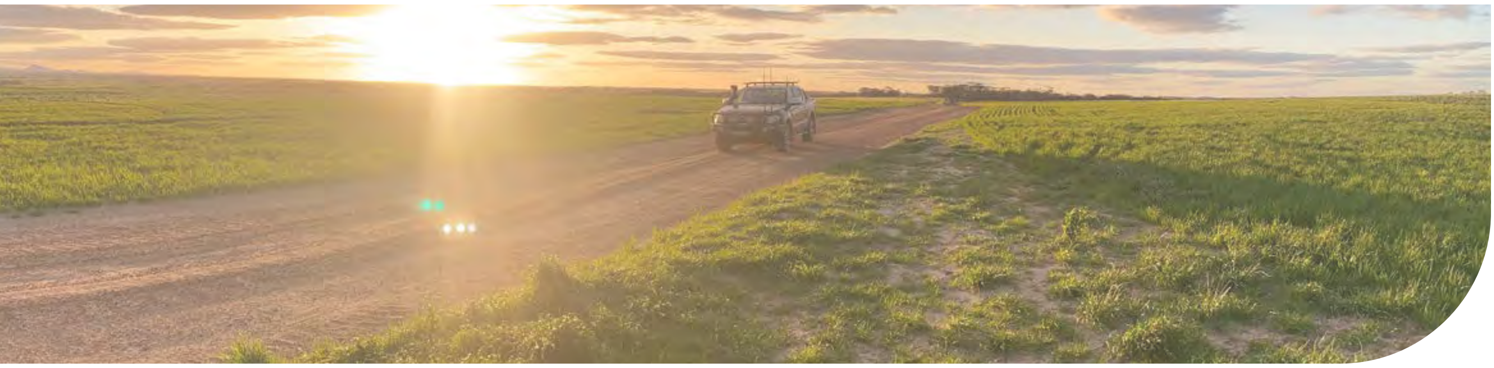
Multi-Year standardized yield analysis involves importing each year's (and its associated crop-types) yield map for a particular paddock, assigning a 0 – 100% scale against lowest to highest yields, and then layering each map on-top of each other to show regions that are consistently low, medium and high yielding. From here, we have analysed "dry-only", "wet-only" or "average" years and gain a better understanding of in-field variability. This data is then used in Variable Rate (VR) applications.

3m High Resolution Satellite Imagery

SCF have access to 3mx3m satellite imagery of biomass which helps the R&D and Smart Farms teams better visualise variation across the Smart Farm VR trial-sites.

Variable Rate Trial Analysis

Utilising the multi-year standardised maps and farmer knowledge, the SCF team devised a variable rate map with rates based off production zones. To further analyse zone efficiency, a replicated variable trial was implemented within the paddock across the variable rate map. Yield data is later imported and analysed to provide trial rate response statistics.



Smart Farm Equipment Trials:

A wide range of technologies currently are still being assessed across the Smart Farms including soil moisture monitoring, aggregated dashboarding, remote rain-gauges, tank monitoring, farm connectivity (Point to Point WiFi & Building WiFi) & sensor connectivity (LoRaWAN & Sigfox). New installations and updates for 2020 include:

Farm Security

SCF have had HikVision security cameras installed at one of the Smart Farm Demonstration sites, with a second site in the process of having WatchDog branded camera equipment installed shortly. These high-quality, low-cost cameras consistently record footage, storing data both internally in the camera and also externally on a Network Video Recorder (NVR).

Additional Farm Weather Stations & SCF Member Network

Extending beyond the two original smart farms, a further 12 Davis Weather Stations have been installed throughout the Amelup, Green Range, Palmdale, South Stirlings and Takalarup areas. These are in addition to the existing two stations previously installed at the two-original smart farms. This data is being fed into the DTN hyper-local forecasting models to build forecast accuracy throughout our membership area.

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, across a range of Davis and DAFWA weather-stations.

SCF Members have the opportunity to take advantage of this service now at the forecasting service charge of $300/year, with some licences available for members to trial free of charge on a limited time basis.

Key Considerations when implementing Smart Farm Technologies

- 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.
- Identify your on-farm problems before choosing your sensor. Consider current sensors available, and where you might like to head in the future.
- Determine what sensor networks currently exist in your area before choosing your connectivity method. Cellular base stations may be a more cost-effective solution than LoRaWAN or Sigfox.
- 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 directly from Philip.

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

Australian Government | National Landcare Program

Acknowledgements:

The development of the Smart Farm Demonstration Sites was made possible through initial funding support from the Australian Government National Landcare Program: Smart Farms Small Grants programme & the WA Government Department of Primary Industries & Regional Development (DPIRD) Decision Ag grant programme. Additional AgTech installations have been made possible through individual grant applications (GRDC) and individual member support.

SCF SMART FARM TECHNOLOGIES

SCF can assist members in the implementation of smart technologies on their farms.

From customisable weather stations to soil moisture probes, water level monitoring stations, farm connectivity, yield analysis and more, we can help you make the most of your data.

Reach out to Phil Honey:
0428 768 589
philip.honey@scfarmers.org.au

Improved internet connectivity from $350

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Tank level sensors from $650 upfront + $90 annual fee

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Student Connect Program 2020 –

Creating connections between farmers and agriculture students through sustainable farming innovative demonstrations, lectures and mentoring.

SCF is proud to support the youth and the future of our industry by providing better links between farmers and agricultural students. The program aimed to better equip students by connecting them to farmers and industry professionals, helping to expose 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.

Last year was the final year for the Student connect program. SCF partnered with the WA College of Agriculture Denmark, Mount Barker Community College and Great Southern Grammar for the Student Connect Program 2020, made possible with support from the Federal Government's National Landcare Program Smart Farms Small Grants.

The start of the year was disrupted due to lockdowns and restrictions as a result of the COVID-19 pandemic. This affected the program by restricting people (farmers and scientists) from entering school grounds. Launch of the program was delayed as welcome pack material was converted from a hard copy into online resources available to students through the SCF website-student portal. In this portal an online introduction to the program was available for the students to watch during class. Also included was informational material, a welcome letter, SCF prospectus, SCF 2019 trials review booklet, newsletter, a pre-program survey and a program outline tailored to each school.

Fortunately, Stratus Imaging were able to come down from Perth early in the year (pre-covid) to present a drone demonstration for the students. Exposing students to the latest technology of UAV's and their practical applications. This included collecting data which can assist in critical crop management decisions, fertiliser application and spraying. At the most disruptive time of the year SCF uploaded a virtual field tour looking at the impact of stubble management on small conical snail mortality to the student portal allowing students the opportunity to virtually attend a field site. By term four a bit of normality had returned and Mount Barker students had an excursion to the smart farm site at West Kendenup. Here students viewed some of the latest technology including automated weather stations and soil moisture probes. Importantly, they were informed as to how data can improve decision making, efficiency, sustainability and profitability. A demonstration site of different mixed pastures at the Slade smart farm were observed and the SCF staff demonstrated how a drone can be used to collect paddock NDVI imagery. This was also demonstrated to WA College of Ag Denmark students later who attended the Livestock' 20 event. These events allow students to network with specialists in the industry resulting in increased knowledge on agricultural careers and understanding of production and management issues.

Over the course of the school year, where possible, SCF organised informative lectures to compliment the current curriculum and enhance industry and NRM themes. Some of the lectures, included presentations from industry representatives on careers in agriculture and technology use. Students were introduced to technology that enable farmers to make better informed farm decisions based on real time hyper local data collected through smart farm equipment. Kim Brooksbank from DPIRD also talked to Denmark students about climate change and how a drying climate is going to require current farming practices to change and how this will create opportunities for new industries and alternate energy sources to emerge.

Students participating in the program were encouraged to apply for a Scholarship valued at $1000 to be held by the school to contribute towards their Agricultural studies. One scholarship was offered to each school. With the last few years having late breaks and minimal runoff to refill dams the pertinent question was asked – "What practices or practice changes would you

encourage local farmers to adopt to sustainably manage on-farm water supplies". Students in year 11 were asked to complete a 500-1000-word essay answering this question. 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 Toby Manson (GSG), Jas Cugley (Denmark) and Dermot McCague (Mt Barker), who were awarded the scholarship during their graduation ceremonies.

The final activity for the school year was the successful career information sessions. A joint event for Mt Barker and GSG students was held at Mount Barker Community College and another session was held at WA College of Ag Denmark. During these presentations students learnt of new career opportunities in the Agriculture industry that they previously may not have considered. These sessions included a wide range of Ag professionals including vets, farmers, corporate farmers, merchandise sales reps, fertiliser reps, DPIRD researchers, agronomists and farm finance advisors. This wide range of individuals broadened the student's understanding of the employment opportunities available in the Agricultural industry and showcased a range of backgrounds taking both secondary and tertiary education pathways. SCF received plenty of positive feedback from students, staff members and presenters. One of our SCF member's reported that they spoke later with a student from the WA College of Agriculture, Denmark who commented on how much they enjoyed the careers session and got a lot out of it (March 2021).

A major outcome for this project has been the lasting networks and relationships being formed that will continue as these student's head to university and out into the workforce. We look forward to continuing partnering with the schools in some way and continuing to hold Ag specific career info sessions annually. I would like to thank all our members, and industry professionals that volunteered to lecture and mentor students throughout the year. Without you this program would not be possible.

