STIRLINGS TO COAST FARMERS

2021 TRIALS REVIEW

Growing Agriculture Together

Hi everyone,

Welcome to the 2021 edition of the Stirlings to Coast Farmers Trials Review Booklet.

Last season was one for the ages, with waterlogged crops and paddocks the 'norm' throughout the year. Some paddocks were not physically seeded until August because that was the first time the seeder could get on the paddock! Despite the late sowing dates, many of our members achieved surprisingly good yields from late sown wheat and barley crops. We had a cool finish which was very fortunate, who knows what yields would have been if we had some hotter days during grain fill. The canola crops did not bounce back in most cases, but the price and paddocks with better profiles for dealing with the waterlogging hopefully mitigated some of the losses.

At the time of writing, it is mid-May with seeding programs winding down or even finished in some cases. The high cost of inputs will hopefully be matched by high grain prices at the end of the year, but I understand the trepidation growers have when expenses have been so extreme. Thankfully, most areas in our membership have had excellent sowing conditions with wet soil to sow into and follow up rains to drive early growth. There is a long way to go in 2022, but so far, so good.

This year's trials review booklet is jam-packed with information on all the SCF project results from 2021. We hope you find a lot of relevant material for your farming operations. Our staff are actively pursuing more livestock-related projects, and you will see a couple of them in this publication.

I want to repeat myself from last year and thank our farmer trial hosts from 2021 and those who have already volunteered to host a trial in 2022. The vast majority of SCF funding comes from grants, and most of the grant activities involve running on-farm trials and demonstrations. Without members supporting our trial work, SCF would not be able to deliver new and exciting farming concepts.

We continue to utilise modern agricultural technology to collect data in the most time-efficient manner for growers and staff members. Not only does the technology help efficiency, but it also collects higher quality data for more robust statistical analysis. Most of our trials can now be measured using the harvest yield monitor data through our smart farms coordinator, Phil Honey, which means one less interruption from pesky researchers when you are harvesting. As I mentioned in last year's booklet, 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, thank you to Kathi McDonald and Samantha Jeffries from our communications team, who put a mountain of effort into this publication. We hope you find the trials review booklet easy to read and full of helpful information. Good luck for the remainder of the 2022 season, and we will see you at the next SCF event.

Best Regards,

Nathan Dovey CEO

Front page photo description: Howard Family Farm, CSBP waterlogged barley trial site.

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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. Error bars at the top of each solid column within bar graphs can represent the LSD or Standard deviation (or standard error). Error bars through points on a line graph are generally the standard deviation or standard error.

Error bars that express the standard deviation extend both up and down from the top of each solid column (Figure 1). A standard deviation is a statistical measurement used to show how much variability exists in a set of data around the average or expected value. A long standard deviation bar indicates a broad range of possible values relative to the expected value. A short standard deviation bar means the data points are considered close to the expected value. The Standard error is a measure of the standard deviation in relation to the sample size (number of observations used to estimate the mean) and is often used in place of the standard deviation.

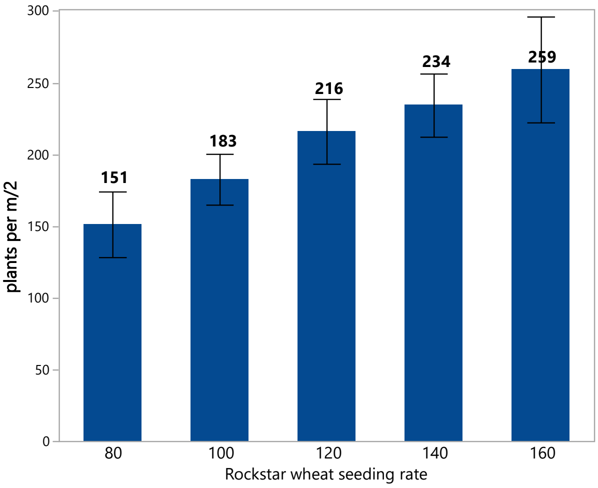
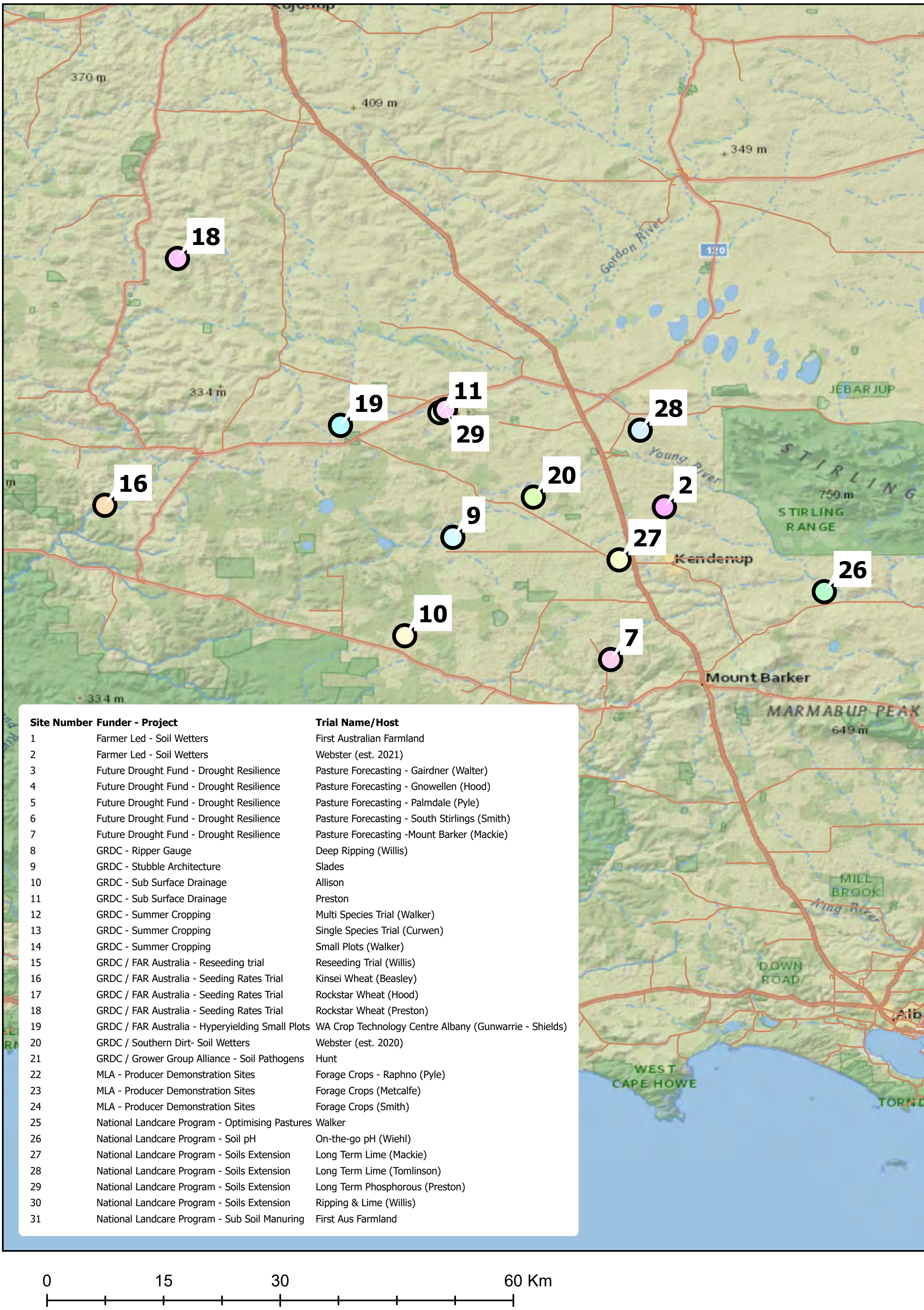
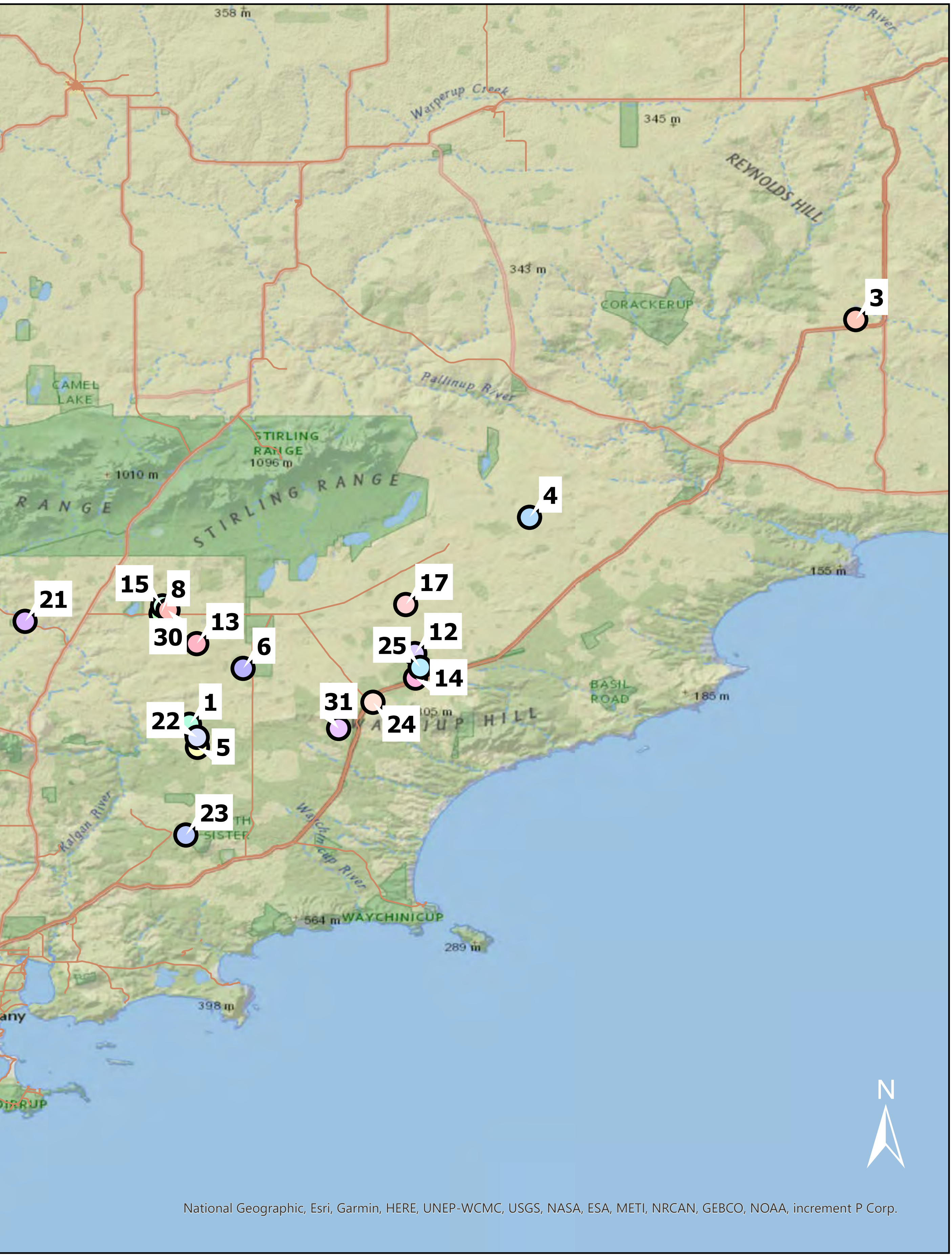


Figure 1: Average Rockstar wheat plants per m^2 in response to seeding rate treatments.

SCF 2021 Trial Site Map

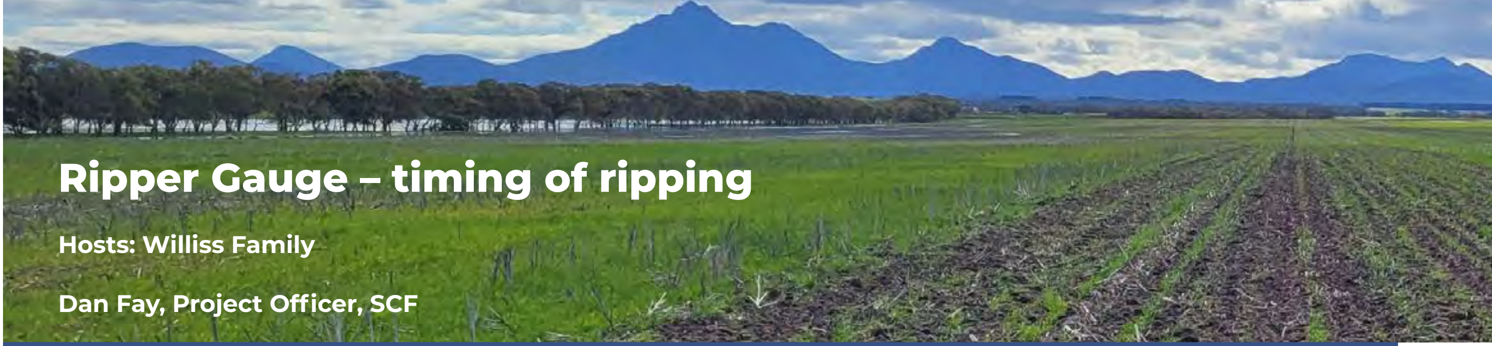


Site Number	Funder - Project	Trial Name/Host
1	Farmer Led - Soil Wetters	First Australian Farmland
2	Farmer Led - Soil Wetters	Webster (est. 2021)
3	Future Drought Fund - Drought Resilience	Pasture Forecasting - Gairdner (Walter)
4	Future Drought Fund - Drought Resilience	Pasture Forecasting - Gnowellen (Hood)
5	Future Drought Fund - Drought Resilience	Pasture Forecasting - Palmdale (Pyle)
6	Future Drought Fund - Drought Resilience	Pasture Forecasting - South Stirlings (Smith)
7	Future Drought Fund - Drought Resilience	Pasture Forecasting -Mount Barker (Mackie)
8	GRDC - Ripper Gauge	Deep Ripping (Willis)
9	GRDC - Stubble Architecture	Slades
10	GRDC - Sub Surface Drainage	Allison
11	GRDC - Sub Surface Drainage	Preston
12	GRDC - Summer Cropping	Multi Species Trial (Walker)
13	GRDC - Summer Cropping	Single Species Trial (Curwen)
14	GRDC - Summer Cropping	Small Plots (Walker)
15	GRDC / FAR Australia - Reseeding trial	Reseeding Trial (Willis)
16	GRDC / FAR Australia - Seeding Rates Trial	Kinsei Wheat (Beasley)
17	GRDC / FAR Australia - Seeding Rates Trial	Rockstar Wheat (Hood)
18	GRDC / FAR Australia - Seeding Rates Trial	Rockstar Wheat (Preston)
19	GRDC / FAR Australia - Hyperyielding Small Plots	WA Crop Technology Centre Albany (Gunwarrie - Shields)
20	GRDC / Southern Dirt- Soil Wetters	Webster (est. 2020)
21	GRDC / Grower Group Alliance - Soil Pathogens	Hunt
22	MLA - Producer Demonstration Sites	Forage Crops - Raphno (Pyle)
23	MLA - Producer Demonstration Sites	Forage Crops (Metcalfe)
24	MLA - Producer Demonstration Sites	Forage Crops (Smith)
25	National Landcare Program - Optimising Pastures	Walker
26	National Landcare Program - Soil pH	On-the-go pH (Wiehl)
27	National Landcare Program - Soils Extension	Long Term Lime (Mackie)
28	National Landcare Program - Soils Extension	Long Term Lime (Tomlinson)
29	National Landcare Program - Soils Extension	Long Term Phosphorous (Preston)
30	National Landcare Program - Soils Extension	Ripping & Lime (Willis)
31	National Landcare Program - Sub Soil Manuring	First Aus Farmland



358 m
Warperup Creek
345 m
REYNOLDS HILL
343 m
CORACKERUP
3
CAMEL LAKE
Pallinup River
STIRLING RANGE
1096 m
1010 m
RANGE
STIRLING RANGE
4
155 m
21
15
8
17
30
13
6
25
12
14
BASIL ROAD
185 m
31
24
1
22
5
23
Kalgan River
Waychinicup River
564 m
WAYCHINICUP
289 m
398 m
N
National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Funded Trials



Ripper Gauge – timing of ripping

Hosts: Williss Family

Dan Fay, Project Officer, SCF

Key messages

- Post-seeding ripping resulted in reduced yield performance across all treatments.
- All ripping treatments resulted in reduced soil strength.
- The pre-seeding ripping outperformed the untreated control.
- The use of inclusion plates in post-seeding ripping resulted in a significant burial effect.
- The trial site was subject to significant waterlogging throughout 2021.