PHOTO COURTSEY OF GREAT SOUTHERN GRAMMAR

Farmer Trials

Lime efficiency trial – East Tenterden

Trial host: Thomlinson Family

Key Messages

- **Lime applications typically achieved a 210 – 870kg/ha increase in oat yield over the nil lime control.**
- **In 2020, there was no significant difference achieved between 5t/ha and 10t/ha lime applications.**
- **In the 2016 & 2019 growing seasons, significant yield responses were seen across the trial site in all lime treatments. Yield differences occur in seasons with a dry spring & not in seasons with a wet spring as experienced in 2020.**
- **The 5t/ha lime application followed by mouldboard ploughing for incorporation led to the highest average yield at this demonstration site in 5 out of 6 years analysed.**

Background & Trial Aims

Soil acidity, if not managed appropriately, has the potential to cause significant losses in yield production across the landscape, as well as creating induced toxicities and increased salinity or erosion risk. The site had severe sub soil acidity and soil tests 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 over time via varying lime application rates and incorporation method.

Treatments

A total of seven different amelioration rates and incorporation methods were analysed during the life of the project, including:

- Nil lime (2014) – control treatment
- Nil lime (2014) + mould board ploughing (MBP) (2015)
- 2.5 t/ha lime (2014)
- 5 t/ha lime (2014)
- 5 t/ha lime (2014) + MBP (2015)
- Nil lime (2014-2018) + 5t/ha lime (2019)
- 10 t/Ha lime (2014)

Results and Discussion

These results build on previous research conducted by SCF since 2014. The original funding for the project came from South Coast NRM. In 2020, SCF successfully applied for a grant from the National Landcare Program (NLP) to communicate and extend the results of long-term soil health projects that had already been established by the group.

Overall, SCF found that there were no significant differences recorded between treatments in the 2020 growing season at a 95% confidence level. However, it is important to note, that all treatments yielded above the nil lime application (avg yield = 4.79t/ha), with the exception of the 2.5 tonne/hectare lime application rate which achieved an average yield of 4.17t/ha of oats.

The 2.5t/ha lime application average yield was brought down by one plot recording a 2.99t/ha yield, which was significantly lower than the other plot's value of 5.34 t/ha for the same

treatment. Removing this outlier would bring the 2.5t/ha lime application average yield to approximately 550 kilograms above the control treatment.

The maximum average yield recorded on the trial site was achieved on the 5t/ha lime + mould board ploughing treatment, which yielded an average of 5.66 t/ha. Both 5t/ha (with & without mouldboard ploughing) achieved 30-90kg/ha higher yield than their neighbouring 10t/ha applications. In 5 out of the 6 recorded seasons, the 5t/ha lime application + mould board ploughing treatment yielded the highest.

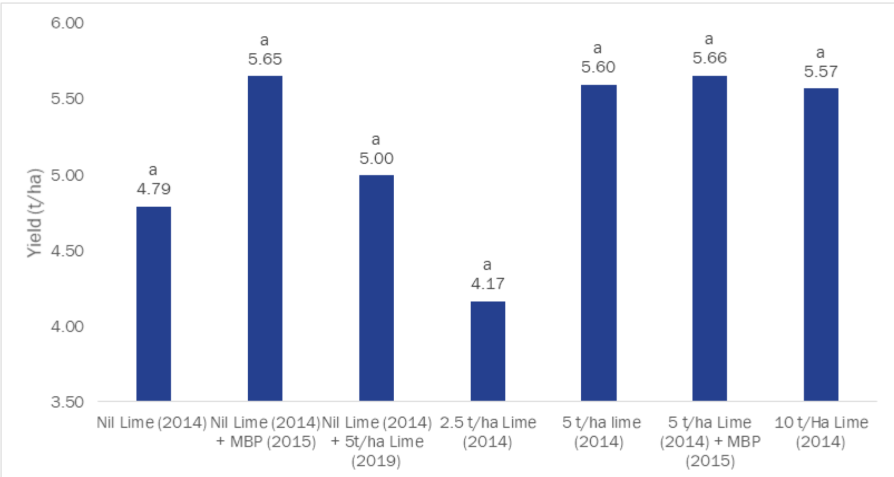

Figure 1: 2020 average yields recorded per treatment type.

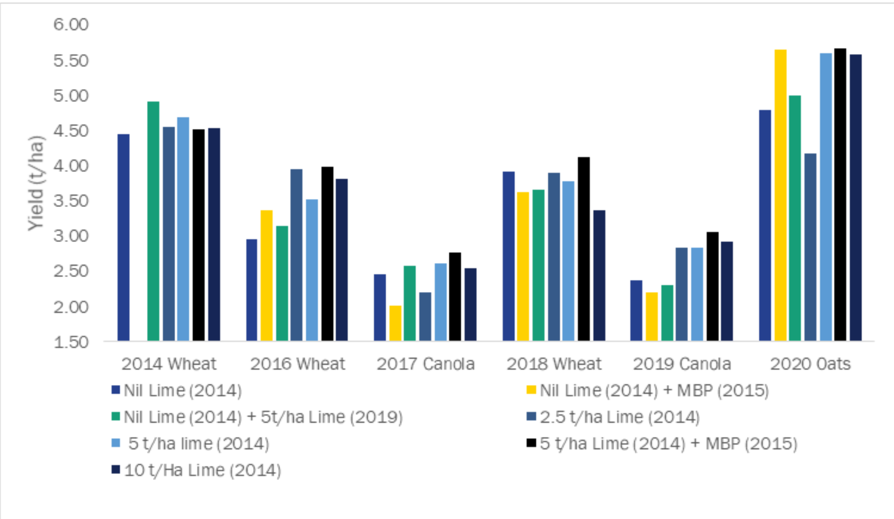

Figure 2: Grouped yields for lime efficiency site (2014 - 2020)

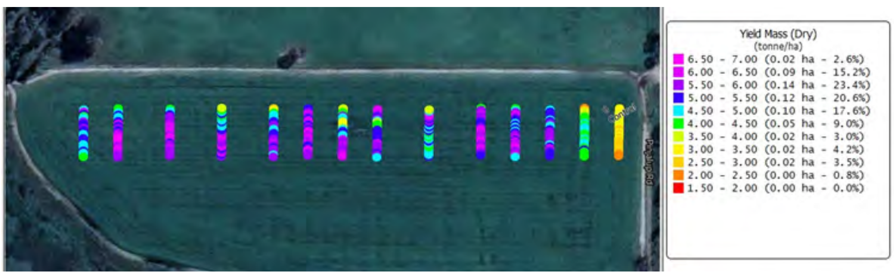

Figure 3: 2020 Oat yield map

Australian Government

National Landcare Program

Returns from ameliorating subsoil compaction and subsoil acidity.

Trial host: Clint Williss

Key Messages

- **Ameliorating subsoil compaction and improving subsoil acidity improved barley grain yields by >1t/Ha at this trial site in 2019.**
- **In 2020 the site was sown to canola and all treatments yielded significantly better than the nil control, including the ripping alone, where no lime was applied. This yield response shows the value in ameliorating subsoil compaction.**
- **There was no benefit in using lime from the commercial pit (Boyanup) compared to farm sourced lime (Williss) when rates were adjusted to achieve the same neutralising value. However much higher rates of the farm source lime needed to be applied to achieve the same affect.**

Background

This trial was setup in 2019 to investigate the effect that ripping with inclusion plates had on moving surface applied lime into the acidic subsoil of a deep sandy duplex. The treatments also included the opportunity to test high rates of farm sourced lime against equivalent rates of commercial grade lime when accounting for neutralising value.

Treatments

Treatments included the following:

- Deep rip. nil Lime
- Deep rip + 5t/ha Boyanup lime
- Deep rip + 12t/ha Williss lime
- Nil rip + 5t/ha Boyanup lime
- Control- nil rip, nil lime

Results from the first year were reported in the 2019 Trials Review Book. In 2020 the site was sown to Canola with the yield data collected and results reported here.

Results and Discussion

All treatments yielded significantly more than the control plots (Table 1). From yield mapping it was determined that there was a ripping effect on yield increasing it by 320kg (2.46 t/ha) above the control (2.14 t/ha). Applying 5 t/ha of Boyanup lime without ripping resulted in an increase of 230kg (2.37 t/ha). The treatment of 5 t/ha of Boyanup lime then ripping with inclusion plates resulted in a total 370kg (2.51 t/ha) above the control plots. The use of the on-farm sourced lime resulted in a slightly higher yield than the commercial grade plots with 330kg above control at 2.47 t/ha. Yield variation in plots can be seen from Figures 1 and 2 looking at both years' yield maps.

Table 1: Average yields (t/ha) for canola (2020) at Willis' Lime ripping trial site.