Introduction

Stirlings to Coast Farmers has completed the first year of a trial aiming to assess the effectiveness of deep ripping post-seeding in the Albany Port Zone (APZ). The trial's objective was to build on the knowledge gained from previous ripping trials and assess whether the ripping window could be extended.

Deep ripping traditionally takes place during the summer fallow period, with the optimal time falling at the end of this period after the autumn break. However, this bumps up against the seeding window, resulting in a small optimal window for ripping to take place. Whilst deep ripping can be done earlier in the fallow period, this increases the risk of wind erosion and increases the costs by having to rip into hard baked soils.

Soil compaction poses a significant constraint to crop production in Western Australia (WA), with estimates that 18.8 million hectares of WA agricultural land are susceptible to compaction. The annual cost to the WA agricultural industry is estimated to be $330 million (DPRID, 2018). Soil compaction is caused by livestock and machinery traffic compressing the macropores in the soil. Seventy percent of compaction occurs in the first pass, often resulting in widespread compaction across paddocks where controlled traffic is not in place.

Soil compaction affects macroporosity in soils by pushing particles closer together, while the micropores remain largely unaffected. This results in a reduction in aeration of the soil, which causes a build-up of CO_2. The increased soil strength resulting from compaction also acts as a physical barrier to root growth, with a soil strength of 2500kPa becoming a limiting factor to root growth and 3000kPa stops root growth. Limited root growth and, as an extension, root surface area, limits water and nutrient uptake, causing a lower nutrient use efficiency (NUE), further exacerbating the stressors on crop growth.

Soil compaction is an ever-present issue in the APZ, particularly on the shallow sandy duplexes which are common to the area. These shallow duplexes are also prone to waterlogging and erosion, which can be further exacerbated by the effects of soil compaction as natural drainage is reduced, and the soil profile is compressed.

Trial design

The trial was a fully replicated and randomised paddock scale trial. There were four ripping treatments all to a depth of 60cm.

- Pre-seeding
- 1 week post seeding
- 3 week post seeding
- 6 week post seeding

The trial also included an untreated control (UTC) and a tramline buffer zone (Figure 1). Throughout the season a range of soil and plant measurements were taken to evaluate the effectiveness of the post seeding deep ripping. The paddock was seeded with RGT Planet barley and the plots were agronomically managed by the host farmer.

Methodology

Soil compaction was measured using a CP200 Cone Penetrometer, which digitally records the soil strength in kPa at 25mm intervals to a depth of 700mm. Readings were taken at random intervals within the plots and the results were averaged out to form a base line soil strength in each plot. These plot readings were analysed and

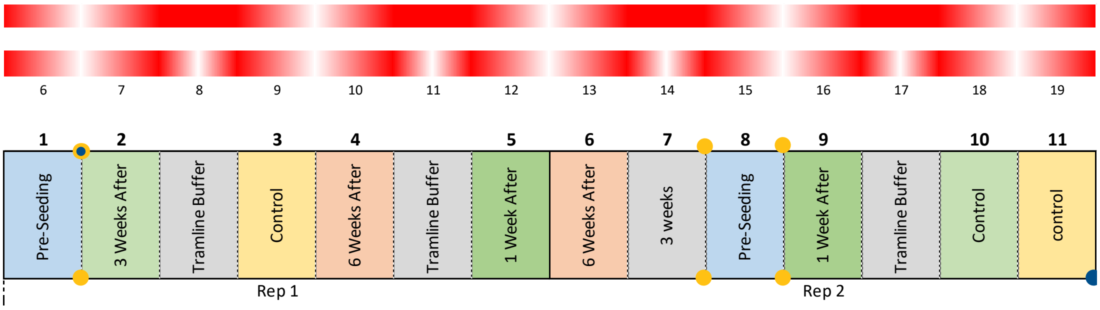


Figure 1: Ripping trial layout at the Williss property at Takalarup in 2021.

graphed using statistical software to determine the relationship between the timing of ripping and the soil strength.

Plant counts were taken after the 6-week rip was applied, and plant biomass cuts and tiller counts were taken two weeks later at growth stage 24-26. The data was analysed and converted to a per m^2 metric. Harvest yields were taken via the calibrated yield monitor of the host farmer's header. These results were analysed to determine the relationship between timing of deep-ripping and yield.

Results

Soil Strength

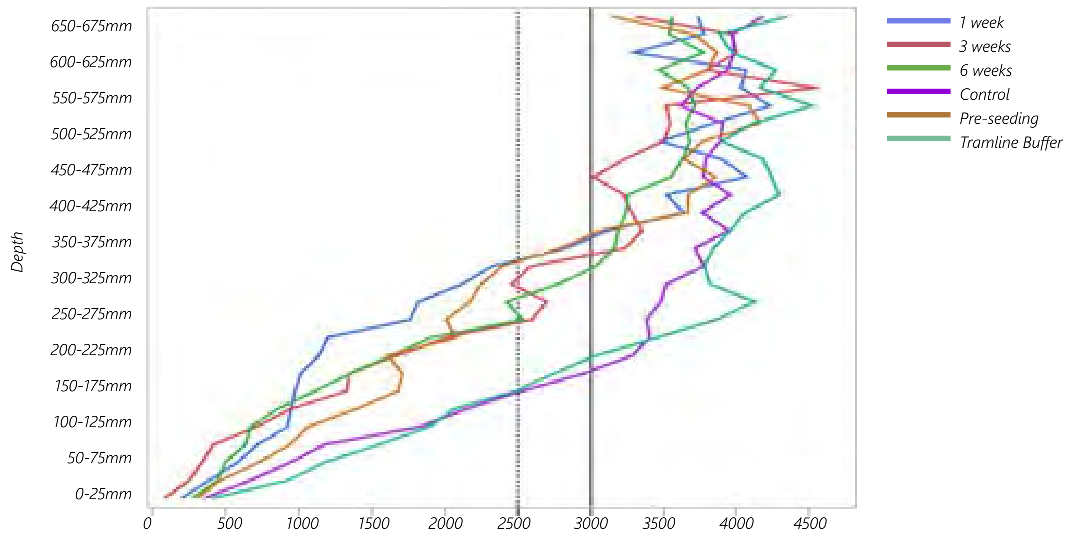


Figure 2: Mean soil strength measured using the CP200 Cone Penetrometer for all treatments from the soil surface to a depth of 700mm.

Each deep ripping treatment was effective in reducing soil strength, allowing the plants to access an average depth of 300mm, compared to 125mm of the soil profile before reaching a soil strength of 2500kPa. (Figure 2) A soil strength of 2500 kPa is deemed to limit root growth, whilst 3000kPa stops root growth stops in most broadacre crops. Notably, each ripping treatment regardless of timing was effective in significantly reducing the soil strength. This is interesting as the paddock became increasingly more waterlogged between pre-seeding and six weeks post-seeding, suggesting that waterlogging does not impact the effectiveness of deep ripping to alleviate soil compaction.

Plant establishment and biomass

All three post-seeding ripping treatments caused a burial effect that reduced plant numbers, tillers, and plant biomass when compared to the UTC and the pre-seeding ripping treatment. The one-week post-seeding treatment resulted in the lowest number of plants and tillers per m^2 (62 and 192 respectively) however the plants that survived appeared a lot less stressed than the 3- and 6-week plots. This is supported by the greater tiller to plant ratio of 3.1 tillers per plant, compared to 2.6 for the 3-week and 2.4 for the 6-week treatment. This is likely due to the 1-week post seeding treatment burying the seed/coleoptile, causing a high rate of mortality, however the plants that did successfully emerge were able to thrive. The pre-seeding rip produced more plants and tillers than the UTC, however this was not statistically significant.

Biomass

Deep ripping post-seeding had a negative effect on plant biomass. This was likely attributed to the loss of plant matter rather than a significant reduction in plant growth. However, the 3-week and 6-week post seeding plots looked particularly stressed at the time when biomass was taken.

The 3-week and 6-week post seeding treatments resulted in significantly less dry matter per m^2 (75 g/m^2 and 77.2 g/m^2 respectively) when compared to the UTC (166 g/m^2) and the pre-seeding (194 g/m^2) treatment. The 1-week post seeding ripping produced greater biomass than the further delayed treatments, however this was very dependent on the number of plants that were in the measured area, which can be seen in the higher standard deviation.

The pre-seeding rip resulted in the greatest level of biomass produced, however this was not statically significant when compared to the UTC. At the time these measurements were taken, the trial plots were subject to a prolonged period of severe waterlogging, which likely stunted plant growth. Under normal conditions, it is likely that there would be a greater difference between biomass produced in the post and pre-seeding rips.

Yield

All three post-seeding ripping treatments negatively impacted barley yields compared to the UTC, whilst the pre-seeding ripping treatments performed better than the UTC. The yield penalty resulting from the 3-weeks after and 6-weeks after seeding treatments was 0.73t/ha compared to the UTC and 1.5t/ha compared to pre-seeding deep ripping. The one-week after seeding treatment (4.05t/ha) yielded only slightly less than the UTC.

It should be noted that each plot was subject to yield limiting waterlogging, which likely reduced the yield potential of all the plots. Under less extreme conditions we would expect a greater differential between the pre-seeding ripping treatment and the control as well as the post-seeding ripping treatments.

The final yields mirror the growth stage 25 dry matter, results which suggest that it is the initial mechanical damage from post season ripping that was carried through the season and affected grain yields.

Conclusion

Whilst deep ripping post-seeding is effective in reducing soil strength and alleviating compaction, the resulting yield penalty is too costly to warrant adopting the technique when pre-seeding ripping is still an option. Over the lifespan of the ripping treatment the initial cost associated with the yield penalty, particularly in the one-week post seeding treatment would likely be recouped, however given this treatment falls in the seeding window, this strategy would face the same opportunity cost as pre-seeding ripping currently does.

This project will continue in 2022 where we will look at the following season's crop performance in response to the 2021 ripping treatments. By the end of the project, we should have a clear picture of the effectiveness of deep ripping post-seeding and the economics around timing of deep ripping.

Reference: Davis S, Bekker D, Lemon J, & Isbister B, soil compaction: overview, Agriculture and Food, The Department of Primary Industries and Regional Development, 2018

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Hyper Yielding Crops - Focus Farm Trials

Hosts: Preston Family, Hood Family Williss Family and Frankland River Grazing

Dan Fay, Project Officer, SCF

In 2021 Stirlings to Coast Farmers (SCF) ran a series of on farm trials as part of the FAR Australia Hyper Yielding cropping (HYC) program. These trials were a scaling up of the ideas explored at the project research facilities at Frankland River. The trials sit alongside an awards program, which benchmarks wheat performance within the Albany Port Zone (APZ), aiming to push productivity by maximising yield potential.

The four trials hosed by SCF members looked at optimising seeding rates and the yield benefits of re-seeding in response to waterlogging.

The aim of the three rate trials was to assess the impact of differing seeding rates on Rockstar and Kinsei wheat yields. These broadscale trials were placed within an existing paddock where the wheat plots were subjected to the growers standard agronomy. The trials aimed to determine if higher seeding rates would improve yields without making any other agronomic changes. Given seeding rate recommendations are often based on broad parameters that are not tailored to specific environmental and agronomic conditions, this trial aimed to determine if there was an optimal Rockstar or Kinsei seeding rate to push yields in the APZ.

The fourth trial examined the potential yield benefits and differentials of re-seeding later in the season as opposed to trying to carry the primary seeded crop through the whole season, in response to severe waterlogging. This trial monitored plant production health and growth stage development, as well as yields, to provide improved decision making around re-seeding options in barley.

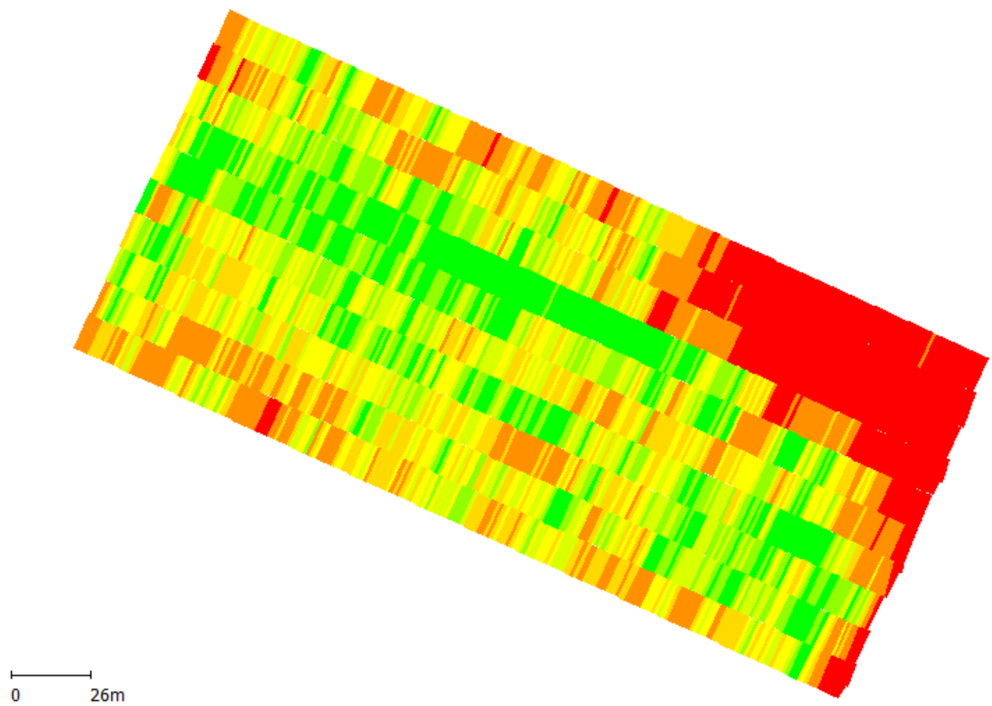


Figure 1: Yield Map showing the large, frosted area (red) which impacted the second replication of the treatment plots at the Preston Mobrup site.

Mobrup: Rockstar Trial

Hosts: Preston family

KEY MESSAGES:

- The trial showed a relationship between seeding rate and yield, with three of the treatments (100kg/ha, 120kg/ha and 140kg/ha) yielding significantly better than the lower rate of 80kg/ha and the higher rate 160kg/ha.
- Early season measurements of plant establishment showed a linear trend between seeding rate and plant numbers, however by GS65, this was no longer observed.
- This trial was affected by a frost event in the 2nd replication that impacted the yield results. However, given the length of the plots and the localised area that was affected, this was able to be removed to give a clearer picture of the crop performance.

Methodology

The Mobrup Rockstar seeding rate trial contained five seeding rate treatments: 80, 100, 120, 140 and 160kg/ha. The trial was fully replicated and randomised to ensure spatial and environmental variation were accounted for.

The plots were seeded on May 13 2021, with the rates adjusted by a calibrated seeder. All plots were seeded on 24cm spacings. The plots received the same agronomic package through the year, which was tailored to the control rate (the rest of the paddock) of 110kg/ha.

Plant counts were taken from two 1m parallel crop rows at GS14-15, a minimum of 10 times per plot. These were then converted to plants per m^2 and averaged to get mean plants per m^2 for each treatment. Biomass cuts were taken from each plot at mid-flowering (GS65) to determine the effect of seeding rate on biomass production.

Plant growth stages and timing were monitored throughout the year to assess if the seeding rate impacted growth stage development, plant physiology and plant health.

Results and Discussion

Early plant counts showed that there was a significant linear trend between seeding rate and plant numbers. The average plants per m^2 ranged between 151 at 80kg/ha to 259 at 160kg/ha (Figure 2). This trend was expected given the early moisture. However, by GS40 there were signs of significant tiller mortality among the higher seeding rates, with a lot of dead plant material among the seeding rows.

There was no evidence of seeding rate influencing the plant growth stages, and interestingly the lack of solar radiation, and prolonged periods of waterlogging, did not delay flowering in the trial. The plots flowered on the 21st of September, falling within the predicted flowering window for Rockstar.

The trial saw a slight yield response to seeding rate, peaking at the 140kg/ha rate with an average yield of 6.28t/ha. However, this is with the frost affected area (Figure 1) removed from the results. There was evidence of lodging within the surrounding paddock and small patches within the treatment plots, however this did not appear to impact yields, and there was seemingly no relationship between seeding rate and lodging.

The standard seeding rate for Rockstar wheat in the HRZ is between 100 and 120kg, this data does not support a case to increase seeding rates. Given the 2021 season was particularly wet, we hypothesised that there might be a potential for the higher rate treatments to utilise the increased soil moisture however this did not actualise. This trial suggests that seeding Rockstar wheat at a rate between 100kg/ha and 140kg/ha will produce a similar yields. It should be noted that the agronomic package was tailored to a seeding rate of 110kg/ha, so that there was a potential for a nutrient limiting factor reducing potential yield on the higher rate plots.