Treatment	**Yield (t/ha)**	
Deep Rip. Nil Lime	2.46a	
Deep Rip + 5t/ha Boyanup Lime	2.51a	
Deep Rip + 12t/ha Willis Lime	2.47a	
Nil Rip + 5t/ha Boyanup Lime	2.37a	
Control- Nil Rip, Nil Lime	1.95b	
LSD P=0.10	**0.3**	**0.336**
Standard Deviation	**0.149**	**0.158**
CV	**6.42**	**6.71**
Replicate F	**0.001**	**0.091**
Replicate Prob(F)	**0.9816**	**0.7784**
Treatment F	**4.287**	**4.334**
Treatment Prob(F)	**0.068**	**0.0923**

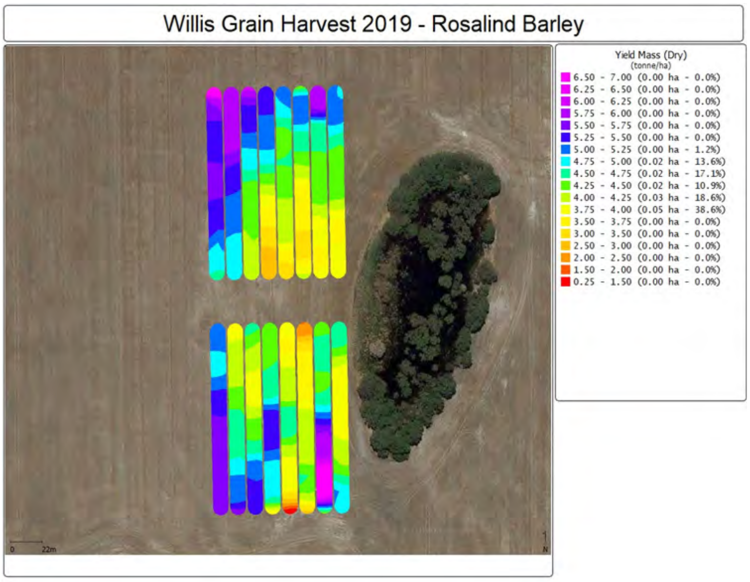

Figure 1: Yield map results from 2019 Rosalind Barley

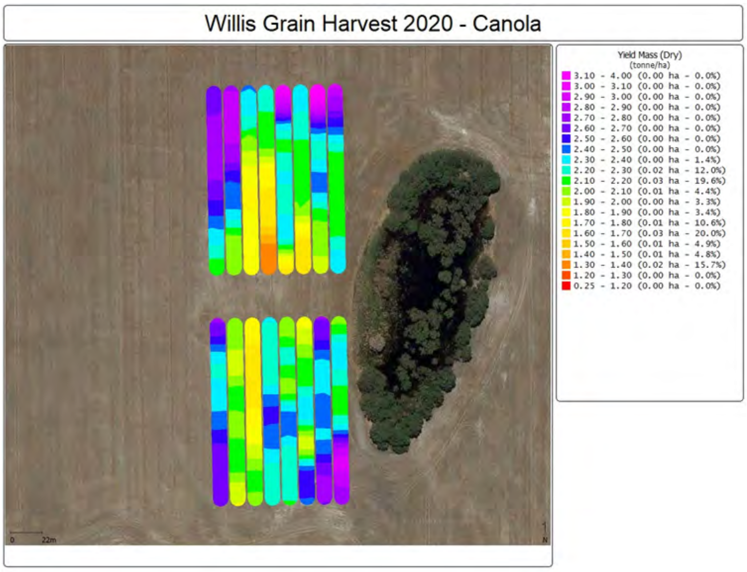

Figure 2: Yield map results from 2020 Canola

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Preston P Trial

Trial host: Preston Family

Key Learnings

- **The control rate of 100kg/ha starter fertiliser produced similar yield results to the 140kg/ha treatments in nearly all years (within 60kg/ha of grain across all crops).**
- **80kg/ha starter fertiliser application has provided sufficient phosphorous levels to maintain the phosphorous balance for cumulative yields achieved since 2017. However, lower phosphorous rates will consume stored phosphorous reserves.**

Background & Trial Aims:

Phosphorous is an essential nutrient for crop growth and is required from the seedling stage right through to maturity, playing an essential role in both photosynthesis and in building plant proteins. Insufficient plant-available phosphorous ultimately results in yield penalty however, over time, historical application rates may lead to sufficient banks of phosphorous within the soil. This trial extends on prior research conducted by the Preston family & Stirlings to Coast Farmers to determine how long it would take to deplete current soil phosphorous reserves.

Treatments:

The trial involved varying the rates of starter fertiliser (80:20 MAPSZC:MOP) applied at the trial site. Scepter wheat was sown at a rate of approximately 120kg/ha, with the remainder of the paddock having a 100kg/ha starter fertiliser application (farmer control/normal practice).

All additional fertiliser and chemical applications, thereafter, were applied at a uniform rate across the research site.

Results & Discussion:

SCF research staff used the weigh trailer to accurately measure grain yields from each plot in the 2017 (canola), 2018 (barley) & 2019 (canola) seasons. In 2020 the data collection process was changed, where harvest yield maps were collected directly from the harvester and analysed.

Overall, there were no significant statistical differences established through the 2020 season in any of the recorded treatments in yield, protein, gluten content, screenings or hectolitre weights analysed. Recorded trial yields varied between 5.12t/ha (120kg/ha starter fertiliser rate) to 5.37t/ha achieved on the 100kg/ha starter rate, the grower's normal pre-starter practice. The average yield of the 6 treatments was 5.24 t/ha.

It is interesting to note that the 60kg/ha application had recorded lower yields than the 40kg/ha starter rate, which follows on from similar results generated in the 2019 trials.

It is also uncertain as to why the 120kg/ha starter rate has consistently yielded less than the 100kg/ha application rates across the 4-recorded years, with a net yield loss of 250kg/ha against the farmer control in cereals in 2018 (barley) and 2020 (wheat).

Table 1: Starter fertiliser rates applied within the trial and their input breakdown (kg provided/hectare).

Fertiliser	Starter Rate (kg/ha)	N	P	K	S
Mapszc/MOP 80:20	40	3.7	6.3	4.0	2.6
Mapszc/MOP 80:20	60	5.6	9.5	6.0	3.9
Mapszc/MOP 80:20	80	7.4	12.7	8.0	5.2
Mapszc/MOP 80:20	100	9.3	15.8	10.0	6.5
Mapszc/MOP 80:20	120	11.1	19.0	12.0	7.8
Mapszc/MOP 80:20	140	13.0	22.2	14.0	9.2

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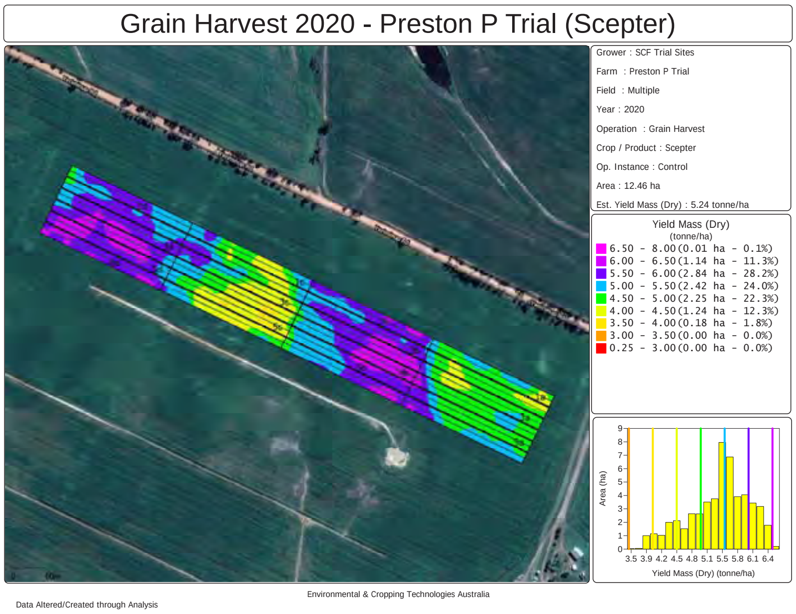

Figure 1: Processed wheat yield map for Preston Phosphorous management site (2020).

Table 2: Reported treatment yields per treatment type between 2017-2020. Yield values followed with the same letter do not significantly differ (P=0.05).

Fertiliser Treatment (kg/ha)	17 Yield t/ha (Canola)	18 Yield t/ha2 (Barley)	19 Yield t/ha (Canola)	20 Yield t/ha (Wheat)
40kg/ha	1.40 c	5.50 d	2.18 b	5.28 a
60kg/ha	1.48 c	5.65 cd	2.03 b	5.16 a
80kg/ha	1.67 b	5.74 cd	2.41 a	5.22 a
100kg/ha - Control	1.81 ab	6.01 ab	2.56 a	5.37 a
120kg/ha	1.73 ab	5.76 bc	2.52 a	5.12 a
140kg/ha	1.85 a	6.06 a	2.49 a	5.35 a

Table 3: Cumulative yield, Phosphorous tally, removal, and net trial balance since trial inception in 2017. Note: it is assumed that there is no net stubble removal from the paddock.

Treatment Fertiliser Rate	P units in Applied Fert	Cumulative Recorded Yield (t/ha)	Estimated Cumulative P Removal	Trial P Balance
40Kg/Ha	24	14.36 t/ha	52	-27
60Kg/Ha	36	14.32 t/ha	51	-14
80Kg/Ha	48	15.04 t/ha	55	0
100Kg/Ha	60	15.75 t/ha	57	4
120kg/Ha	72	15.13 t/ha	58	15
140Kg/Ha	84	15.75 t/ha	59	26

Upon viewing the yield map, we could determine that there are two distinct higher & lower-yielding zones within each trial treatment. These higher and lower-yielding zones were separated and further analysed for each treatment. Variation between treatments after this analysis showed no significant difference from the farmer control in either the low or high-yielding zones.

Overall phosphorous balance was also assessed within the trial, taking into consideration the total phosphorous applications provided from the starter fertiliser application (P-Balance Gains) and yields generated & accumulated (P-Balance Removal) over the 2017-2020 seasons. Assuming phosphorous removals of 7.5kg removed per tonne of canola and 2.5kg removed per tonne of cereals generated, the 80kg/ha rate has been sufficient to cover the estimated phosphorous removal from cumulative grain yield generated since 2017. Where low rates of starter phosphorous were applied (60kg/ha & 40kg/ha), it is assumed that 14-27 units of phosphorous was removed from the banked established reserve, respectively. It is assumed that rates above 80kg/ha of MAPSZC/MOP will provide a positive P-balance, contributing to increased stored phosphorous reserves.

Mackie lime sources trial

Trial Hosts: Mackie Family

Key Learnings

- **There were no significant differences in wheat yields between the different lime treatments in 2020.**
- **Grain yields measured in 2017 (canola) and 2018 (barley) were also not significantly different between the lime treatments.**
- **Soil pH data collected in 2019 show an increase in soil pH for all lime treatments in the topsoil (0-10cm) and 10-20cm layers compared to data collected in 2015 at the beginning of the trial.**
- **Soil pH changes in the 20-30cm layer have been negligible compared to the untreated control over the six years.**
- **This trial shows that the addition of lime has improved soil pH to a depth of 20cm. The improvement in grain yield shows soil pH levels at this site were not low enough to be a constrain grain yields.**

Background & Trial Aims:

The lime sources trial at Kendenup was established in 2015 to address the lack of long-term lime trials in the southern High Rainfall Zone (HRZ). John Blake (SCF) set up the original trial with funding from South Coast Natural Resource Management (SCNRM). The aim was to evaluate five different sources of lime from the southwest to determine if there were changes in soil pH or grain yields over time. SCF received funding in 2020 from the National Landcare Program (NLP) to continue monitoring and reporting on the trial results to benefit members and the agricultural industry.

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Treatments:

A two-replicate broad-scale trial was set up in 2015 with plot dimensions of 130m by 30m. The lime sources were:

1. Bornholm
2. Denmark
3. Lancelin
4. Redgate
5. WALCO
6. Nil control
7. 3 times 2(t/ha) lime equivalent or 6t/ha lime

Each lime source had the product rate adjusted to ensure each plot received the same amount of neutralising value (NV). For example, the reference liming rate was 2t/ha with a NV of 80%. Lime with a slightly lower NV, say 74%, had a higher rate of lime applied to make the NV's even between treatments. Soil-sampling contractors carried out a comprehensive soil testing regime to determine the baseline levels of soil acidity in each plot from three different soil depths; 0-10cm, 10-20cm and 20-30cm in 2015. The soil sampling locations were geo-referenced, so re-testing years later can be carried out from the same position within the plot.

Results & Discussion:

Wheat yields collected in 2020 from the harvester yield maps showed no significant yield differences between any of the lime treatments compared to the untreated control. Figure one also displays the grain yields measured in 2017 and 2018, showing no significant yield differences between the treatments.

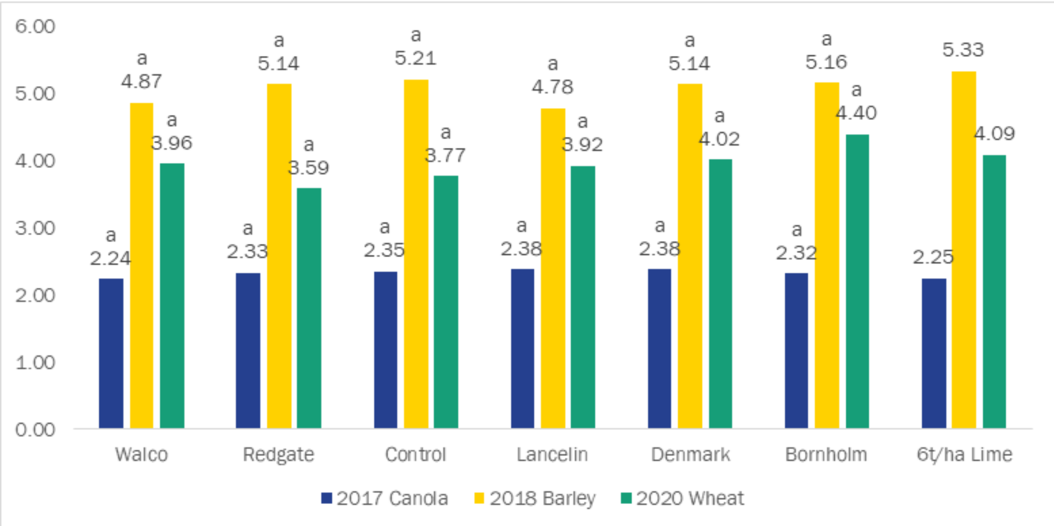

Figure 1: Grain yields (t/ha) from the Kendenup Lime sources trial in 2017, 2018 and 2020. Means followed by the same letter or symbol do not significantly differ (P=.05, LSD).
NB: There is only one replicate of the high rate (6t/ha lime treatment), which means we cannot complete statistical analysis on this treatment.

Soil pH data from 2019, displayed in table one, show the 2t/ha lime treatments have changed soil pH in the topsoil (0-10cm) and a small amount in the 10-20cm subsoil layer. Soil pH changes in the 20-30cm layers have been negligible from 2015-19.

The stand-out treatment was applying 6t/ha of lime, which was tested in only one plot. This treatment has clearly improved soil pH levels faster than any of the 2t/ha lime treatments. This is reassuring for farmers that have been investing in high lime rates.

Final Comment:

The lack of grain yield differences in 2017, 2018 and 2020 reflects the adequate starting soil pH levels and the 'soft' seasonal finishes, which tend to mask the effects of soil constraints. Despite no yield differences, 2t/ha of lime has lifted the soil pH levels, and the un-replicated 6t/ha lime treatment raised soil pH by even more (>1 pH unit). After four years, the subtle soil pH changes deeper than 0-10cm show how slowly lime moves in the profile. At the end of this 2021 growing season, we will conduct more soil testing to determine the pH levels in the different soil layers. We will also continue to monitor the grain yields in upcoming years.

Table 1: The soil pH levels (CaCl2) measured in April 2019 for the Mackie lime sources trial in Kendenup.

Changes in soil pH over and above the control			
Treatment	pH 0-10cm	pH 10-20cm	pH 20-30cm
Control	**5.43**	**5.09**	**5.58**
Bornholm	5.94	5.18	5.60
Denmark	5.77	5.14	5.44
Lancelin	5.64	5.34	5.63
Redgate	5.99	5.40	5.46
Walco	5.89	5.49	5.60
High rate 6t/ha lime	6.44	5.47	5.53

Future Trials

Optimised Pasture Management – managing pastures to their full potential.

Summary

Training workshops and best practice pasture management demonstration sites will be established across three farms in the high rainfall zones of Mt Barker/Albany, in southern WA. The project is funded as part of the Australian Government's National Landcare Program Smart Farms Small Grants Round four. It will utilise a range of modern tools and technologies that will help remove the barrier to best practice management, allowing landholders to sustainably build pasture productivity and carrying capacity. This will be delivered through a comprehensive extension program including farmer to farmer learning activities, with a focus on technologies that remediate and help improve groundcover quality.

Background

The main objective of delivering this project is to increase the skills & knowledge of growers and researchers in the use of effective and practical digital tools that can help monitor and improve pasture quality and productivity through positive management of groundcover.

We will help farmers & landholders become more resilient in dealing with soil degradation & ground cover management by utilising digital technologies. There are technologies available (satellite/drone imagery, vehicle sensors & computer modelling systems) that can accurately measure groundcover and forecast future pasture growth based on the climatic data. When farmers harness this technology, they will reduce soil degradation from livestock in poor seasons and increase pasture productivity & utilisation in favourable conditions. Adopting these technologies will help farmers to adapt to changing climatic conditions, build financial resilience and make better management decisions.

Activities

The proposed project activities for this project include:

1. Stirlings to Coast Farmers will establish pasture demonstration sites across three locations. These sites will be utilised as focus sites for extension activities throughout the life of the project. Landholders can compare livestock management techniques & measure their effect on groundcover throughout the season (Activity 2). A baseline soil condition survey of the sites before and after the project will be conducted to benchmark and measure groundcover changes. Measurements will include changes or improvements in pasture productivity, positive effects on weed burdens & plant diversity, levels of erosion and soil quality.

2. Develop & implement an extension program for landholders which provides new information materials, demonstration events & learning activities that raise awareness on best management practices for pasture management & production. The extension program will include two workshops and two field walks plus communication materials for landholders & NRM/Landcare staff in our region to attend. Key topics covered in extension materials and demonstration events include:

   - The tools currently available to landholders to map, monitor& predict groundcover levels such as satellite-based & ground-based tools and modelling [Cibo Labs, Pastures from Space, CSIRO Farming Forecaster/GrassGro, UAV/Drone imagery & free NDVI services].
   - How to best utilise these tools & technologies, what landholders should look for in a tool/technology, service limitations & comparisons, and 'how to' instructions on implementing each of the technologies,
   - Importance of managing soil health/fertility and livestock to develop effective, productive groundcover,
   - How to implement, measure & conduct pasture trials for validating these systems, and
   - Calibration techniques for validating satellite-based feed estimate services.
   - The website, CSIRO Farming Forecaster, which covers the options available and shows current pasture levels, will be developed for the demonstration sites, and will be made publicly available. The website presents as a simple dashboard (Figure 1) with the key information

available on the front page, and options to look further into the data easy to access.

3. A formal case study booklet that follows the three farmers involved in the demonstration sites, their key learnings and reported efficiency & production changes. This will be electronically distributed through the SCF website, neighbouring grower groups, project partners, project attendees and social media.

4. An introductory NRM/Landcare officer training workshop dedicated to increasing the skills, capability, & knowledge in relation to the use of digital agricultural technologies locally, and in neighbouring regions with the aim of increasing capacity & confidence. The training workshop will cover the different monitoring techniques available for measuring groundcover (satellite, ground-based and UAV/drone), and the tools available to effectively track groundcover management strategies. These information materials will be distributed widely to SCF staff, grower groups and NRM/Landcare groups through the SCF website about how to engage effectively with growers plus demonstrations of the latest technology.