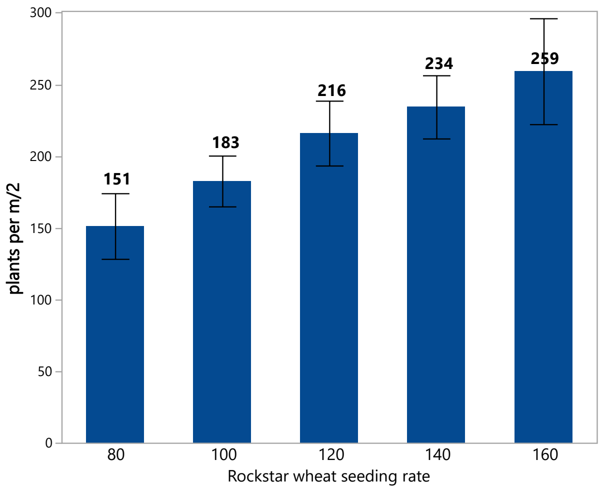


Figure 2: Average Rockstar wheat plants per m² in response to seeding rate treatments.

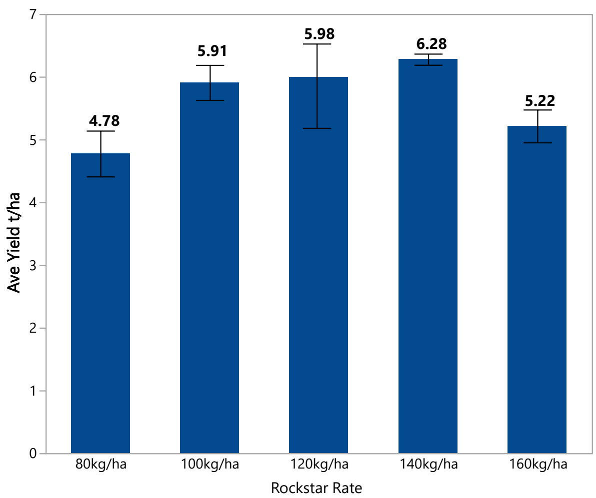


Figure 3: Average Rockstar wheat yields in response to seeding rate treatments.

Kojaneerup South: Rockstar Seeding Rate Trial

Hosts: Hood family

KEY MESSAGES:

- The trial was subject to significant waterlogging and did not result in any yield responses to the seeding rate. The yields within the plots were variable, depending on how wet areas of the plots got.
- The early season plant establishment counts showed a response to seeding rate, however this was also variable depending on where they were taken.
- NDVI showed no variability in response to seeding rates.
- The trials yielded on average 4t/ha across the plots. This was surprising given this trial looked like it would be washed out completely at stages throughout the year.

Methodology

The Kojaneerup South Rockstar seeding rate trial contained four seeding rate treatments: 80, 100, 120 and 130kg/ha. The trial was fully replicated and randomised to ensure spatial and environmental variation was accounted for.

The plots were seeded on the 20th May 2021 on 24cm spacings. The plots received the same agronomic package through the year, which was tailored to the control rate (the rest of the paddock) of 120kg/ha.

Plant counts were taken from two 1m parallel crop rows at GS14-15, a minimum of 10 times per plot These were then converted to plants per m^2 and averaged to get an mean plants per m^2 for each treatment. Biomass cuts were taken from each plot at mid-flowering (GS65) to determine the effect of seeding rate on biomass production.

Plant growth stages and timing were monitored throughout the year to assess if the seeding rate impacted growth stage development, plant physiology and plant health.

Harvest yields were recorded via calibrated yield monitor, and grain quality was tested to assess the impact of seeding rate on grain quality.

Results and Discussion

The trial was affected by severe and prolonged waterlogging across all plots, which was a major yield limiting factor. Studies have found that 21 days of waterlogging in cereals will limit shoot and root growth, decreasing biomass, nutrient acquisition and grain yield.

In the trial, waterlogging was the major limiting factor, and as a result there was no evidence of yield response to seeding rate, with the average yield across all plots being 4t/ha. There was also no significant relationship between heads per m^2, however there was a linear trend that showed that heads per m^2 went up slightly as the seeding rate increased (data not shown).

Early in the season there was a significant relationship between plant establishment and seeding rate, however at this early stage there was evidence of poor germination in areas within the plots that were already suffering

from waterlogging or seed burst.

Whist very little information gleaned from this trial can inform an optimised seeding rate for the APZ, this trial does show that lifting seeding rates in response to waterlogging is not an effective strategy if the waterlogging is too prolonged or severe.

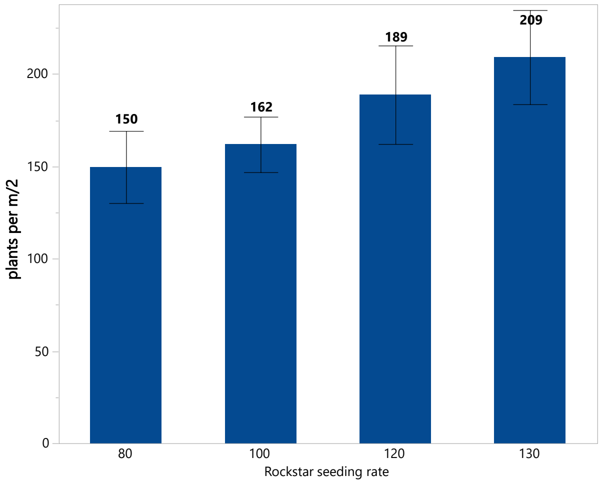


Figure 4: Average Rockstar wheat plants per m² in response to seeding rate treatments at Kojaneerup in 2021.

Frankland: Kinsei wheat seeding rate trial

Hosts: Frankland River Grazing - Jon Beasley

KEY MESSAGES:

- This trial showed no relationship between increased seeding rate and grain yield.
- The baseline seeding rate of 90kg/ha (7.45t/ha) out yielded the 110kg/ha (7.01t/ha) and 130kg/ha (7.04t/ha) treatments, although this was not statistically significant.
- The trial site showed a linear relationship between plant establishment/tillering, and seeding rate, however by GS65 this was no longer evident.
- There was no observable trend between head count and seeding rate.
- There was no relationship between seeding rate and grain quality.

Methodology

The Frankland River Kinsei seeding rate trial contained three seeding rate treatments: 90, 110, and 130kg/ha. The trial was sown on a paddock scale and was fully replicated and randomised to ensure spatial and environmental variation was accounted for.

The plots were seeded on the 16th May 2021. All plots were seeded on 25cm spacings. The plots received the same agronomic package through the year, which was tailored to the control rate (the rest of the paddock) of 90kg/ha.

Plant counts were taken from two 1m parallel crop rows at GS14-15, a minimum of 10 times per plot. These were then converted to plants per m^2 and averaged to get mean plants per m^2 for each treatment. Biomass cuts were taken from each plot at mid-flowering (GS65) to determine the effect of seeding rate on biomass production.

Plant growth stages and timing were monitored throughout the year to assess if the seeding rate impacted growth stage development, plant physiology and plant health.

Harvest yields were recorded via a calibrated yield monitor, and grain quality was tested to assess the impact of seeding rate on grain quality.

Results and Discussion

Like the two Rockstar trials, the Kinsei trial showed a significant relationship between seeding rate and plant establishment (Figure 5), which then failed to translate to a yield advantage. The Kinsei variety appeared to handle the periods of waterlogging and wet conditions well, producing a large canopy that was able to transpire water.

The trial resulted in no significant difference in yield or grain quality resulting from the changes in seeding rate (Figure 6). The 90kg/ha plot which was seeded at the same rate as the surrounding paddock yielded approximately 0.5t/ha better than the heavier seeding rates. However, there was no statistically significant difference between yields, and all three rates yielded exceptionally well.

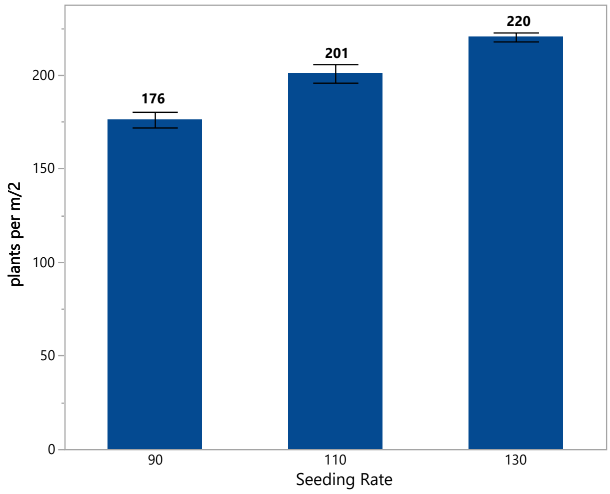


Figure 5: Average Kinsei wheat plants per m^2 in response to seeding rate treatments at Frankland River in 2021.

Within each Kinsei plot there were areas that had been significantly affected by waterlogging with lower lying points in each run suffering periods of stress. However, this did not result in any noticeable yield penalty in these zones of the plots at the end of the season. This could suggest that the Kinsei variety of wheat is able to recover from periods of waterlogging stress without a major yield penalty. The Kinsei trial suggested the optimal seeding rate could be 90kg/ha, however it should be explored to see if these rates could be lowered further to determine the lower limit for seeding rate in Kinsei.

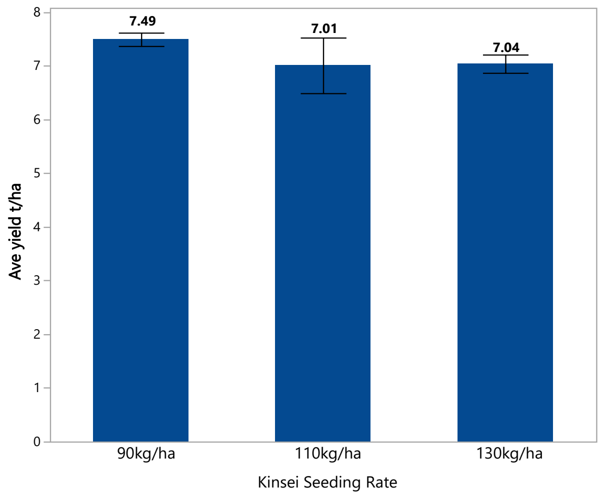


Figure 6: Average Kinsei wheat yields in response to seeding rate treatments at Frankland River in 2021.

Takalarup: Re-seeded Planet Barley Trial

Hosts: Williss family

KEY MESSAGES:

- This trial was developed after discussion with a member who had decided to re-sow 45% of a paddock of barley in response to severe waterogging and was interested in tracking its performance against the area that was not resown.
- The original seeding date was the 16th of June, and barley sown into a fully saturated profile. The western half of the paddock was suffering from severe waterlogging and was sprayed out and re-seeded on the 25th of August.
- The reseeded crop produced a greater number of plants and tillers per m^2, and a higher level of dry-matter per m^2, when recorded at the same growth stages.
- The re-seeded crop (4.3t/ha) out yielded the primary seeded crop (3.7t/ha).

This trial examined and assessed the performance of re-seeded barley, against the primary sown barley in response to waterlogging.

Methodology

Approximately 45% of a barley paddock which was sown on the 16th of June, was reseeded on the 25th of August after crop failure due to severe waterlogging. Performance metrics such as plant establishment, tiller numbers, biomass cuts, growth stage (GS) timings, yield and grain quality were taken throughout the season on both the primary and re-seeded crop, to analyse the performance of each.

Results and Discussion.

The primary crop was seeded into a fully saturated profile of soil. It continued to rain and as a result a large portion of the paddock failed with plant density less than the re-seeded crop (Figure 7). This was likely due to seed burst in the primary seeded crop. The re-seeded crop was also sown into a fully saturated profile but the conditions after seeding were dry, and as a result the crop germinated well. This is highlighted by the differential in early biomass production (Figure 8), whereby GS24 re-seeded barley was producing 26% more biomass than the primary seeded crop at the same growth stage.

The primary crop flowered on the 15th of October, whilst the re-seeded crop flowered on the 11th of November. This highlights the strong vernalization triggers within Planet barley, and the ability of the later sown paddock areas to 'catch up' with the primary seeded crop. The primary seeded crop was harvested on the 19th of December, and the re-seeded crop was harvested on the 11th of January.

The early biomass advantage was carried through to harvest where the primary crop yielded, on average, 3.9t/ha and the re-seeded crop yielded 4.3t/ha. The fact that the re-seeded crop outperformed the primary seeded crop by 400kg justifies the decision to re-seed. The post October climactic conditions were ideal for grain fill with cool and dry temperatures coupled with above average solar radiation (Figure 9). These conditions made for a perfect finish for the re-seeded crop that would be unlikely to be replicated in future years.

This trial demonstrated the capacity for late sown barley to yield well in the high rainfall zone of Western Australia. Sowing in late winter and early spring is standard practice in other regions of Australia. However, the

risk of a heat stress event during the critical 21-day window post-flowering likely means this practice would not be widely adopted in WA. This trial demonstrated the capacity to mitigate waterlogging by seeding late in the season, without suffering yield penalties if the conditions are favourable.

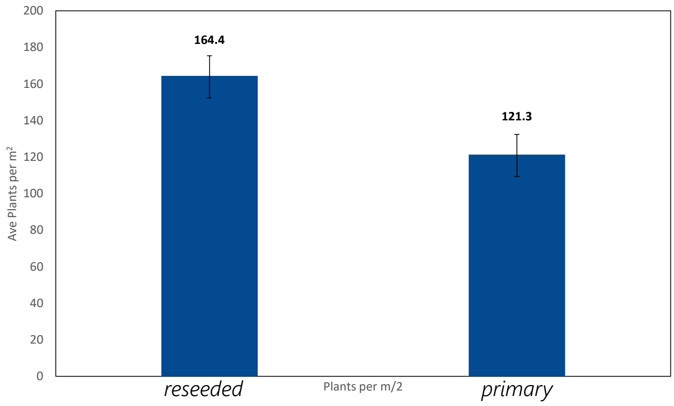


Figure 7: Average plants per m2 for the primary v re-seeded barley at Takalarup in 2021.

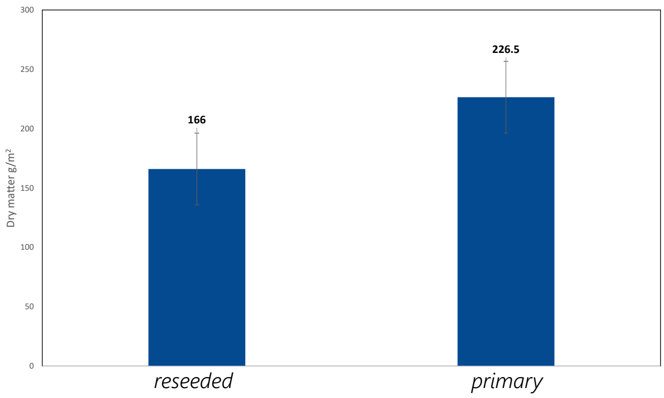


Figure 8: Average GS24 Barley dry matter per m^2, for the primary v re-seeded barley at Takalarup in 2021.

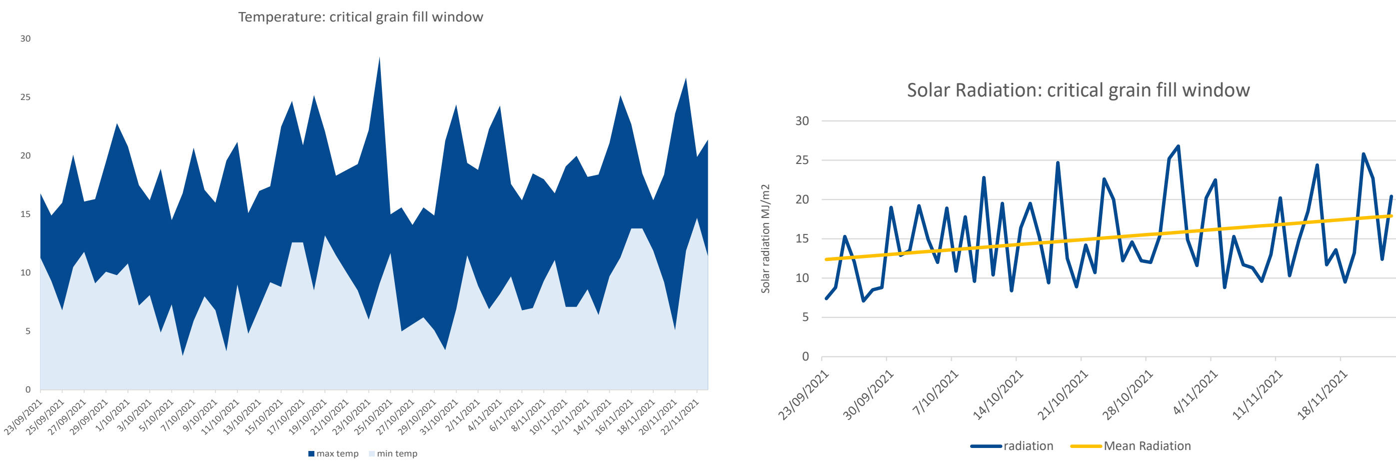


Figure 9: Temperature and available solar radiation at Takalarup in 2021 in the critical yield determinate period.