Activities will take place over a 24-month period from the start of the project, with ongoing communication beyond the life of the project. Our Smart Farms Co-ordinator, Phil Honey, will have direct responsibility for managing the project.

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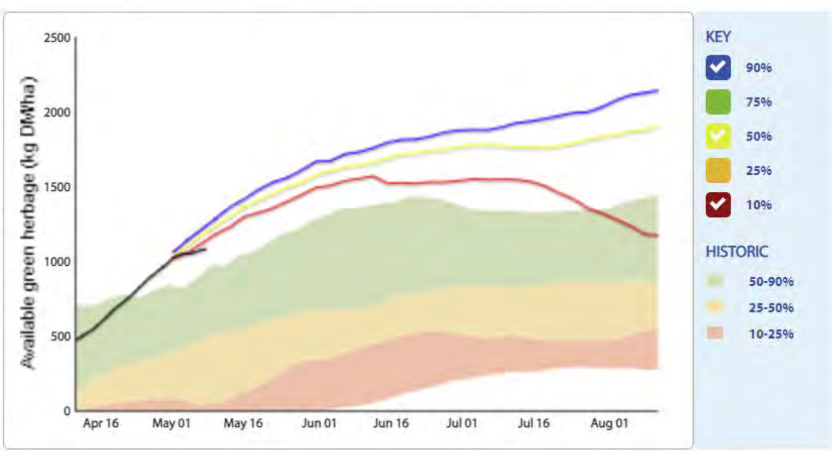
Projected green herbage available relative to historic variation



Current Growth (modelled)
18kg/ha/day

Summary

- Currently tracking in top 10% of years on record
- Poor conditions until August 10 will result in pasture availability in the top 50% of years on record
- Average conditions will see pasture availability in the top 10% of years on record
- Really good conditions will see pasture availability in the top 10% of years on record

Subsoil manuring poorly structured clays in the high rainfall zone of South Western Australia

Recently SCF was successful in receiving a National Landcare project to look at placing high rates of organic material into poorly structured clay subsoils to increase yields.

Background

The high levels of microbes, carbon, nitrogen and other nutrients in the organic manure physically interact with the clay to permanently change it from a dense and sometimes sodic soil into a fertile, highly porous structure. This provides a subsoil that is high in nutrients and which also holds highly accessible water for later in the growing season to finish off plants during grain fill. It also allows better drainage of water from the top root zone giving the entire soil depth a better water 'bucket' and reducing the intermittent waterlogging that often affect our paddocks.

We are currently only achieving on average about 50-60% of our potential yield, subsoil manuring could increase our yields and significantly close the yield gap towards our potential. There has been a large amount of research over the past 10 years on this process in the eastern states with the average yield increase over all trials found to be 62% per annum with the same benefits extending at least seven years. This benefit is most likely a permanent fixed benefit. There are the additional nutritional benefits for the first three years which is then continued by the permanent change in soil structure at depth.

However, the benefits that are likely to be achieved always come at a price. Subsoil manuring can cost over $1000 per hectare to implement, varying significantly depending on the ameliorant used and the distance to the source. These costs are most commonly paid off in the first two years with the continuing future benefits providing a return to the farmer. For example, a wheat paddock that usually yields around 4 t/ha could improve to 6.5 t/ha, at a price of $300/t this would equate to $750/ha in improved income. It will also reduce the variability seen in our seasons, in a wet year it should reduce intermittent waterlogging and in dry years will provide subsoil moisture to finish crops. Other than the initial financial risk in investment the addition of sub soil manure can increase production, profitability and sustainability.

The project

SCF will implement at least one demonstration site for subsoil manuring using a compost by-product created from wastewater treatment by Abbotts Liquid Salvage. The compost is completely unregulated for everything other than vegetable root crops, so no restrictions apply for our broadacre agriculture. The deep placement of compost will be compared to an untreated control, placement on the surface, deep ripping only, deep placement of gypsum and deep placement of a nutrient matched fertiliser. Soil moisture probes will monitor the use of plant available water at depth across the treatments along and grain yields will be monitored over two years.

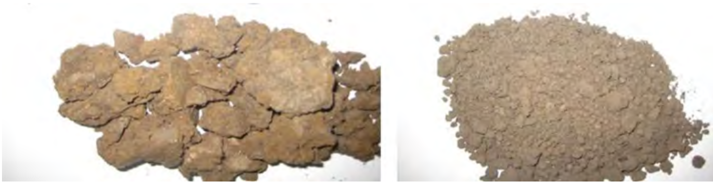


Figure 1 https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/02/subsoil-manuring

Figure 2 http://www.ausvegvic.com.au/wp-content/uploads/2018/05/Sub-Soil_manuring_Fact_Sheet_v4_20180115.pdf

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MIFWA

MENTAL HEALTH FIRST AID Australia

BLENDED ONLINE MENTAL HEALTH FIRST AID REGIONAL COURSE

LEARN SKILLS AND GAIN CONFIDENCE TO ASSIST PEOPLE EXPERIENCING MENTAL HEALTH PROBLEMS.

The Blended Online Mental Health First Aid Course for adults living in regional grain growing communities across WA teaches participants how to assist a friend, family member, or other members of the community who may be developing a mental health problem or experiencing a mental health crisis.

COURSE INFORMATION

SESSION DATES & TIMES

Stage 1 - Complete eLearning (5 to 7 hours self-paced)

Stage 2 - 8 June 2021, 9:30am to 12.00pm
ZOOM online

Stage 3 - 15 June 2021, 9:30am to 12:00pm
ZOOM online

This free training for regional grain growing communities across WA is proudly supported by CBH Group and MIFWA with thanks to the CBH Regional Mental Wellness Program.

CBH GROUP

To register: Contact Janine at janine.ripper@mifwa.org.au or call 08 9237 8900

Note: All components must be completed to qualify as an accredited Mental Health First Aider for three years.

MIFWA

Soilborne pathogen identification and management strategies for winter cereals.

Background

Soilborne diseases remain an important constraint to grain crop production in Australia. For example, Murray and Brennan estimated that soil-borne diseases are estimated to cost grain growers over $370 million each year. In the Western and Southern Regions, the propensity for cereal-dominant rotations and no-till has led to an increase in PREDICTA B detections of specific soilborne pathogens such as Rhizoctonia root rot, crown rot, root-lesion nematodes (RLN), and an increased risk of cereal cyst nematode (CCN) and take-all. Irrespective of the disease, any pathogen that affects the roots ultimately limits the uptake of water and nutrients and is an important contributor to the yield gap.

This project aims to deliver an integrated suite of extension and knowledge transfer activities focused on localised soilborne disease management strategies. It will utilise a series of interactive workshops and large plot, non-replicated demonstration sites across the Western, Southern and Northern winter dominant, cereal growing regions, with associated communication and extension activities.

Methodology

DPIRD cereal pathologists will deliver a knowledge, identification and diagnosis workshop in 2021 for SCF members. These will align with (non-replicated) farmer-sown demonstration trials in 2021 of practices for pathogen management. These sites will then be planted as confirmatory demonstrations with a cereal crop in 2022 to assess the impact management techniques the following season. A local grower group will manage each demonstration site – SCF will be working with Hunt's as the farmer hosts for our demonstration site.

The 2021 demonstrations will assess up to four management options considered available to growers. The 2021 demonstration will be followed in 2022 by sowing each site with a single cereal to determine any impacts from 2021 management on pathogens in the following year. The management options will be selected with knowledge of the pathogen present, paddock history, grower preference, available equipment and as advised by the cereal pathologist(s).

The demonstrations will test three management techniques available to growers to potentially manage the relevant pathogen at each site and one NIL grower practice. The options will include considerations of chemical, cultural and mechanical approaches as advised and agreed between the grower groups, cereal pathologists and grower. The sites will be established using grower equipment where possible, and demonstration treatment plot size varies depending on the scale and set up of the host growers' machinery. Treatments may include, but are not limited to, seed or fertiliser applied fungicide, various stubble management options, tillage, use of break crops or potential combinations of these. In 2022 all four treatments will be sown into a cereal crop and managed by standard grower practices to investigate the impact of the 2021 treatments on the following season.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION
GOVERNMENT OF WESTERN AUSTRALIA Department of Primary Industries and Regional Development
GROWER GROUP ALLIANCE

Other Trials

Faba beans gaining traction on the south coast

Emma Pearse, Carla Milazzo, Sarah Belli and King Yin Lui
Research Agronomists, Department of Primary Industries and Regional Development

Department of
Primary Industries and
Regional Development
GOVERNMENT OF
WESTERN AUSTRALIA

Interest in producing faba beans has increased in recent years among south coast grain growers seeking an alternate break crop to canola in a cereal dominant farming system. We believe the term ‘failure beans’, coined in the late 2000s, is no longer appropriate with the availability of new varieties with improved disease resistance, greater adoption of soil amelioration practices, and better legume agronomy.

In order to shake this reputation, we have compiled the publication, ‘Growing faba beans on the south coast of Western Australia’ that includes tips on establishment, inoculation, weed control, disease management, harvesting and much more. This document was produced through the Regional Research Agronomy project, a GRDC and DPIRD joint investment. Included in the document are fifteen case studies from growers across the south coast region (Albany and Esperance port zones) of WA. These case studies capture various soil types and rainfall zones, and highlight different ways that faba beans fit into our farming systems. The ability for growers to learn from other growers can be limited by time and geography. We hope that by having these case studies in one place others can find common ground. The publication will be available for electronic download on the DPIRD website by the end of March with limited hardcopies available through your local grower group.

We believe faba beans are a good fit for growers who are looking for a legume that:

- fits into 100% cropping and mixed farming systems
- has a higher yield potential than other pulses
- fixes nitrogen for itself and subsequent crops
- can be sown early, dry, and to depth to chase moisture
- tolerates waterlogging better than other grain legumes
- offers robust genetics with improved disease resistance or improved tolerance to imidazolinone (IMI) and other herbicides
- is a break crop for root lesion nematode (RLN; Pratylenchus neglectus)
- can be sown and harvested using existing machinery and equipment used for cereals.

While the 2020 season was drier than average on the south coast, faba bean crops in our case studies averaged almost 2 t/ha. The main variety was PBA Samira and most crops were dry sown in April. Challenges in the season included pressure from cowpea aphid due to early drought stress, high weed pressure due to late germination (dry start), waterlogging in the high rainfall areas and hot, strong winds impacting pod set and causing necking.

We would like to take this opportunity to thank the growers involved in the case studies and for their time and expertise, as well as Mark Seymour for his knowledge and guidance. For more information please contact Vanessa Stewart (vanessa.stewart@dpird.wa.gov.au) or Megan Abrahams (megan.abrahams@dprid.wa.gov.au).

Weed management options in faba beans

Stacey Power and Mark Seymour, Research Scientists, Department of Primary Industries & Regional Development

Take Home Messages

- Post-emergent Ecopar® caused substantial damage to both PBA Bendoc and PBA Amberley during early crop growth stages, but plants showed full recovery and it had no significant effect on seed yield
- Despite some damage to the crop, none of the herbicides tested impacted on yield of PBA Amberley or PBA Bendoc
- Growers need to choose a robust pre-emergent regime based on the weed spectrum that they have in their paddock, as post-emergent options are limited

Aim

To demonstrate pre and post-emergent broadleaf herbicide options in two faba bean varieties that are suited to the Frankland River region

Background

Faba beans are well suited to the Albany port zone and in recent years they have been growing in popularity, with many new farmers trying this crop. There are limited registered herbicide options for in-crop weed control and only one imi-tolerant faba bean variety is available. Thus, it is important to understand thoroughly the available pre and post-emergent herbicides to maintain weed free paddocks through the faba bean phase of a rotation. In order to support growers, we demonstrated tolerance of two faba bean varieties to a range of the registered pre and post-emergent herbicide options during 2020.

The two varieties tested were – (1) PBA Bendoc, the first faba bean variety released with improved tolerance to imidazolinone herbicides, and (2) PBA Amberley a large seeded variety with a good resistance rating for chocolate spot.

Trial Details

Trial Location	Shamrock Road, Frankland River
Soil type	Forrest gravel
Sowing date	21/5/20
Sowing rate	Target 25 plants/m^2. 229kg/ha PBA Amberley, 197kg/ha PBA Bendoc
Fertiliser	21/5: 220kg/ha Superphosphate
Herbicides, Insecticide & Fungicide	21/5: 1kg/ha Propyzamide 500WG® (500g/kg propyzamide) 14/7: 500mL/ha Select® (240g/L clethodim) + 180mL/ha Factor® (250g/kg butroxydim) + 1% Hasten® 15/9: 500mL/ha Spin Flo® (500g/L carbendazim) 5/10: 300g/ha Pirimor® (500g/kg pirimor) 5/12: 400mL/ha Paraquat 250® (250g/L paraquat)

Site Details

Table 1: Soil test results from Frankland faba bean trial site.

Depth	Ammonium Nitrogen (mg/kg)	Nitrate Nitrogen (mg/kg)	Phosphorus Colwell (mg/kg)	Potassium Colwell (mg/kg)	Organic Carbon (%)	pH (CaCl2)
0-10	3	15	34	160	3.8	5.2
10-20	1	5	8	74	1.02	4.8
20-30	1	3	3	67	0.52	5.1

Table 2: Rainfall at BOM Frankland weather station (9635). Average 2004-2020.

Frankland	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	May-Oct
2020	10	44	25	17	94	70	56	78	76	31	54	16	569	405
Average	19	13	22	44	53	67	82	81	62	38	32	20	531	382

Method

Two varieties, PBA Amberley and PBA Bendoc, were sown with six different herbicide regimes.
Three of the regimes included pre-emergent herbicide only and three included both pre and post-emergent herbicides (Table 3).
Post emergent treatments were applied at 5 leaf stage.
Plots were rated 5 weeks after sowing (29th June) for pre-emergent herbicide damage using the scale in Table 4. They were rated again 2 weeks after treatments were applied (4 August) for post-emergent herbicide damage.

Table 3: Details of herbicide treatments

	Incorporated by sowing (21/5)	Post-emergent (21/7)
1	0.86kg/ha Terbyne Xtreme® (875g/kg terbuthylazine)	nil
2	0.86kg/ha Terbyne Xtreme® + 1500mL/ha Reflex® (240g/L fomesafen)	nil
3	0.86kg/ha Terbyne Xtreme® + 180g/ha Terrain® (500g/kg flumioxazin)	nil
4	0.86kg/ha Terbyne Xtreme® + 180g/ha Terrain®	800mL/ha Ecopar® (20g/L pyraflufen-ethyl)
5	0.86kg/ha Terbyne Xtreme® + 180g/ha Terrain®	750mL/ha Intercept® (33g/L imazamox + 15g/L imazapyr)
6	0.86kg/ha Terbyne Xtreme® 180g/ha Terrain®	45g/ha Raptor® (700g/kg imazamox)

N.B. Nufarm Intercept® is registered for use on faba bean varieties with improved tolerance to imidazolinone herbicides, including PBA Bendoc, under permit PER86849.
Reflex® is expected to be registered for use on all faba beans varieties before the start of the 2021 season.
All other treatments are currently registered for use on all faba beans varieties.

Table 4: Herbicide damage rating scale

0	None evident
20	Slight: discolouration and/or stunting clearly seen
40	Substantial: much discolouration, distortion and/or stunting; some damage probable irreversible
60	Nearly all plants damaged, many irreversibly; some plants killed (<40%); substantial necrosis and distortion
80	Very severe: majority of plants killed (60-80%); remainder show much necrosis and wilting
100	Complete loss of crop

Results

Table 5: Herbicide damage rating on 4 August 2020. Herbicide.Variety *P=0.021*, LSD: 6.4.
Treatments with a shared letter are not significantly different.

Treatment		Herbicide damage rating 4 Aug			
Incorporated by sowing	Post-emergent	PBA Bendoc(i)		PBA Amberley(i)	
Terbyne Xtreme®	nil	0	a	0	a
Terbyne Xtreme® + Reflex®	nil	0	a	0	a
Terbyne Xtreme® + Terrain®	nil	0	a	0	a
Terbyne Xtreme® + Terrain®	Ecopar®	37	d	40	d
Terbyne Xtreme® + Terrain®	Intercept®	0	a	20	c
Terbyne Xtreme® + Terrain®	Raptor®	3	ab	10	b

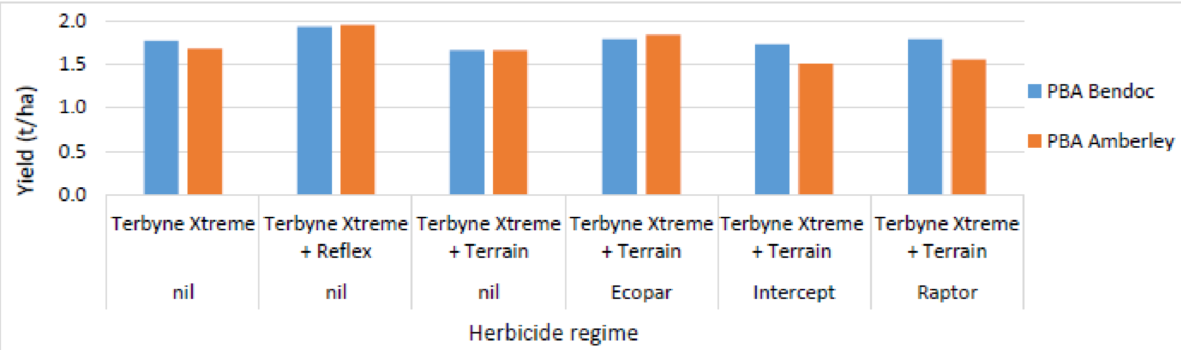

Figure One: Yield (t/ha) at Frankland River in 2020. Herbicide.Variety *P=not significant*.

Comments

None of the pre-emergent herbicide treatments caused any damage to either variety (Table 5). As expected, given the increased tolerance of PBA Bendoc to imidazolinone herbicides, post-emergent Intercept® didn't cause any damage to PBA Bendoc, but it did to PBA Amberley. The yellowing and stunting damage to PBA Amberley was considered slight (20/100 on rating scale) and was not visible later in the year. The yield of PBA Amberley when treated with Intercept was statistically on par with the same variety with no post-emergent herbicide, but there was a trend toward lower yields (Figure Two). In a similar trial at Frankland in 2019, PBA Samira looked to have recovered from the damage done by post-emergent Intercept®, with no visual signs at the end of the season. However, it yielded 0.4t/ha less than the PBA Samira plots that weren't sprayed with Intercept®. This is a reminder that whilst it may be tempting to spray imidazolinone products on varieties they are not registered for, you may see substantial yield penalties and should follow all label guidelines.