Lime sources trial

Hosts: Mackie Family

Nathan Dovey, CEO, SCF

KEY MESSAGES

- The 2021 season was exceptionally wet at Kendenup, with 831mm recorded at the nearby DPIRD Kendenup West weather station.
- Severe and prolonged waterlogging was experienced at the trial site, and this likely caused yield variation unrelated to the lime treatments.
- The two lower yielding treatments are likely to be due to waterlogging effects in 2021 rather than differences due to the lime sources.
- Stirlings to Coast Farmers will employ a contractor to test the soil pH ($CaCl_2$) at 10cm increments down to 50cm soil depth in 2022.

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 continued monitoring the trial in the intervening years and 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.

Methodology

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

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

Each lime source had the product rate (t/ha) 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 soil acidity levels 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.

In 2021 the trial paddock was sown to canola.

Results and Discussion

Canola yields from the 2021 season show that none of the treatments are significantly different, despite the Bornholm and WALCO lime treatments having lower yields than the others. The trial site suffered severe waterlogging in 2021, with 831mm of rainfall for the calendar year. The waterlogging caused significant yield variation across the trial site, which would have had a greater influence on final grain yields than soil pH. The large variation in the untreated control (UTC) plots is displayed in table one below.

Table 1: Mean canola yields (t/ha) in 2021 from the untreated control (Control) plots.

Replicate 1	Replicate 2
UTC Plots	UTC Plots
1.48	2.24
1.13	1.74
2.85	1.75

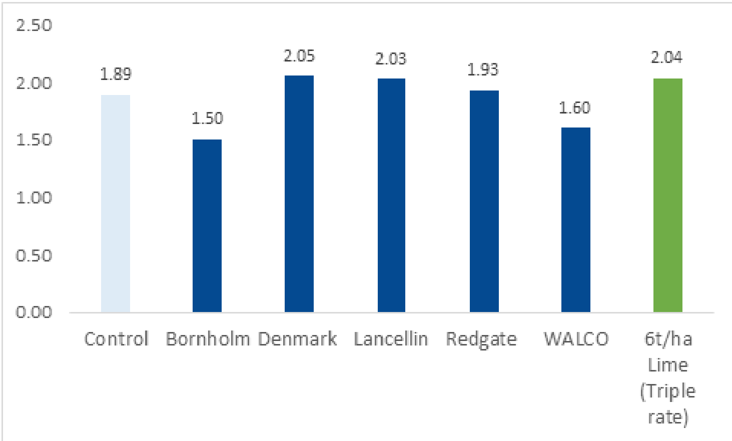


Figure 1: Canola yields (t/ha) from the Kendenup Lime Sources trial in 2021. None of the treatments was significantly different from each other.
Note: The paddock suffered severe waterlogging in 2021, which affected yield results in ways we could not quantify.

Last year's results should be interpreted with caution. We recommend waiting until the 2022 yield data is determined before putting the 2021 results in context. SCF researchers have booked a soil sampling contractor to test the soil pH at 10cm increments down to 50cm soil depth before seeding in 2022. The soil data will compare pH at depth from the different lime sources.

During the 2017, 2018 and 2020 seasons, there were also no significant yield differences between the trial treatments. Our interpretation was that the paddock started with an adequate soil pH of (4.8-5.2 $CaCl_2$) and then had the equivalent of 2t/ha Lime applied at 80% neutralising value. The adequate starting soil pH means that pH would not have had a significant impact on crop yields at this site. Any impact from root systems compromised by sub soil pH issues would be masked by the ‘soft’ seasonal finishes experienced in the past few years, where the crops could access sufficient moisture and nutrients from shallower soil unaffected by pH.

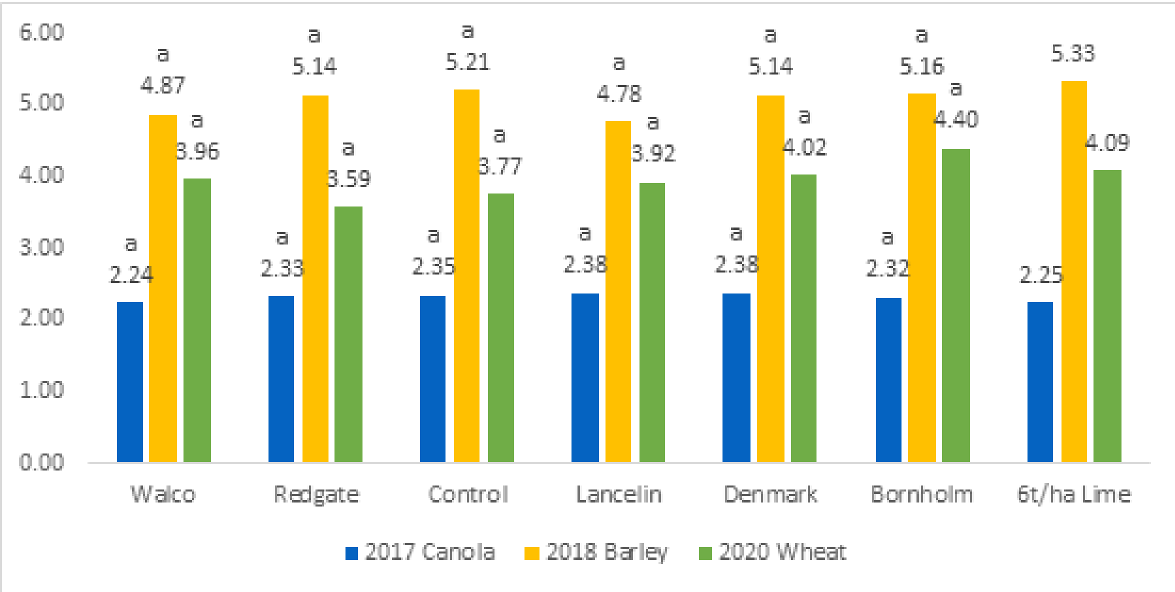


Figure 2: Grain yields (t/ha) from the Kendenup Lime sources trial in 2017, 2018 and 2020. Means followed by the same letter or symbol do not significantly differ (P=.05, LSD).
NB: There is only one replicate of the high rate (6t/ha lime treatment), which means we cannot complete statistical analysis on this treatment.

Conclusion

The yield variation between plots caused by severe waterlogging in 2021 was much greater than any possible effects due to the different lime sources being evaluated. In isolation, the 2021 data set has negligible value but may be interesting to review in the coming years when more yield and soil data is obtained. The soil data to be collected in 2022 will be valuable in assessing if there are any commercially valuable differences between each lime source. For example, has one or more lime sources changed the topsoil pH faster than others? Have one or more lime sources improved soil pH at depth compared to others? Results will be published for SCF members later in the year.

Thank you to South Coast Natural Resource Management (SCNRM) for providing the original funding for this trial.

Many thanks to the National Landcare Program (NLP) for funding the ongoing trial observations since June 2020.

Australian Government | National Landcare Program

Non-wetting soil management options for growers in the Albany Port Zone

Hosts: Webster Family

Nathan Dovey, CEO, SCF

KEY MESSAGES

- Seeding 'on-row' or 'near-row' significantly improved germination and early biomass for canola in the 2020 season.
- Seed placement was a more significant factor than the wetting agent treatments for improving germination and early biomass in canola in 2020.
- SE14 was more effective when placed closer to the seed compared to a surface application behind the press wheel in 2021.
- There were no significant canola yield differences between treatments in the 2020 growing season.
- In the 2021 growing season, there were no increases in wheat grain yield as a result of wetting agent treatments that were applied in 2020.

Background

In recent years, grain growers in the Albany port zone have found it more challenging to achieve an even crop germination because early growing season conditions are drier and more volatile. Non-wetting expression is particularly problematic for growers with forest gravels. These soils usually rely on late summer and early autumn rains to alleviate their 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 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 the grower; but, they also have long-lasting results. They also carry a significant economic risk due to the cost and environmental risk from wind erosion.

Some mitigation options being looked at include wetting agents, on-row seeding, furrow seeding and stubble retention. There are a range of wetting agents available on the market for farmers to use and a range of placements including on the seed, 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. He also noted a long-term benefit of using soil wetters in paddocks and farmers have anecdotally supported this observation. A farm-scale trial was established at Tenterden in 2020 on highly non-wetting forest gravel. The replicated air-seeder width trial included 11 treatments over 200m long and was sown initially to canola in 2020, followed by wheat in 2021.

2021 Trial Method

In 2021, the grower sowed wheat directly over the 2020 canola plots without using a wetter or engaging the Pro-Trakker. The aim in 2021 was to determine if there were any residual yield benefits from the treatments applied the year before.

Key details

- The trial utilised the grower's liquid delivery system applying 50L/ha of water plus product on the furrow behind press-wheel in 2020.
- For the 2020 season the trial was harvested using a combination of a farmer's harvester and small-plot machine.
- In 2021 the trial was harvested using a small-plot harvester only.
- Soil type- Forest Gravel: MED testing between 3.4-3.6 (severe to very severe) non-wetting.

Treatments

1. Untreated Control
2. 2 L/tonne SE14 directly on the seed
3. 4 L/tonne SE14 directly on the seed
4. 2 L/ha SE14 behind press wheel
5. 4 L/ha SE14 behind press wheel
6. 2 L/tonne SE14 directly on seed and 1 Lt/ha behind press wheel
7. 2 L/ha SE14 behind seed boot
8. 4 L/ha SE14 behind seed boot
9. 1 L/ha SE14 behind seed boot and 1 L/ha behind press wheel
10. 2 L/ha SE14 behind seed boot and 2 L/ha behind press wheel
11. 2 L/ha BASF Divine (80% integrate / 20% Agri) behind press wheel

Results & Discussion

For a comprehensive summary of the 2020 trial results, please look at pages 14-15 of the 2020 Stirlings to Coast Farmers Trials Review Booklet.

2021 Results

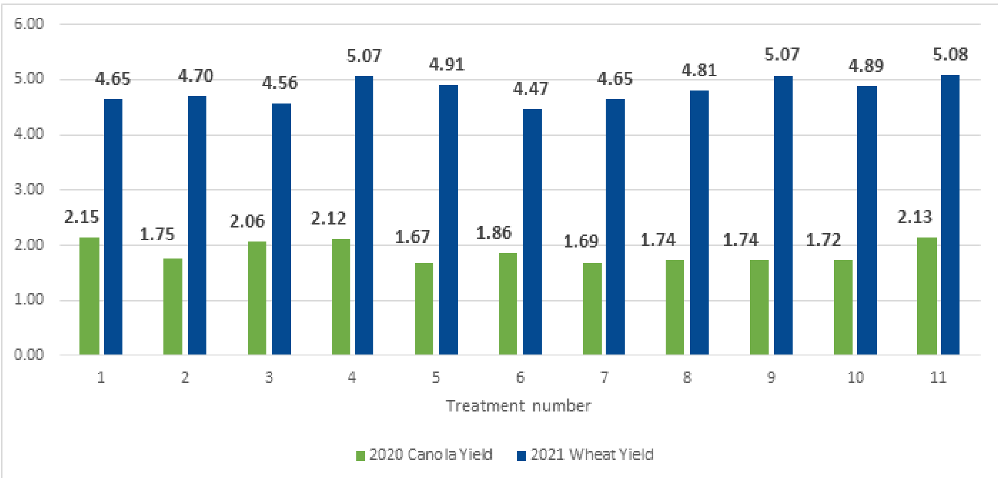


Figure 1: Grain yields (t/ha) recorded in 2020 (canola) and 2021 (wheat) at the Webster/Beech non-wetting trial site in Tenterden. No statistical differences were measured between treatments in 2020 or 2021.

- There were no significant differences between wheat yields in 2021 from the wetting agent treatments applied in 2020.
- In 2021 698.4mm of rainfall (Decile 10) fell between April 1-October 30 at the West Kendenup DPIRD weather station, effectively removing the non-wetting soil constraint in 2021.

Conclusion 2021 Results

Growers have anecdotally observed long term cumulative benefits from applying soil wetting agents year on year. We attempted to measure this observed benefit in the trial design, but the unusually wet 2021 season minimised the expression of non-wetting at this site. Data from our trial does not support the hypothesis that wetting agents provide residual benefits for more than one growing season. However, the idea deserves further research since it would add utility to wetting agent investments made by growers.

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Southern Dirt

A GRDC Invested Trial. Thank you to Southern Dirt for inviting Stirlings to Coast Farmers to collaborate on this project.

Preston Phosphorus Rate Response trial

Hosts: Preston Family

Dan Fay, Project Officer, SCF

Trial Aim and Background

Phosphorus (P) is an essential nutrient for plant development in all broadacre crops. It is a constituent of plant cells and is essential for cell division and plant growth. Phosphorus is vital for early plant growth, so P enriched starter fertilisers are needed to meet this demand. The weathered soils of WA are among the most P depleted in the world. When combined with the low P use efficiency of fertilisers (5-30% is plant available), P deficiency can be a significant yield constraint for growers in the Albany Port Zone. However, phosphorus can remain soluble within the soil over seasons, and as a result, P can be banked in the soil and accessed by the plant over the following years. This trial is a longitudinal study conducted by the Preston family and Stirlings to Coast Farmers to determine how long it takes to deplete the pooled P supplies and what rate of P fertilisers are needed to meet these P demands.

Treatments

The trial was designed to use varying rates (Table 1) of starter fertiliser (82:18 MAPSZC: MOP) applied across farm-scale plots, with the rest of the paddock receiving a control rate of 100kg/ha. Flinders barley was sown in 2021 at 100kg/ha.

The starter fertiliser was applied on the 11th of May when the paddock was sown. The trial plots were then subject to the farmer's "normal" agronomic package, and no further in-season P was used.

Table 1: Starter fertiliser rates applied in the Preston phosphorus trial in 2021 and their input breakdown (kg provided/hectare).

		N	P	S	Cu	K
MAPSZC®/MOP 82:18	*40kg/ha*	*3.8*	*6.6*	*1.9*	*0.098*	*3.6*
MAPSZC®/MOP 82:18	*60kg/ha*	*5.7*	*9.8*	*2.8*	*0.148*	*5.4*
MAPSZC®/MOP 82:18	*80 kg/ha*	*7.6*	*13.1*	*3.7*	*0.197*	*7.2*
MAPSZC®/MOP 82:18	*100 kg/ha*	*9.5*	*16.4*	*4.6*	*0.250*	*9.0*
MAPSZC®/MOP 82:18	*120 kg/ha*	*11.4*	*19.7*	*5.6*	*0.300*	*10.8*
MAPSZC®/MOP 82:18	*140 kg/ha*	*13.3*	*23.0*	*6.5*	*0.340*	*12.6*

Results and Discussion

The harvest yields were collected directly from the harvester using a calibrated yield monitor data. These were then spatially analysed to form an accurate set of data. The paddock was subject to prolonged periods of waterlogging, which likely influenced the P accumulation. Waterlogging does not influence P sorption (Phillips, 2008). Still, the reduced root mass resulting from prolonged periods of waterlogging would reduce the plants' ability to accumulate P. For this study, we have assumed that the plant phosphorus removal for the barley was at the standard rate of 2.7kg/t/ha.

The relatively high barley yields across all plots resulted in a P deficit in 2021 for the 80kg, 60kg, and 40kg/ha plots, whilst the plots with a fertiliser rate of 100kg/ha or higher resulted in a P credit.

In 2021 there was a statistically significant relationship between fertiliser rate and harvest yields. There was also a strong trend to suggest that the P rate directly influenced yields, with yields going up in response to the P rate, except for the 140kg/ha plots. The result for the 140kg/ha treatment was influenced by a replicate that suffered from significant waterlogging stress and yielded much lower than the other three replications. With the outlier removed, the 140kg/ha treatment averaged 5.66t/ha compared to the 4.87t/ha with the waterlogged replicate included. The adjusted 140kg/ha result indicates that P responses follow a non-linear pattern with a flattened response curve at 100k/ha of applied fertiliser.

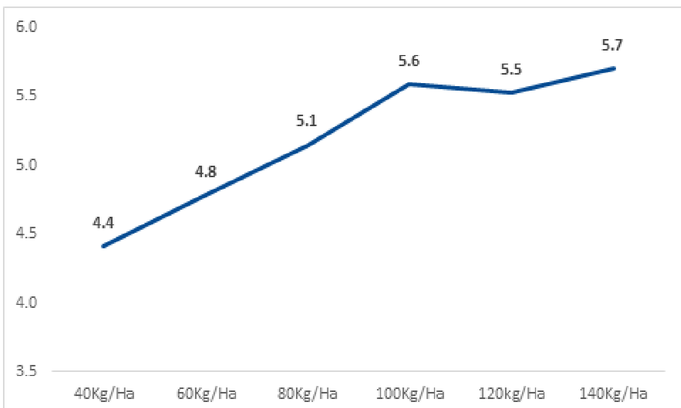


*Figure 1: Preston Phosphorus (P) rate response trial results in 2021. The crop sown was Flinders barley and the X-axis depicts the fertiliser rate (MAPSZC®/MOP 82:18) applied in kg/ha. The Y-axis displays the adjusted barley yields in t/ha. *Adjusted because a waterlogged replicate was removed from the 140kg/ha treatment.*

Table 2: Summary of the fertiliser applied on the Preston Phosphorus (P) rate trial in 2021. The paddock was sown to Flinders barley in 2021. The fertiliser was a blend of MAPSZC®/MOP 82:18.

Fertiliser Rate	P units in Fert	Yield (t/ha)	P removal	P Balance
40Kg/Ha	*6.6*	*4.4*	*11.9*	*-5.3*
60Kg/Ha	*9.8*	*4.8*	*12.9*	*-3.1*
80Kg/Ha	*13.1*	*5.1*	*13.9*	*-0.8*
100Kg/Ha	*16.4*	*5.6*	*15.1*	*1.3*
120kg/Ha	*19.7*	*5.5*	*14.9*	*4.8*
140Kg/Ha	*23.0*	*5.7*	*13.2*	*9.8*

Table 3: The cumulative Phosphorus (P) applied from fertiliser and the P removed in grain over the last five seasons in the Preston Phosphorus rate trial in West Cranbrook WA. The yield in (t/ha) displays the combined yields from the same period.

Fertiliser Rate	P units in Fertiliser	Yield (t/ha)	P removal	P Balance
40Kg/Ha	*31*	*18.7*	*63.6*	*-34.7*
60Kg/Ha	*46*	*19.0*	*63.8*	*-18.6*
80Kg/Ha	*61*	*20.1*	*69.4*	*-11.6*
100Kg/Ha	*76*	*20.9*	*72.1*	*0.6*
120kg/Ha	*92*	*21.0*	*73.0*	*13.9*
140Kg/Ha	*107*	*20.6*	*72.1*	*30.7*

The cumulative P from the five years of the project shows a surplus for the three heavier fertiliser rates and the 100kg/ha rate, netting a small credit but essentially breaking even. The lower rates continue to enter a P deficit.

The 2021 yields would suggest the P deficit in the 40, 60, & 80kg/ha applications are influencing grain yields, with the 40kg/ha and the 60kg/ha plots yielding significantly less than the 120 and 100kg/ha treatments.

Given there is a positive P balance resulting from the three heavier rates 100, 120, 140kg/ha in the 2021 season, the slight differences observed in the yields of these plots is unlikely to be a result of P availability. For example, there would have been enough available P in the 120kg/ha plot for it to yield the same as the 140kg/ha plot, however this did not occur, hence there is something other than P availability limiting yield in the plots with a positive P balance.

Conclusions

The results of the 2021 Preston P trial showed a continuation of the trend observed in prior seasons. We are now observing yields being limited by the absence of P on the lower treatment rates applied over the last five seasons. The P yield limitations are expected to escalate over time as the P balance moves into a further deficit. Whist the positive P balance won't increase yields, it will result in ample P being available to support higher-yielding crops. P availability will always be an issue in the typically acidic soils of Southwest WA, it's availability in the soil solution is reduced in acid soils, and the need for P based fertilisers is critical. While P does not easily leach, it's often bound in organic forms and is not readily available for plant uptake. Plants also compete with microflora for the available P, further reducing fertiliser efficiency.

This trial highlights the effect seasonal yield variability has on P requirements and the need for adequate fertiliser input or a bank of P within soils to support crop growth and increase yield potential. When coming from a low base, the P input must meet the yield demand and be adjusted with the paddock's cumulative yield demand in mind.

The monitoring of yield results and trial interpretation have been funded through the National Landcare Program (NLP) since June 2020.

Australian Government

National Landcare Program

Harvest losses

Dan Fay, Project Officer, SCF

KEY MESSAGES

- The harvest losses measured in the Albany Port Zone in 2021 were within the acceptable range of 3% for cereals and 1% for canola.
- Front losses were the most variable, with a range of contributing factors.
- Sieve and rotor losses could be rectified easily in the paddock, where front losses could not.
- Low yielding crops lost more grain as a total percentage, and machine adjustments to overcome the losses were limited.
- Environmental factors played a much more significant role in harvest losses than many growers previously thought.

Background

Stirlings to Coast Farmers were part of a Grower Group Alliance (GGA) led GRDC funded project that aimed to determine the current level of grain losses through the harvest process, including front and machine losses. This project was statewide and utillised the Bushel Plus system to ascertain the level of losses, with a focus on improving losses in field. This project was developed after a study by Planfarm found that 90 million dollars' worth of canola is lost in the harvest process each year in Western Australia.

Method

From the Great Southern area, 16 participating crops, that covered cereals, pluses and oilseeds, all of varying yields and varieties, were measured for harvest losses. The methodology for measuring losses was tailored to each machine/front set up to best capture the losses in the most representative fashion.

A wide range of variables were recorded to provide context to the results. These included; time of day, ambient conditions (temperature and humidity), time after maturity, variety, crop conditions, straw conditions, crop yield, grain moisture, crop cut height and average crop height, and whether the farmer had used drop trays before.

Front Losses

Front losses were calculated by placing trays, under the header front. The trays were placed under the divider, feeder house and offset of the feeder house, to ensure the accuracy of the measurement. The machine then drove over the trays, capturing the losses. The material from the drop trays was then cleaned, separating the grain from the residue. Where whole pods or whole heads had fallen in, the grain was threshed by hand out of the heads. Notes were taken when whole heads/pods appeared in the sample to provide a greater context to the source of the losses. The weight of the losses from each tray were then weighed separately and the total front loss was calculated using the formula below.

$$FL = \frac{D + 2C + ((W - 2.5) \times S)}{W + 0.5} \times \frac{10}{T}$$

Where:

- Divider tray at the end grain mass (D) in grams,
- Centre grain mass (C) in grams,
- Side grain mass (S) in grams,
- Front width (W) in metres and
- 1m wide tray area (T) is expressed in m^2

Machine Losses

Machine losses (sieve and rotor) were measured together, with the mode of straw and chaff management factored into the measurement. The Bushel Plus App factors in the different modes of operation, to ensure that losses are accurately calculated irrespective of the chaff/straw management system.

Machine losses were calculated using two trays, one dropped under the centre of the machine, usually off the back axle and one dropped within the residue spread zone,

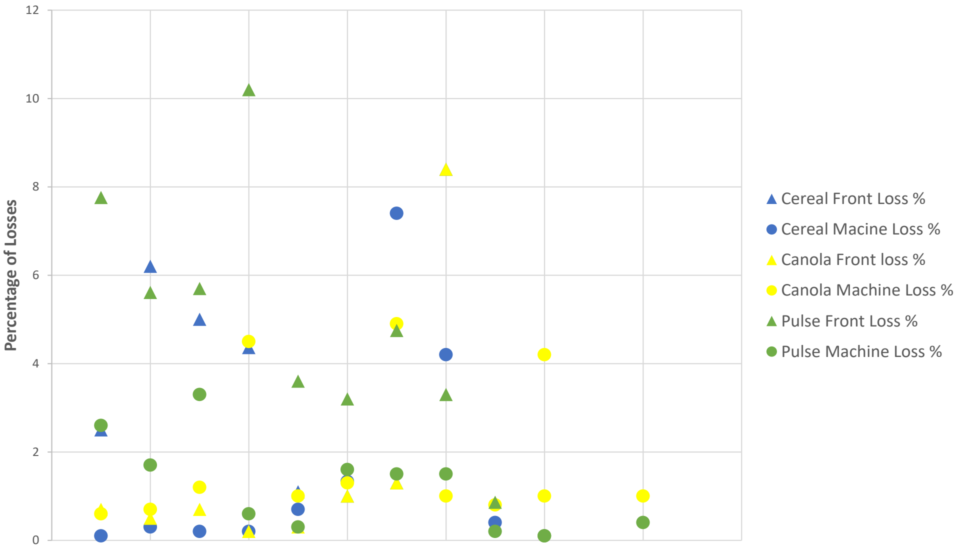


Figure 1: Combination plot: losses % x grain type x loss type, values are expressed in a %.

typically just outside the wheel. Measurements were taken from the left and the right side of the machine to account for wind/preferential spread. It should be noted that the calculations assume that the spread is even within the spread range, ie, the same amount of grain is being lost at the far edge of the residue spread as it is directly behind the machine.

Results

Pulses

- Farmers generally accepted a higher level of pulse losses.
- Environmental conditions played a role in the level of front losses.
- Front losses were often a result of whole pods being lost.
- The majority of farmers were surprised with how little they were losing.

The harvest losses in pulse crops were very low compared to acceptable levels, which DPIRD specify as a range from 5-25%. Total losses averaged 4.91%, with the vast majority of this being made up from front losses. The high yielding pulse crops within the Great Southern meant that although the weights recorded within the drop trays were often quite high the percentage of the total lost crop was still low. The majority of front losses were a result of whole pods falling into the drop trays, which were either being lost over the drapers or falling from the plant on impact with the reel. Machine losses were often immature pods that had been carried through the machine or were cracked grains, with very few whole grains making up the machine losses samples.

Farmers within the Albany Port Zone (APZ) generally viewed pulses as a lower value crop compared to cereals and canola, and as a result they were accepting of a

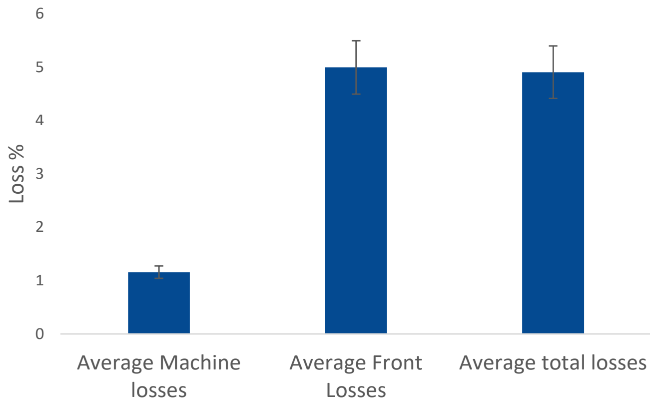


Figure 2: The average machine, front, and combined losses for pulses, values are expressed as a % of the total yield.

higher level of losses and saw a secondary value as livestock feed.

Cereal

- The average cereal losses were quite high; however, this was exacerbated by a series of really high losses from a stripper front, and some losses on low yielding crops.
- The high losses from the stripper front were the result of whole heads being plucked off.
- Farmers felt they had a strong understanding of machine set up for cereals.
- Front losses on barley appeared to be exacerbated by environmental conditions, particularly hot weather.

Farmers within the APZ felt they had the greatest understanding of their machine set up for cereals. As a result, the machine losses were well below the acceptable level of 3%. It should also be noted that machine losses were often pinched and deformed grains.

The front losses were highly variable depending on which front was in operation. Draper fronts, which are by far the most common header front used in the APZ for cereals, resulted in relatively low front losses. Farmers felt confident in the set up of the draper front, to ensure they were minimising losses and managing the standing stubble and residue correctly. It should also be noted that with draper fronts the greatest level of losses were occurring at each end of the front, whist losses were at their lowest directly under the feeder house. There were also very few whole heads being lost when using draper fronts.

A stripper front was also measured as part of this project. Use of the stripper front resulted in a large percentage of front losses. Unlike the draper fronts, there was no relationship between the zones of the front that were captured and the percentage of losses. Resulting losses largely consisted of whole heads being lopped off in the stripping process and ending up in the captured sample rather than individual grains as for the draper fronts. The stripper front also resulted in a number of intact heads being left behind where the crop height was uneven, whilst lowering the front resulted in even greater grain loss. Given the barley paddock was high yielding, the total percentage of losses was minimalised, however it is expected that this could be a greater issue if the paddock yielded less. It should be noted that the stripper front was borrowed from another member and not set up ideally for the conditions. The percentage of yield loss might be more effectively managed in the future.

Cereal harvest losses appeared to not be as influenced by yield compared to the other crop types and losses could be effectively managed in response to reduced yield. It was evident that environmental conditions played a role in the harvest losses in cereals, with hot conditions seemingly exacerbating the front losses. This view was widely held by farmers, however the time pressure at harvest resulted in crops being harvested in less than ideal conditions.

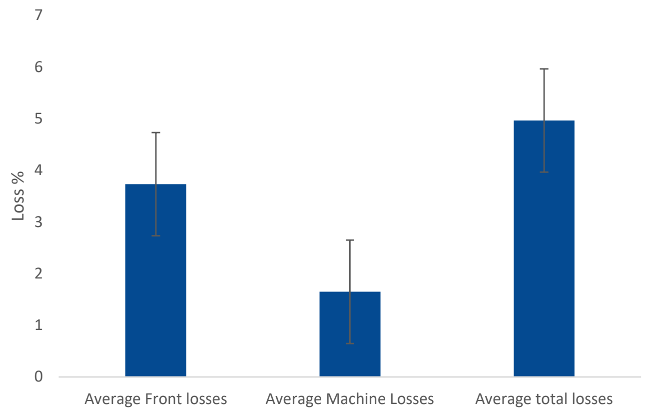


Figure 3: Average machine, front, and combined losses for cereals, values are expressed as a % of the total yield.

Canola

- Harvest losses on canola were generally quite low, especially given the variability in crop yields.
- Tin fronts had the lowest level of front losses, followed by pickup fronts, then draper fronts.
- Crops with low yields resulting from waterlogging had a larger percentage of losses.

- There is a floor in the losses with canola where a certain amount of front and machine losses are inevitable, irrespective of yield, or harvest method.
- Farmers on a whole were confident with their machine set up with canola.
- Ground speed significantly influenced canola losses.

The harvest losses measured in canola were largely within an acceptable level, with losses across all machines measuring 2.5%. The losses within canola showed a relationship between yield and total loss percentage. Samples from a low yielding crop resulted in disproportionally high machine and front losses compared to the other measurements. The wide range in variability in yields within the APZ (0.3t/ha to 4.5t/ha) highlights the issue that many farmers face when trying to minimise losses, as a single 'set up' does not necessarily work in all situations.

Most farmers tended to have a strong understanding on machine set up in canola to minimise losses, and canola was a crop type in which the majority of farmers had measured losses previously, due in part to the high value. However, the commonality in minimising machine losses was a tendency to slow down the ground speed. At one property in Woogenellup losses were reduced by 0.8% by slowing the ground speed from 4.7 to 3.9km/ha.

A floor for canola losses was observed in low yields, whereby a small amount of both machine and front losses could not be reduced any further and the resulting percentage of yield loss was quite high (5%).

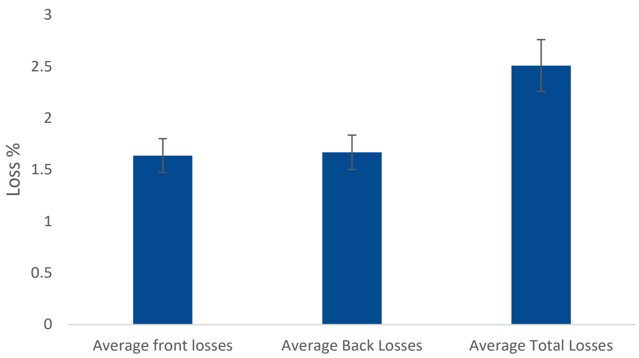
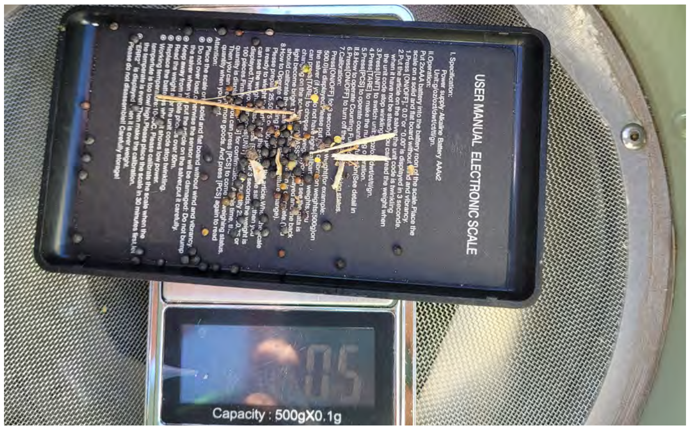


Figure 4: Average machine, front, and combined losses for canola, values are expressed as a % of the total yield.