Post-emergent Ecopar® caused substantial damage to both varieties (Table 5), with dead leaves and a lot of black spotting. It is important to note that despite seeing levels of crop damage that farmers may consider unacceptable, the Ecopar® damage on both varieties was barely visible at the end of the season. Moreover, it did not impact on yield compared to the plots that didn't get any post-emergent herbicide application (Figure One). The Ecopar® treated plots also had much smaller weeds (suppression) than those that got no post-emergent herbicide (data not shown), but it did not control them fully.

This trial aimed to evaluate the impact and possible damage that a range of registered herbicide options have on two different faba bean varieties. The weeds at this site (capeweed and clover) were suppressed rather than controlled by the products that were trialled, and this is a reminder that growers need to choose their herbicide regime based on the specific weed spectrum that they have in their paddock. The trial demonstrated that there are limited post-emergent herbicide registered in faba beans and that those options may cause damage to the crop that some consider unacceptable, even though yields may not be impacted. This reinforces the need to use a low weed burden paddock and have robust pre-emergent herbicide practices. For more information on the available pre and post-emergent herbicide options, see the DPIRD 2021 Western Australia Crop Sowing Guide.

Acknowledgements

This trial is part of the DPIRD/GRDC co-investment "High Value Pulses - Raising awareness, optimising yield and expanding the area of lentil, chickpea and faba bean in Western Australia". Thanks to the Katanning TSU for trial management. Thanks to Stirlings to Coast for their continued support and to Simon Hilder for providing the trial site. Michelle Sampson provided excellent technical assistance.

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Fungicide strategies for managing chocolate spot in faba beans

Stacey Power and Mark Seymour, Research Scientists, Department of Primary Industries & Regional Development

Take Home Messages

- Low disease levels meant variety was more important than fungicide timing on disease severity
- PBA Amberley had less severe disease than PBA Samira and PBA Bendoc
- PBA Bendoc slightly out yielded PBA Samira and PBA Amberley

Aim

For newly released faba bean varieties: demonstrate the effectiveness of different fungicide timing strategies on chocolate spot.

Background

Chocolate spot is the most important disease of faba beans in Western Australia. Heavy infections can result in high yield loss, so management of the disease is very important. Chocolate spot is caused by the fungus Botrytis fabae, which can survive on previous years' stubble and as sclerotia in the soil. These can release spores and infect new crops when weather conditions are right. Spores can travel long distances, so it is recommended that faba bean crops are placed no closer than 500m to last year's stubble and paddocks be given a break of at least 4 years between faba bean crops. Advice in eastern parts of Australia, where both ascochyta and botrytis are common, has been for foliar fungicides to be applied in the period from 4-6 weeks after crop emergence (ascochyta spray) with later sprays through to early pod fill aimed primarily at botrytis. This results in a lot crops being sprayed many times throughout the season. This differs from the recommended practice in WA, where farmers are advised to monitor their crop for signs of chocolate spot with a view to begin spraying as the canopy closes and flowering begins through to early pod fill.

Research conducted by SARDI in South Australia shows that Botrytis fabae needs temperatures between 15-25° and humidity >75% for spores to be released and infection of new plants successful. Based on this information, SARDI are developing a warning system to give farmers the information that they need to make spray decisions, including the confidence to leave a crop unsprayed. A temperature and humidity sensor is placed at canopy level in the crop. From this sensor, an automated alert is sent when temperatures exceed 15° and humidity is greater than 70% for 8 hours (warning alert), 10 hours (prepare alert) and 12 hours (spray alert). Farmers then have 48 hours to respond to the alert and spray their crop before infection is likely to occur. SARDI hope to make this system commercially available in the future.

Three varieties were included in this trial. PBA Amberley was released in 2019 and has the best chocolate spot resistance rating of all current faba bean varieties. PBA Samira has been a consistently high performing variety in the Albany port zone and PBA Bendoc is the first imidazolinone tolerant variety to be released in Australia. These three varieties make up most of the faba bean area in Western Australia.

This trial aims to compare the recommended flowering spray regime for WA with the more regular spray regime that is common practice in other states, along with the new spray alert system to determine a robust fungicide spray strategy for farmers in the Albany port zone.

Trial Details	
Trial Location	Shamrock Road, Frankland River
Soil type	Forrest gravel
Sowing date	21/5/20
Sowing rate	Target 25 plants/m². 229kg/ha PBA Amberley, 197kg/ha PBA Bendoc, 230kg/ha PBA Samira
Fertiliser	21/5: 220kg/ha Superphosphate
Herbicides & Insecticides	21/5: 1kg/ha Propyzamide 500WG® (500g/kg propyzamide) + 120g/ha Terbyne Xtreme® (578g/kg terbuthylazine) + 180g/ha Terrain® (500g/kg flumioxazin) 14/7: 500mL/ha Select® (240g/L clethodim) + 180mL/ha Factor® (250g/kg butroxydim) + 1% Hasten® 21/7: 45g/ha Raptor® (700g/kg imazamox) + 200mL/100L BS1000® 5/10: 300 g/ha Pirimor® (500g/kg pirimicarb) 5/12: 400mL/ha Paraquat® 250 (250g/L paraquat)

Site Details

Table 1: Soil test results from Frankland faba bean trial.

Depth	Ammonium Nitrogen (mg/kg)	Nitrate Nitrogen (mg/kg)	Phosphorus Colwell (mg/kg)	Potassium Colwell (mg/kg)	Organic Carbon (%)	pH (CaCl2)
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Average	19	13	22	44	53	67	82	81	62	38	32	20	531	382

Treatments

Three varieties were sown, with each variety exposed to four different foliar fungicide application timings. Fungicide products were changed at each timing to rotate groups as per resistance management guidelines.

Table 3: Treatment details.

Fungicide Timing		**Variety**	
Nil fungicide			**Chocolate Spot Rating**
Flowering Sprays	4 Sept + 22 Sept	PBA Amberley(D)	MR
Regular Sprays	21 July + 14 Aug + 4 Sept + 22 Sept	PBA Bendoc(D)	MS
Temperature/Humidity Sensor Spray	29 Sept	PBA Samira(D)	MS

21 July: 500mL/ha Sporex® (500g/L procymidone)
14 Aug: 500mL/ha Spin Flo® (500g/L carbendazim)
4 Sept: 600mL/ha Aviator XPro® (150g/L prothioconazole & 75g/L bixafen)
22 Sept: 500mL/ha Spin Flo
29 Sept: 500mL/ha Spin Flo

Table 4: Disease severity rating system.

0	No infection	5	Some coalesced lesions with some defoliation
1	Very small specks	7	Large coalesced, sporulating lesions, 50% defoliation and some dead plant
3	Few small discrete lesions	9	Extensive lesions on leaves, stems and pods, severe defoliation, heavy sporulation, stem girdling, blackening and death

Results

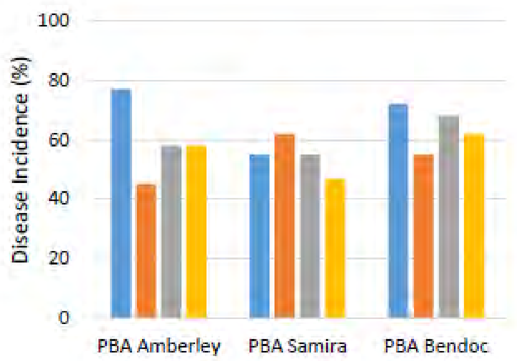

Figure One: Disease incidence on 20 October. Fungicide *P = not significant*, Variety *P = not significant*, Fungicide.Variety *P = not significant*.

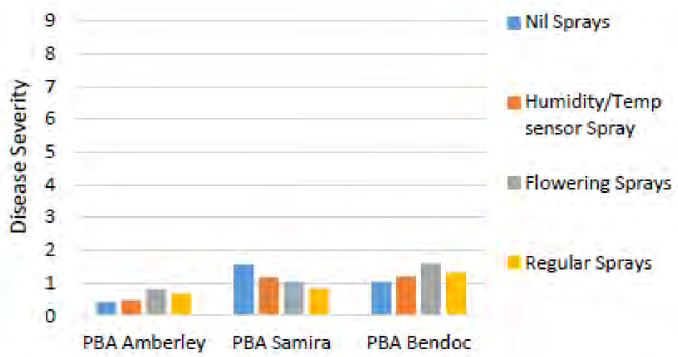

Figure Two: Disease severity on 20 October (see rating system above for description). Fungicide *P = not significant*, Variety *P = 0.004*, Fungicide.Variety *P = not significant*.

Neither fungicide timing or variety impacted disease incidence when measured on 20 October (Figure One), however variety did impact on disease severity (Figure Two). This means all varieties and fungicide timing strategies had the same number of plants showing symptoms of chocolate spot, but the symptoms were less severe in PBA Amberley than PBA Bendoc and PBA Samira. Given the MR rating of PBA Amberley compared to MS for PBA Samira and PBA Bendoc, the similarity in disease incidence was unexpected, however the difference in severity is in line with expectation. PBA Amberley showed a few small specks on leaves, while PBA Bendoc and PBA Samira had specks and some small lesions on leaves and flowers.

Fungicide timing did not impact on the severity of disease due to the very low ratings in all treatments. Monitoring showed that humidity in the canopy of the crop was consistently above the 75% threshold, however temperature was not above 15° for the required amount of time until the end of September, therefore only one spray alert was received when the crop was already podding and yield potential was set. This suggests that in 2020 farmers in Frankland River could have saved money by not applying fungicide until later in the season than canopy closure/start of flowering.