Discussion

The academic consensus on acceptable harvest losses vary widely depending on which institution has conducted the research, and when the research was conducted. However, 3% machine losses for cereals, and 1% for canola are widely accepted, while losses on pulses ranging from 5-20% depending on crop and variety are deemed acceptable. Overall, the percentage of harvest losses from growers within the APZ fell within these acceptable levels. Farmer's motivations often dictated the level of losses they were trying to achieve, with there often being a balance between time spent adjusting machines and waiting for ideal conditions to harvest being weighed against getting the crop off. On top of this, commodities price, the scale of the harvest, and whether the farmer ran livestock also played a roll in what they deemed to be an acceptable level of losses, and what their target losses were. Most farmers had the view that the new machines were contributing to the reduced harvest losses, as the technology in the machines makes losses easier to manage.

Interestingly, there was a lot of evidence of pre-harvest – post-maturity losses, particularly in barley and legumes, where environmental factors or crop physiology had resulted in what appeared to be a significant percentage of grain being lost. This is potentially an area for future research as there is a need to ascertain the level of these losses to get a full picture of the crop potential.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Subsurface Drainage Project

Hosts: Preston Family and Allison Family

Philip Honey, Smart Farms Co-ordinator, SCF

KEY MESSAGES

- Despite a challenging season, the yield gain from implementing sub-surface drainage equated to a 1 tonne/ha yield benefit.
- Subsoil drainage is a waterlogging solution that requires substantial upfront investment from growers, with estimated fully "installed" costs around $13,500/km*.

Background:

Waterlogging is a common problem within the southwest region of Western Australia (WA), particularly in the wetter months of winter and typically occurs when rainfall exceeds the ability for soils to drain away soil moisture. Under these conditions, the excess water within the root zone creates anaerobic conditions (conditions without free oxygen) and prevents the plant from performing gaseous exchange with the atmosphere or biological activities with the oxygen in the soil, air & water (DPIRD 2019). Left unmanaged, waterlogging can lead to soil structural decline and has the potential to create nutrient deficiencies & toxicities (such as Iron & Manganese toxicity), create root death/reduced plant growth, or result in the death of the plant (DPIRD 2019).

Overall, it has been estimated that approximately 3 million hectares of land within the southwest agricultural region of WA has moderate to very-high susceptibility to waterlogging or inundation, which represented an estimated annual opportunity cost of $35m between 2009/10 to 2013/14 (DPIRD 2019).

There are methods available that farming operations can utilise to minimise and mitigate against the effects of waterlogging, including the use of either surface water management or subsurface water management methods. Surface drainage/management options available to growers include options such as raised beds, evaporation basins, & interceptor drains, while subsurface options include slotted pipe, mole drains & pumping options.

Preston Drainage Site - Methodology

In January 2021, Stirlings to Coast Farmers collected elevation data for the Preston drainage trial paddock utilising high-accuracy RTK GPS equipment. This data was collected in 12 metre swaths and processed through a mapping platform to create elevation maps, contour maps (in 5cm, 10cm, 20cm & 50cm contours), watershed, flow-direction, streamflow, and accumulation (ponding) maps. In conjunction with the 2020 harvest yield maps, this data was utilised to help plan drainage designs focused on managing accumulated ponding and intercepting water movement.

February 2021 saw the installation process begin at the Preston Family Farm with the sub-surface drainage contractors – Drainage Downunder – laying the pipework. The process involved trenching a path before burying the slotted pipe at depth, laying a limestone rubble on top of the pipe, before covering the pipe/rubble with soil. The slotted pipe installed is bare (without a sock), 100mm wide, ribbed, with incisions throughout the whole length. Installed depths varied across the demonstration sites, with buried depths ranging from 500mm below the soil surface through to depths of approximately 1200mm. Pipework was laid to ensure that there was sufficient fall for the water to drain to the waterway located at the southern edges of the drainage site (Figure 1). A control region was left adjacent to the eastern side of the drained trial plots, to be utilised as a comparison point against the drained region. This part of the paddock (control) also has a medium-high risk of susceptibility to waterlogging.

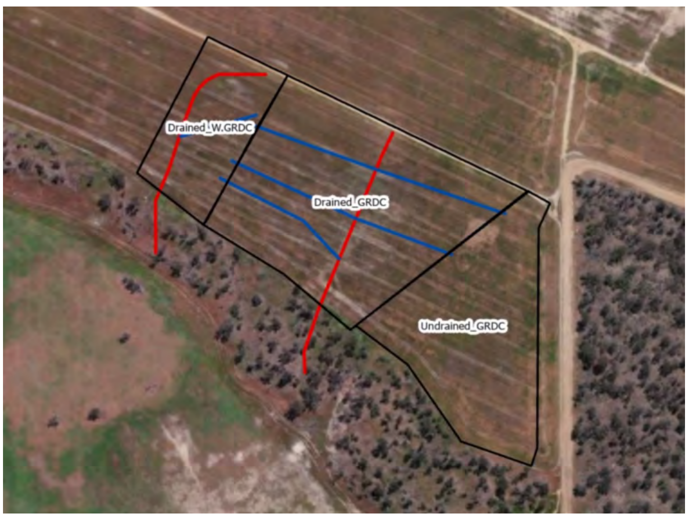


Figure 1: Preston Drainage Site trial layout, comprising buried 100mm wide slotted pipework.

The paddock was sown to Flinders barley on the 11th May 2021 at 100kg/ha into exceptional soil moisture, with some regions of the paddock inaccessible to vehicles without getting bogged. Throughout the year, we monitored differences in plant biomass (NDVI) and yield in lieu of plant and nutritional measurements.

Preston Farms Results & Discussion:

2021 was a well above average year for rainfall across the membership zone. It was also the first year for our installed pipework at the Preston GRDC and SCF Sub Surface Drainage Site, located approximately 100km North-West of Albany. With nearly 750mm of rain falling throughout the year and approximately 530mm of that amount falling within the growing season, it was well above the yearly rainfall average of 480mm. Rainfall data was collected by the on-site weather station and was plotted against the local average [Silo Rainfall] data for the previous 20 years. Overall, it ended up being a 99-percentile year at the drainage site (Figure 2).

Throughout the early growth stages the barley crop was underwater for a considerable amount of time, which led to some challenges in managing in-season weed control and plant nutrition (Figures 3 & 4). There were also noticeable differences in trafficability across the drained and undrained regions of the trial, with the drained regions remaining more trafficable for significantly longer than what was experienced in the control/undrained regions of the paddock.

Following seasonal NDVI values throughout the 2021 growing season, we found that higher NDVI values were observed along where the drainage lines were installed, as represented in the southern green regions of Figure 5. These regions, when assessed at tillering, also had up to 30% more tillers overall in the drained region in sections compared to that observed in the control region. Overall, the control region laying to the south-eastern edge of the paddock tracked lower in NDVI values throughout the whole growing season.

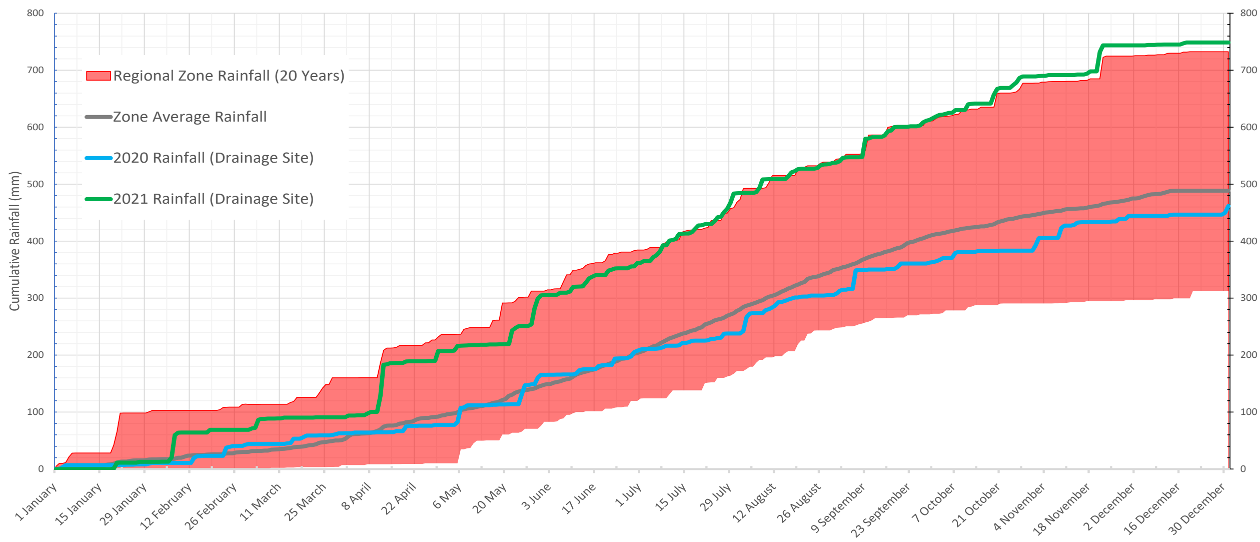


Figure 2: Site rainfall data for 2020 (blue), and 2021 (green), against regional local average range (red).

* Pricing is dependent upon a wide range of factors including rubble costs, purchasing and size of pipe utilised, size of drainage application, mobilisation costs, ground conditions & soil-types, and equipment availability. Please contact drainage contractor.

Figure 3: Waterlogging throughout the growing season, top - 1st June 2021, bottom - 7th July 2021.

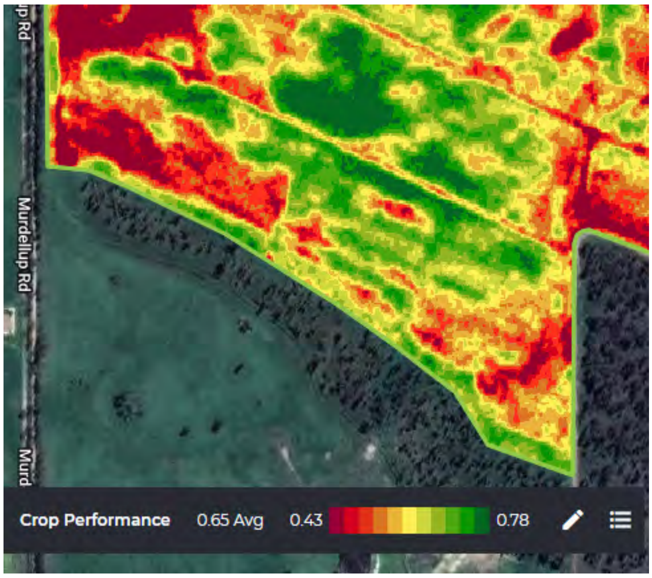


Figure 4: NDVI imagery collected on 12th August 2021 outlining higher biomass on the southern edge of the paddock, where the drainage lines have been installed.

In mid-December 2021, the paddock was harvested by the Preston family. Overall, yields were approximately 1 t/ha higher in the drained regions (3.2 – 3.29t/ha) compared to the control treatment (2.21 t/ha) in a 99-per-centile year. Two additional areas were also assessed at harvest, dubbed the "control controls". That is, where there is no drainage installed and where it is unlikely to suffer from waterlogging. These areas across medium and high-performing soil landscapes represent what the maximum potential yield might be, should an area not express the yield penalty effects from waterlogging. When we compare the drained GRDC trial regions against the medium-performing control "control", we see that there is a potential yield opportunity of an extra 410-500kg of yield per hectare, should waterlogging be effectively managed. Should the drained soil type be more reflective of a high-performing soil, then a potential yield opportunity of up to an additional 2.8t/ha is available.

2021 was an interesting first year to host the subsurface drainage trial, and it certainly left SCF staff with quite a few questions regarding nutrient management in paddocks so wet you could not physically walk on, and as to whether there was sufficient pipework installed to be reflective in the capability of managing such high rainfall

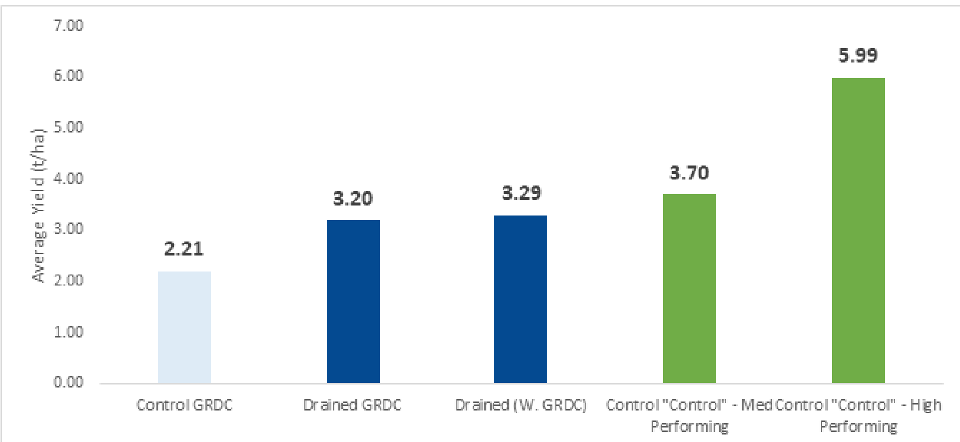


Figure 5: Final grain yields (t/ha) recorded at the Preston family sub-soil drainage site in 2021.

intensity seasons. Overall, we saw a positive yield benefit through the implementation of subsurface drainage in an outlier season. The question remains whether these yield differences between the drained and undrained will be evident in upcoming seasons across a wide range of seasonal conditions.

With installation costs in the order of approximately $13,500 per kilometre*, getting the installation locations of pipework perfected will be critical to ensure that the economic efficiency of subsurface drainage is maximised. Some back of envelope calculations for the remaining regions of the paddock currently estimate that there is the potential for a payback period of approximately 3.8 years to occur, pending similar grain pricing and yield differences as in 2021.

Amerillup Pastoral Company – Second demonstration site commencing 2022

In 2022, Stirlings to Coast Farmers successfully applied for a second demonstration site, which was installed at the Allison family farm, located in Perillup, west of Mount Barker. With mapping activities conducted in early January 2022, installation of the initial sub-surface drainage work was implemented in late January and early February. Previously sown to barley in 2021, this paddock will be sown to canola in mid-April, with field measurements conducted throughout 2022 and 2023. Stay tuned to follow the progress of the Perillup drainage site and its learnings over the next two growing seasons.

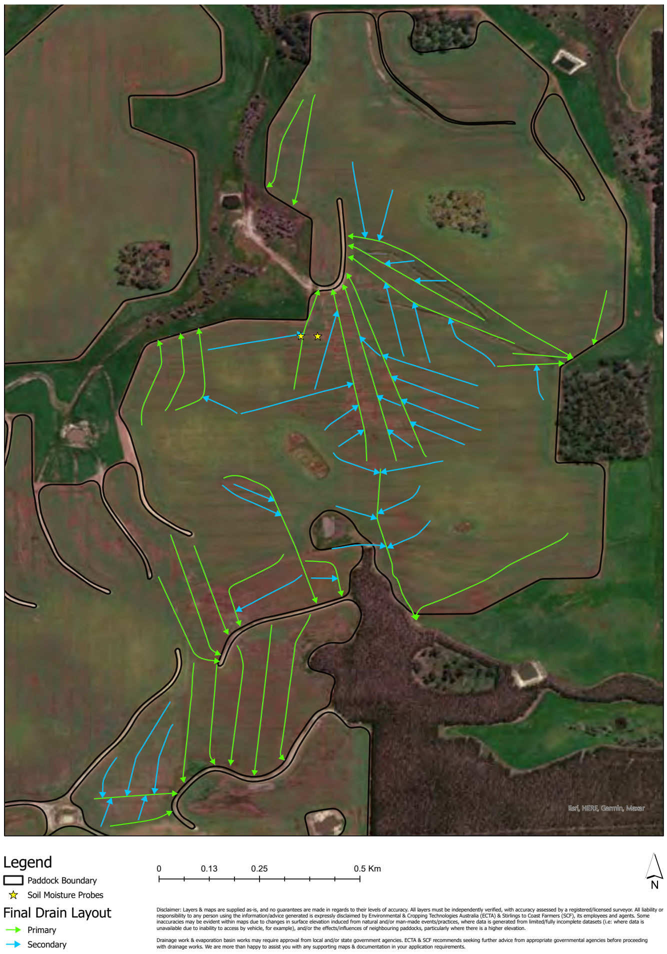


Figure 6: Subsurface drainage installation layout for the Allison family drainage trials.

Reference: DPIRD. 2019. "Waterlogging: The Science." Department of Primary Industries & Regional Development,. Last Modified 29 May 2019. Accessed 10 January 2020. https://www.agric.wa.gov.au/waterlogging/waterlogging-western-australia.

The SCF Sub-Surface Drainage project has been supported by a combination of individual farm contributions (Preston Family Farms & Amerillup Pastoral Co) and the GRDC.

Water Use/Rainfall Variability Project

Philip Honey, Smart Farms Co-ordinator, SCF

KEY MESSAGES

- Twenty four digital rain gauges have been installed across the SCF membership zone to record rainfall events throughout the growing season.
- Access to the digital rain-gauge network is available to all SCF members.
- Rainfall variability is often for greater than shown in the current DPIRD rainfall summary maps. An increased deployment and density of rain-gauges and weather-stations will build greater accuracy in rainfall maps and lead to greater opportunities for more accurate weather forecasting.

Project Aims, Background & Methodology

The Stirlings to Coast Farmers (SCF) Rainfall Variability/Water Use Efficiency trial is a 12-month project that involves the implementation of digital technologies (automatic digital rain gauges) that help raise growers' awareness of weather variability and methods to improve overall on-farm water use efficiency. Ultimately, we want to lead our grower members onto a successful digital technology adoption path that helps improve their overall farm productivity & profitability.

Sponsored by AgriFutures, this two-part program will involve a workshop-based training component (held on June 14 2022) and a broad-scale member trial which utilises low-cost digital rain-gauge devices scattered across 24 farming locations throughout the Great Southern. This rainfall data will be collated to produce rainfall variability maps each fortnight across the whole membership zone, with a final rainfall value map and yield-potential map produced at the end of each season. Members will be able to analyse their management processes and identify potential shortcomings where their actual yield is lower than their potential yields.

Seasonal Rainfall Variability – Why more is better?

To better understand rainfall variability and change across the landscape you will need to increase the number of measurement locations. Sadly, depending on what weather source you may use, some rainfall variability maps could potentially be generated by as little as four automatic weather stations in the region (Albany Airport, North Walpole, Rocky Gully or Jacup), through to 16+ stations in the region when you consider the addition of DPIRD's weather stations throughout the zone.

Whilst 16 stations might sound like a representative number for the SCF membership zone, there are instances in the zone where there could be up to 50km between weather stations. This brings with it two potential challenges:

- an unknown amount of potential rainfall variation between the stations, and
- no known certainty of whether a current weather-station's placement is representative of the area it covers.

For the period of 15-30th November 2021, SCF recorded the total rainfall amounts throughout the recently installed weather-station network, which featured a storm event recorded during harvest. As seen in Figure 1, there were high levels of variation between stations along the Chillinup road with some gauges nearly recording double their neighbouring rainfall records, even with stations only 4kms apart.

Where to from here?

Additional weather monitoring points help add an extra level of information to the current deployment of DPIRD/BoM stations, and could be utilised to help improve the accuracy of measuring rainfall events. From the data collected, there is potential end-use cases for adding this data to further improve forecasting accuracy, combining the data with soil maps to nowcast plant-available soil water, through to creating yield potential maps for a range of crop types throughout the membership zone.

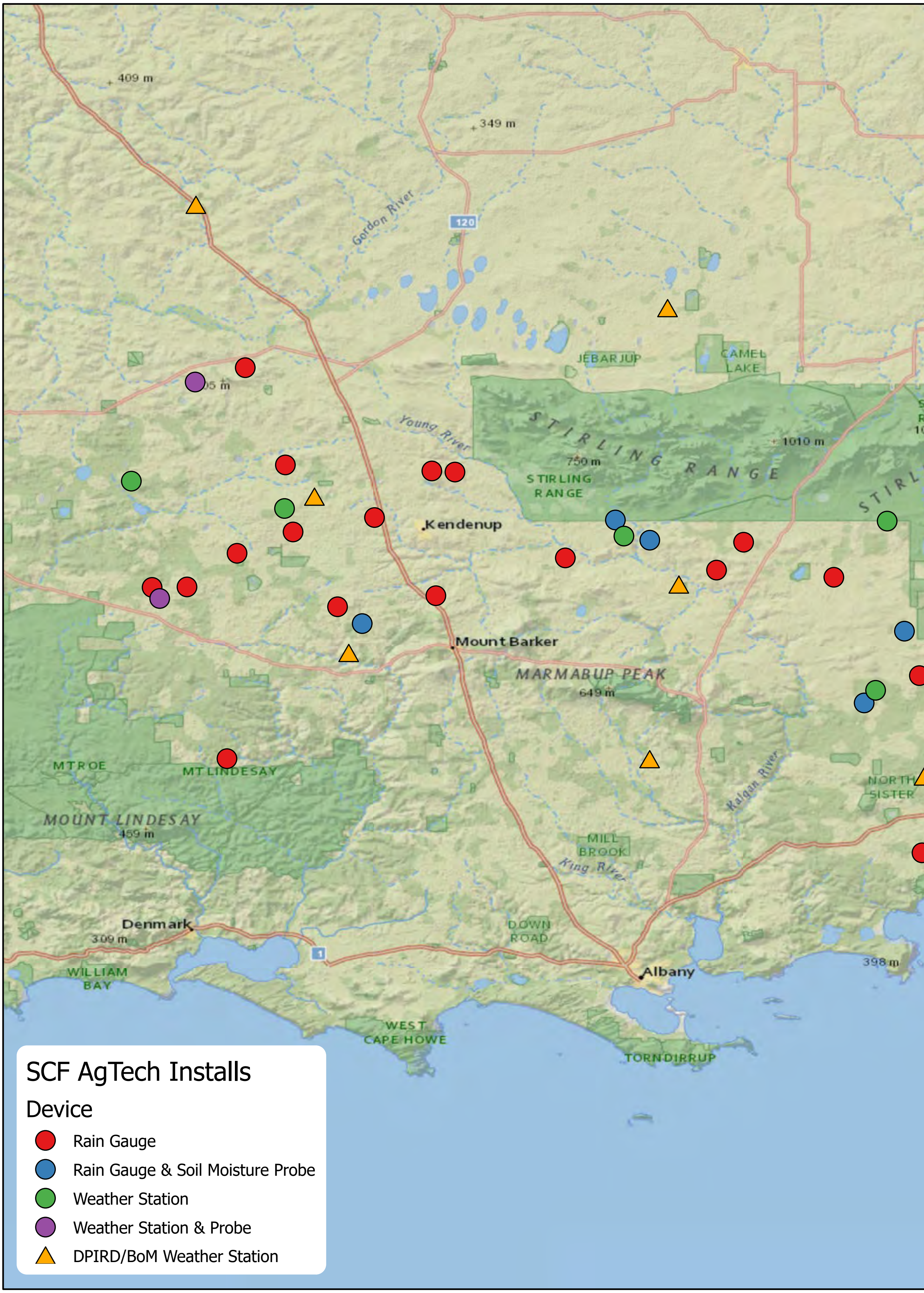
While there are still quite a few 'black-spots' to infill, SCF is committed to helping our members make the most from their data and welcomes discussions about collaborating to improve the accuracy & spatial resolution/density of weather monitoring throughout the membership zone. Installing weather monitoring equipment on your farm effectively means that members can achieve the highest levels of accuracy for rainfall mapping, water-use mapping or even potential-yield maps, helping lead to better production and quality outcomes for our members, relevant to their specific location.

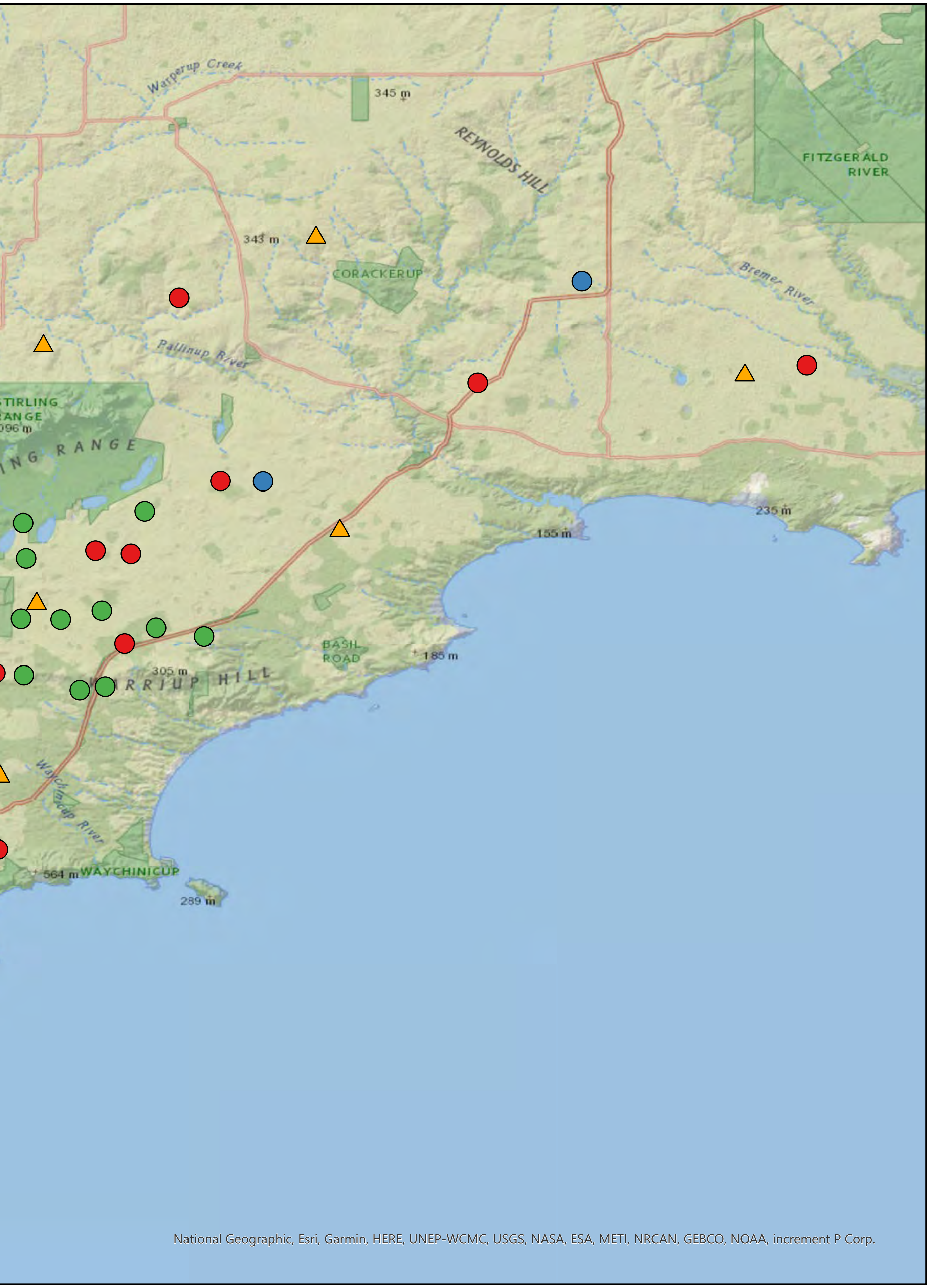
Figure 1: The raw rainfall data points collected through the combination of installed weather-stations and rain-gauges, distributed throughout the SCF membership zone for the period of 15-30th November 2021.

AgriFutures Australia

SCF 2021 AgTech Map

A list of project funded and privately funded public infrastructure installed by SCF.





Warperup Creek
345 m
REYNOLDS HILL
FITZGERALD RIVER
343 m
CORACKERUP
Bremer River
Pallinup River
STIRLING RANGE
RANGE
155 m
235 m
BASIL ROAD
185 m
305 m
HILL
Waychinicup River
564 m
WAYCHINICUP
289 m
National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Soilborne Pathogen Identification and Management Strategies for Winter Cereals Project

Alison Lacey, Project Manager, GGA; Daniel Huberli, Sarah Collins & Dominie Wright, DPIRD

KEY MESSAGES

- Due to the low levels of pathogens and nematodes at the start of the season, and the site location and weather conditions during the trial, it is difficult to make any definite conclusions from the trial results.
- The impact of treatments on yield is not likely to be seen until a cereal crop is over-sown into these treatments in 2022.

Aim

This project aims to provide growers with knowledge and experience in diagnosing soilborne pathogens from symptom expression on plant roots. It will also provide them with knowledge of management of these pathogens and demonstrate some management options in field situations and deliver extension activities nationally.

Background

Despite the significance of the issue, diagnosing soilborne pathogens can be difficult. Currently, the presence or absence of soilborne pathogens can be ascertained through diagnostic services (e.g. PREDICTA® B, and DDLS), through the observation of root symptoms, and to a lesser extent, above-ground crop symptoms. Unfortunately, it has become apparent that growers frequently rely on above-ground crop symptoms to diagnose crop issues.

Above-ground symptoms for soilborne disease diagnosis can be problematic and incorrect for several reasons. Firstly, several of the observable crop symptoms can be similar between different pathogens and plant parasitic nematodes and even other crop issues such as nutrient deficiency. Secondly, some in-crop symptoms of soilborne diseases can be affected by seasonal conditions. For example, last year's higher rainfall reduced the visual symptoms (patches) in the field. Another example, Rhizoctonia solani crown root infection can be more prevalent with early sowing but is more difficult for growers to diagnose as there is no typical bare-patch and variation between a crown root infected crop and a healthy crop is not as easily discernible.

Thirdly, some pathogens co-exist and impact cereals in a complex interaction that may increase the complexity of visual identification above and below crop. Reliance on a single method of identification increases the likelihood of incorrect management strategies being implemented, and a holistic approach to identification with all available tools is ideal.

Soilborne disease management differs according to which soilborne disease and/or nematode pests are present, it is reliant on correct identification of the causal pathogen. Growers and advisors need to have the knowledge and experience to be able to achieve this. The purpose of this investment is to extend to growers and advisors the different methods for correctly identifying soilborne pathogens.

This report summarises the 2021 demonstration trial at Woogenellup.

Table 1: Field Trial Details and Treatments

Trial Location **Plot size & replication**	Hunt Property, Mt Barker 14.5m x100m x 1 replication
Paddock rotation	2018: Canola (GT 53), 2019: Wheat (Scepter), 2020: Canola (45y28)
Sowing date	12/6/2021
Sowing rate	100 kg/ha Rock Star Wheat; 90 kg/ha Flinders Barley; 30 kg/ha Vetch
Fertiliser	Seeding 100 kg/ha K-Till Extra Treatment 4 & 5 – 300 mL/ha Uniform
Herbicides, Insecticides & Fungicides	Pre-seeding: 2 L/ha Glyphosate; 1.5 L/ha Paraquat No other chemical treatments
Growing Season Rainfall – Stirling South	600.4 mm (Apr -Oct.) Annual Rainfall 2021 – 743.8 mm Ave. Annual Rainfall – 469 mm

Table 2: Treatments

	Crop	Treatment
1		Fallow - (poorly germinated wheat) due to a seeding issue
2	Barley (Flinders)	Control - untreated
3	Vetch	Break Crop – Vetch
4	Barley (Flinders)	Uniform Treatment
5	Wheat (Rockstar)	Uniform Treatment

Results and Discussion

Start of season (Tables 1, 2 & 5)

At the start of the 2021 season, PREDICTA® B results for the trial area had low risk of rhizoctonia (1.24 log(pg DNA/g soil)) and crown rot (0.97 log(pg DNA/g soil)). No root lesion nematodes were detected at the site in 2021. Flinders barley and Rockstar wheat were sown for the trial, and Uniform® fungicide was coated on granular fertiliser in-furrow for 2021. Due to the PREDICTA® B results from 2020, treatments focused on rhizoctonia management.

Barley establishment counts were slightly higher in the untreated control compared to the Uniform® treated plot (181 versus 174 plants/m2). Wheat establishment counts for the Uniform treated plot were much higher than for the poor wheat germination plot (175 versus 71 plants/m2).

In season plant root assessment (at GS30) for soilborne disease pathogens

Results from live plant sampling collected on 17 August 2021 found no evidence of rhizoctonia in any of the four plots (Table 3). As the baseline PREDICTA® B found a low risk for rhizoctonia it is entirely plausible that few plants would be found that were infected. Fusarium was detected in the two barley plots only. Pythium was detected in all plots except in the barley Uniform® treated plot. Root lesion nematodes were detected in all plots, but the numbers are considered not to cause significant damage on crops. The cause of poor growth is considered to be due to pythium root rot and Fusarium.