The only factor that impacted on yield was variety, with PBA Bendoc slightly out yielding PBA Samira and PBA Amberley over all treatments. Fungicide strategy did not impact on yield, due to the weather conditions for infection coming late in the season leading to very minor symptoms. By the time the correct conditions occurred, the crop was already podding and infection with chocolate spot at this time would have minimal impact on yield. Average yield across the site was 2.9t/ha, lower than expected given the above average rainfall, but still a profitable yield at current prices around $390/t.

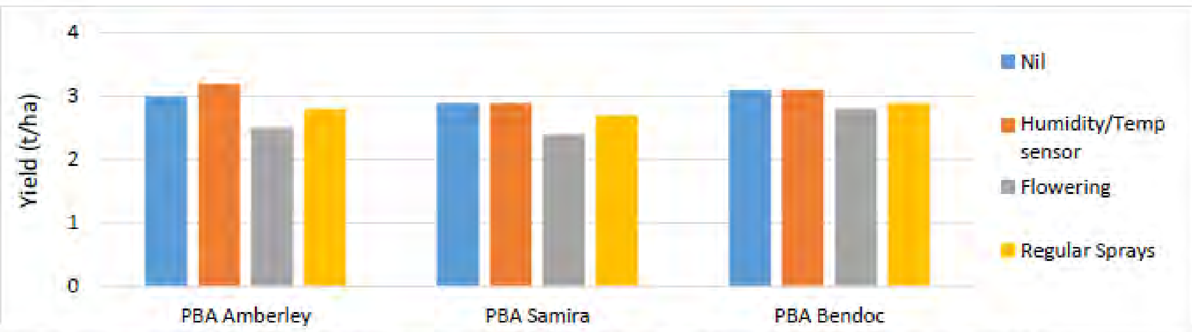

Figure Three: Yield at Frankland River in 2020. Fungicide *P = not significant*, Variety *P = 0.044*, Fungicide.Variety *P = not significant*.

Comments

In 2020 there was very low levels of disease due to weather conditions not favouring development of disease. This led to little variation in efficacy of the different fungicide strategies that were trialled. Disease severity differences were based on varietal resistance rather than fungicide timing. In more favourable years for disease development, or at sites where other diseases are present, we would expect fungicide timing to be more important. DPIRD will continue to assist SARDI as they test and refine the spray alert system before it is commercially released.

Acknowledgements

This trial is part of the DPIRD/GRDC co-investment "High Value Pulses - Raising awareness, optimising yield and expanding the area of lentil, chickpea and faba bean in Western Australia". Thank you to Jenny Davidson and Mohsen Khani from SARDI for allowing us to trial their warning system. Thanks to the Katanning TSU for trial management, Stirlings to Coast for their continued support and to Simon Hilder for providing the trial site. Michelle Sampson provided excellent technical assistance.

Peer review: Mark Seymour
Contact: Stacey Power, 0472 847 815, stacey.power@dpird.wa.gov.au

Department of
Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

CSBP South Stirlings Trial Results: Increasing Nitrogen Use Efficiency in Wheat

James Easton, CSBP Senior Agronomist

Key Findings:

- Wheat yields responded strongly to N from 2.9 t/ha (with 14 kg N/ha) to 4.6 t/ha (165N)
- No significant differences between different placement and timings with N applications up to stem elongation
- No response to N applied at flag leaf emergence – in either yield or protein
- Grain protein was low in all treatments.

Background:

With declining soil N reserves and increasing demand from high yielding crops, there is more reason to increase the agronomic efficiency of N fertilisers.

The trend towards dryer winters should reduce the risk of losses from applying higher rates at seeding, and applying N to the surface may not be as effective as banding N – especially without good follow up rains.

Aim:

The aim of the trial last year was to compare the effectiveness of banding Flexi-N (at seeding and early stem elongation) to streaming it onto the crop.

Site details:

The site was a loamy sand (10% gravel at the surface increasing with depth). Soil tests before seeding highlighted low nitrogen reserves - organic carbons were only 1.2%. Canola was grown the year before.

Scepter wheat was sown on the 21st of May.

Results:

Grain yields responded strongly to N from 2.9 t/ha (with 14 kg N/ha) to 4.6 t/ha (165N) (Table 1).

Banding Flexi-N was as effective as streaming it at the three leaf stage (Z13). There was no benefit from banding Flexi-N at the start of stem elongation (Z30).

Early flag leaf emergence (Z37) applications did not increase yield or protein.

Grain protein was low (8.0% or below) in all treatments; hectolitre weights were 76-78 kg/hL and screenings about 2%.

Table 1. Treatments, yield and protein

Trt	Seeding Banded (L/ha)	24-Jun Z13 Stream (L/ha)	29-Jul Z30 Stream (L/ha)	29-Jul Z30 Banded (L/ha)	20-Aug Z37 Stream (L/ha)	N	Harvest Yield (t/ha)	Harvest Protein (%)
1	-	-	-	-	-	14	2.9	7.3
2	120 Flexi-N	-	-	-	-	64	4.1	7.6
3	-	120 Flexi-N	-	-	-	64	3.9	8.0
4	120 Flexi-N	-	120 Flexi-N	-	-	114	4.1	7.8
5	-	120 Flexi-N	120 Flexi-N		-	114	4.6	7.1
6	-	-	240 Flexi-N		-	114	4.3	7.9
7	120 Flexi-N	-	-	120 Flexi-N	-	114	4.3	8.0
8	-	120 Flexi-N	-	120 Flexi-N	-	114	4.1	7.7
9	-	120 Flexi-N	120 Flexi-N	-	120 Flexi-N	165	4.3	7.6
10	120 Flexi-N	-	240 Flexi-N	-	-	165	4.7	7.8
11	-	120 Flexi-N	240 Flexi-N	-	-	165	4.6	7.4
12	-	120 Flexi-N	240 Flexi-N	-	120 Flexi-N	216	4.4	7.6
						Prob	<0.001	0.026
						LSD	0.5	0.5

Basal fertiliser: 80 kg/ha MoP (IBS), 140 kg/ha MacroPro Extra banded below the seed (splitter boots)

Discussion:

Nitrogen fertiliser requirements at this site were expected to be high following continuous cropping for many years (without a legume in the rotation) and high yield potential.

This trial did not show any consistent treatment effects relating to N placement or timing of N up to early stem elongation. Relatively dry growing conditions up to early August would have limited any leaching losses to N applied early, and there was not the stubble load to tie up much of the N applied through the boom.

The lack of response to N applied at flag leaf emergence in yield or protein may have been related to lack of rain in the 18 days after it was applied.

The inability to produce grain with more than 8.0% protein, even with high N rates, highlights the challenge and risk of relying solely upon N fertiliser to grow high yielding wheat with good protein in this environment.

The return on investment from 151N applied up to early stem elongation (in addition to N supplied by the seeding fertiliser) was about 200%.

This trial will be repeated in 2021 at South Stirlings to look at results in a different season.

For more details: Keith Gundill, CSBP Albany 0429 048 455

SCF WOULD LIKE TO THANK ALL OF OUR PROJECT CONTRIBUTORS!

Stirlings to Coast Farmers Inc. members and staff would like to thank the following people for their contributions to our research ventures in 2020. Without your contribution, the group could not complete our projects which benefit SCF members and the broader agricultural community

- Goad Family- GRDC Ripper Gauge Demonstrations
- Lindsay Watterson & Family- GRDC Ripper Gauge Demonstrations

- Preston Family- GRDC High Rainfall Zone, Yield Constraints
- Ashton Hood & Family- GRDC High Rainfall Zone, Yield Constraints

- Michael Webster & Family- GRDC Non-wetting Soils Mitigation

- Slade Family- National Landcare Program (NLP)- Round 2, Smart Farm Hosts
- Adams Family- NLP Round 2, Smart Farm Hosts

- Reece Curwen- NLP Round 2, Mid Row Banding Nitrogen
- Slade Family- NLP Round 2. Mid Row Banding Nitrogen

- Mackie Family- COGGO, Impact of Stubble Management of Small Conical Snail Mortality
- Preston Family- GRDC Sub-soil Drainage

- Pyle Family- Meat & Livestock Australia (MLA), Producer Demonstration Site Host
- Rochester Family- MLA, Producer Demonstration Site Host
- Smith Family- MLA, Producer Demonstration Site Host

- Mackie Family- NLP, Round 3 Soils Extension, Lime Sources Trial
- Tomlinson Family- NLP, Round 3 Soils Extension, Lime Efficiency Trial
- Preston Family- NLP, Round 3 Soils Extension, Phosphorous Rate Response Trial
- Wood Family- NLP, Round 3 Soils Extension, Nil Disturbance Seeding Systems Trial
- Williss Family- NLP, Round 3 Soils Extension, Lime and Ripping Trial

- Smith Family- GRDC Hyper Yielding Crops, Small Plot Site
- Smith Family- GRDC Hyper Yielding Crops, Late Season Nitrogen Applications (farm-scale)

- Mackie Family- GRDC Hyper Yielding Crops, Seeding Rate & Starter Fertiliser Combinations
- Hilder Family- GRDC Hyper Yielding Crops, Foliar K Applications
- Ben Beech & Family- GRDC Hyper Yielding Crops, Farm-Scale Trial
- Rohan Thorn- GRDC Hyper Yielding Crops, Farm-Scale Trial

- Smith Family- GRDC Herbicide Resistance Testing & Survey
- Moir Family- GRDC Herbicide Resistance Testing & Survey
- Mark Wood & Family- GRDC Herbicide Resistance Testing & Survey
- Lindsay Watterson & Family- GRDC Herbicide Resistance Testing & Survey

Stirlings to Coast Farmers Inc. are always looking for more trial site hosts for our ongoing and new projects. Please contact any of our staff or board members to register your interest in future opportunities.


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