End of season

The PREDICTA® B results showed that pathogens and nematodes present at the site did not increase significantly when the start of season results were compared to the end of season (Table 4). The two barley plots both had one PREDICTA® B result for P. neglectus that was in the medium range, indicating there was an area in these two plots that had a hot spot of nematodes (Table 4). Pythium (clade F) was detected in all samples at the end of the season (1-9 pg DNA/g sample). The season, including high rainfall, may have contributed to a lack of infection or establishment of some of the diseases and nematodes. Higher soil moisture is favoured by Pythium. No conclusions can be drawn for the Vetch treatment as no start of season soil sample was collected from this plot.

There was no difference in yield for any of the cereal plots, apart for the plot with poor wheat germination (treatment 1) which yielded less than half the remaining plots of wheat and barley (Table 4). The treated barley plot had a very slight increase in yield compared to the untreated.

Table 3: Live plant assessment of disease for 2021 Stirlings to Coast farmers trial in Mount Barker
[1] No plants sent

Treatments	Live plant results			
	Rhizoctonia solani	Fusarium spp.	Pythium spp.	Pratylenchus spp. number per g of root
Fallow - (poorly germinated wheat)	Not detected	Not detected	Detected	703
Barely - Control, untreated	Not detected	Detected	Detected	678
Break Crop - Vetch	-[1]	-	-	-
Barley, Flinders - Uniform® coated fertiliser in-furrow	Not detected	Detected	Not detected	149
Wheat, Rockstar - Uniform® coated fertiliser in-furrow	Not detected	Not detected	Detected	935

Table 4: Grain yield of wheat treatments in Mount Barker

Treatments	Yield t/ha
1. Fallow - (poorly germinated wheat)	2.0
2. Barley Control, untreated	5.1
3. Break Crop - Vetch	1.4
4. Barley, Flinders - Uniform® coated fertiliser in-furrow	5.2
5. Wheat, Rockstar - Uniform® coated fertiliser in-furrow	5.0

Table 5: Baseline PREDICTA® B testing at the start of the trial sown in June 2021 and at the end of season (December 2021). PREDICTA® B risk categories indicate the potential for developing disease in the following season (in parenthesis for each result).

Treatments	*Crop planted*	*Pathogens detected from initial PREDICTA® B tests (pg DNA/g sample)*			*Pathogens detected from final PREDICTA® B tests (pg DNA/g sample)* [1]		
		Rhizoctonia solani	*Fusarium sp (crown rot)*	*Pratylenchus neglectus*	*Rhizoctonia solani*	*Fusarium sp (crown rot)*	*Pratylenchus neglectus*
	Fallow	*29 (Low)*	*7 (Low)*	*1 (Low)*	*0; 0 (BDL[2])*	*4; 1-8 (Low)*	*1;1 (Low)*
Control, untreated	*Barley*	*22 (Low)*	*18 (Low)*	*2 (Low)*	*0; 0 (BDL)*	*2, 0-4 (Low)*	*5; 2-9 (Low-Medium)*
Break crop	*Vetch*	*-[3]*	*-*	*-*	*0; 0 (BDL)*	*1, 0-2 (Low)*	*3; 2-3 (Low)*
Uniform® coated fertiliser in-furrow	*Barley*	*54 (Medium)*	*5 (Low)*	*2 (Low)*	*2; 0-3 (BDL)*	*19; 0-56 (Low)*	*5; 0-14 (Low-Medium)*
Uniform® coated fertiliser in-furrow	*Wheat*	*0 (BDL[2])*	*17 (Low)*	*1 (Low)*	*13; 1-33 (Low)*	*7; 0-19 (Low)*	*2; 1-3 (Low)*

[1] Three samples were taken at end of season except for Control wheat plot where only two results were received; the average and the range are presented
[2] Below detection limit
[3] No soil samples sent start of season for Vetch plot

Note from Stirlings to Coast Farmers: The poor wheat germination in plot one was due to problems encountered with the trial seeder. We were having troubles blocking the hoses, which took some time to rectify. The low yield in plot one is not related to disease levels in the trial.

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

Summer cropping after waterlogging

Dan Fay, Project Officer, SCF

KEY MESSAGES

- A small plot trial was established to assess the viability of late spring sown grain crops and compare to summer crops to determine the best economic outcome after severe winter waterlogging.
- The summer crops had excellent establishment across all locations and were successfully grazed three times throughout the summer period.
- Adequate biomass was produced at each site despite the relatively dry summer.
- Late summer rains allowed for continued biomass production after a dormancy period and subsequent grazes before termination of the multi-species trials.
- All sites were deemed to be profitable by the grower hosts.

Introduction

This GRDC invested trial is looking at the viability and profitability of summer cropping in response to waterlogged seasonal conditions. The trial was set up in response to the severe waterlogging experienced in 2021. The wet conditions caused widespread yield penalties in winter crops, degraded grain quality, poor germination, seed burst and often the inability to traffic paddocks to either seed or re-seed failed crops. Most areas within the Great Southern region of WA were adversely affected by severe water logging in 2021. Silo data shows that most of the region received a decile 8-10 rainfall year, with the key seeding months of April-June receiving well above the 51-year average rainfall. All of the growing season rainfall came after above average rainfall for the summer of 2019-2020. In 2021 we saw widespread early season crop loss or the inability to seed crops due to trafficability problems.

In the Great Southern region summer crops have predominantly been grown opportunistically when there is ample soil moisture post-harvest with the express purpose of filling the summer and autumn feed gap. Recently, some growers have started using summer crops to dry out waterlogged paddocks over the summer fallow period to prevent early season waterlogging in the following winter crop. This trial will examine if there is an opportunity to utilise summer crops to both mitigate losses from waterlogging, and whether there is a scope for a widespread integration of summer cropping into farming systems within the Albany Port Zone.

Results and discussion

Multi-species trial

The multispecies trial was sown into a saturated soil profile, on the 26th of October. Three large scale plots of 10ha, summer cropping varieties (sorghum, millet, and millet/lab lab mix) and a bare fallow (3ha) were established to assess the performance, viability, and legacy impacts of each summer crop. Soil tests and soil cores were taken from each plot prior to seeding, to examine how each summer crop effects soil water availability and soil nutrients for the following winter crop.

Grazing

The multi-species site was grazed a total of three times throughout the 2021/2 summer period.

The host of the summer cropping multi-species trial bases his economic decision-making process around one full graze being needed to make the crop financially viable. At the time of the first grazing the sorghum had produced 3.81t/ha of dry matter, the millet had produced 2.41 t/ha and the millet/lab lab mix had produced 2.59 t/ha.

Each treatment plot had a feed test analysis conducted on it to determine the nutritional benefits of each crop type. The millet and the millet/lab lab mix provided ewes with the highest metabolised energy per kg/DM. This coupled with the higher digestibility led to preferential grazing of the millet and lab lab, while the sorghum was left until last. As a result of this the millet and mixed species plots were over grazed during the first grazing event and struggled to regenerate biomass for the remainder of the trial period. Given the dry summer conditions, the species remained dormant for a long time before the late summer rains restarted the growth cycle, and the plots were able to be grazed two more times. Anecdotally each fodder treatment was successful in achieving the economic breakeven based on the grower hosts experience. However, the sorghum proved to be much more resilient producing a greater level of biomass at the time of termination.

Table 1: Nutritive value of each of the summer crops grown at Green Range in 2021/22.

NV Analysis	Millet	Millet/Lab Lab	Sorghum
Dry Matter (DM)	39.8%	19%	28.5%
Moisture	60.2%	81%	71.2%
Crude Protein	5.7% of DM	6.7% of DM	8.4% of DM
Acid Detergent Fiber	36.6 % of DM	40.2% of DM	36.1 % of DM
Neutral Detergent Fiber	68.7 % of DM	67% of DM	64.3% of DM
Digestibility (DMD)	65.7 % of DM	64.9 % of DM	59.1% of DM
Digestibility (DOMD)	62.5 % of DM	61.8% of DM	56.9% of DM
Est. Metabolisable Energy	9.7 MJ/kg DM	9.6 MJ/kg DM	8.5 MJ/kg DM
Fat	2.5 % of DM	2.5% of DM	2.6% of DM
Ash	6 % of DM	10.6% of DM	7.7% of DM

Table 2: Biomass (t/ha) produced from the three treatments in the multi-species summer cropping farm-scale demonstration at Green Range in 2021/22.

Treatment	*Biomass at First Graze (t/ha)*	*Terminal Biomass (t/ha)*
Millet	*2.41*	*0.71*
Millet/Lab Lab	*2.59*	*0.56*
Sorghum	*3.81*	*2.48*

The lab lab was very slow germinating and produced very little biomass until the end of the fallow period. This was likely due to the higher soil temperature requirements and the preference for warm and humid conditions to optimise growth. As a result, the roots failed to nodulate well enough to fix nitrogen, so it is likely that all three summer crops will result in a N deficit at the time of seeding the winter crop.

Figure 1: Millet/lab lab mix (left) sorgum (right) at the time of termination.

All the summer cropping treatments were effective in reducing the weed burden when compared to the bare fallow. Each treatment produced enough early biomass to out compete summer weeds in the early growth stages and the maintained biomass coupled with the grazing pressure supressed the weed burden throughout the fallow period.

Soil Moisture

At the end of the fallow period (29/04/2022) each of the summer cropping treatment preserved more water then the bare fallow treatment (figure 2). This can be seen as a somewhat paradoxical result, whereby growing a crop can preserve more water than chemically controlling weeds in a bare fallow. However studies conducted in nothern Australia have found that cover crops routinely result in more plant availble water than a bare fallow when the right variety of cover crop has been selected. As a rule of thumb, brassicas will use the most soil water, followed by legumes then grass crops.

A bare fallow's water retention is dictated by environmental factors and weed control. Typically, early termination of grass variety cover crops results in the greatest soil water conservation, as they provide ground cover, which prevents evaporation before developing a full canopy that will consume a large amount of soil moisture. This effect

Table 3: The volumetric water content percentage differential (the percentage of water, equalised to the volume of soil) for each summer cropping treatment at depths of 0-10cm, and 10-30cm, compared to the bare fallow at termination.

Treatment	*Depth*	*VSM% differential*
Millet	*0-10cm*	*+11.91*
Millet	*10-30cm*	*+1.69*
Mil/Lab	*0-10cm*	*+3.02*
Mil/Lab	*10-30cm*	*+1.77*
Fallow	*0-10cm*	*-*
Fallow	*10-30cm*	*-*
Sorghum	*0-10cm*	*+8.19*
Sorghum	*10-30cm*	*+8.80*

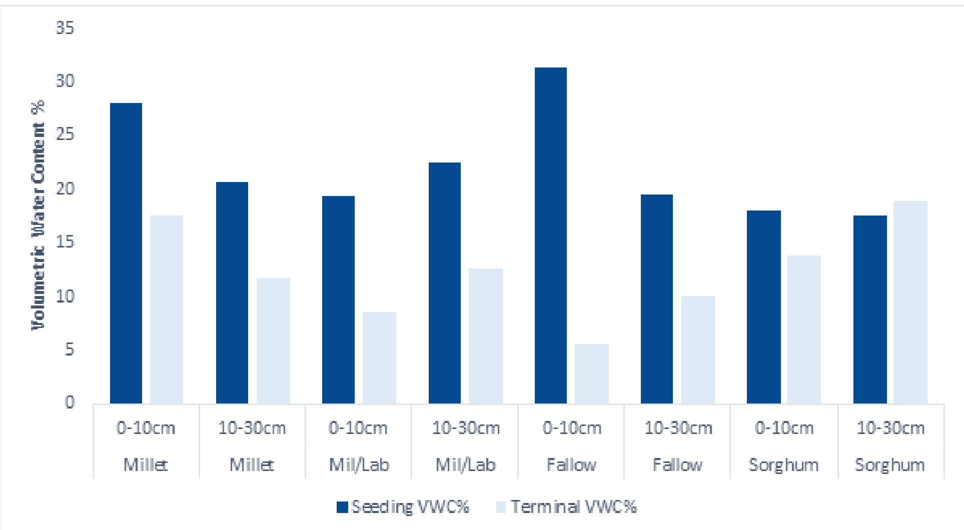

Figure 2: Soil volumetric water percentage for each treatment plot at the start and the end of the sumemr cropping phase.

has likely been amplified in this trial, where the grazing essentially resets the plant's traspiration requirements by removing the large leaf area, while a level of soil cover remains in place, in comparison to the bare fallow, which remains exposed to evaporation and the tranpiration requirments of any less palatable weeds. Additionally, summer cropping can improve water infiltration by increasing soil porosity and aggregation essentially increasing the field capacity of the soil compared to the bare fallow.

In this trial we found that the soil moisture in all three of the summer cropping treatments had a higher gravametric water content at the surface (0-10cm) and the sub surface (10-30cm) than the fallow treatment when factoring in the spatial variability observed in the baseline soil moisture testing at the time of seeding the summer crop (Table 3 and Figure 2).

It should be noted that the host farmer was aiming to utilise the summer crops to alleviate waterlogging pressure and dry out the soil profile leading into the 2022 winter cropping period. Given the high water use efficiency of the grass crops particularly in the early growth stages, the summer cropping plots failed to reduce the soil moisture content compared to the fallow. A brassica or legume species of summer crop would be more effective in reducing soil water content as a preventative strategy for waterlogging. However, these varieties likely would have suffered during the prolonged dry period throughout the summer.

Single Species Demonstration site

The single species demonstration was set up to examine the viability of winter type canola to fill the summer feed gap and be carried to full maturity the following season. The single species trial site was seeded with Hyola 970CL on the 29/10/2021, with the idea of grazing the crop throughout the summer and into the following autumn/ winter, before removing the livestock before the crop's vernalisation trigger period (usually late July early August).

Table 4: Nutritive value the Hyola 970CL summer crops grown at South Stirlings in 2021/22.

NV Analysis	Winter Canola
Dry Matter (DM)	10.4%
Moisture	89.6%
Crude Protein	26.4% of DM
Acid Detergent Fiber	21.2% of DM
Neutral Detergent Fiber	28.5% of DM
Digestibility (DMD)	81.2% of DM
Digestibility (DOMD)	75.5% of DM
Est. Metabolisable Energy	12.3MJ/kg DM
Fat	4.4% of DM
Ash	10.5% of DM

The crop was sown into a saturated soil profile resulting from the wet winter/spring and established an average of 61.4 plants per m2, this figure is on the high end of the recommended target density of 40-60 plants per m2, however plants will be lost through the grazing period, so this should not adversely affect grain producing.

Figure 3: Grazed canola has"crisped off" during the dormant summer phase at South Stirlings (8 March 2022).

Figure 4: Canola during the regrowth phase after early the autumn break at South Stirlings (13 April 2022).

A feed test was conducted on the Winter Canola (970 CL) prior to grazing, to assess the digestibility and nutritional value.

The crop so far has been grazed twice, the initial grazing period lasted from the 27th of November until the 5th of January. Ewes were rotated on the crop, and were able to maintain their condition throughout this period, with the nutrition value of the canola easily meeting their nutritional requirements.

The crop then went into a prolonged dormant period from the 16th of Jan until the 10th of April. The grazing of the canola reduced its soil water requirements, by reducing the leaf surface area, this coupled with the plant's deep roots, allowed the crop to survive the prolonged summer period without rain and subsequently recover.

The winter canola's ability to recover from prolonged dry periods makes these varieties a particularly good option to mitigate waterlogging. The crop can be seeded into paddocks where the primary crop has failed, and grower can be confident that it can survive into the following season if managed well given it's tolerance for tough summer conditions.

The single species demonstration will be continually monitored over the 2022 season, after which the complete grazing and yield data will be analysed to establish the combined economics and profitability of the winter-canola.

Small plot trial

The small plot trial managed by Nutrien carried eight of the 11 varieties sown through to grain fill. The plots were seeded on the 15/10/2022. The cereals produced the best results, with the wheat yielding 2.14t/ha and the barley yielding 2.32t/ha. The ryecorn yielded 1.56t/ha, which represents a typical to good yield, when grown under ideal conditions. Ryecorn, when grown in Victoria, typically yields from 0.4 to 1.8t/ha. This result proves the viability of cereal rye to be produced as a summer crop in southern WA when soil moisture is available or as an alternative when crops have failed due to winter waterlogging. Given the high water use efficiency, heat tolerance and quick maturity, cereal rye sown into a saturated soil profile has a high yield potential, irrespective of the environmental conditions following sowing.

The wheat and barley yielded quite well given the lack of late spring and early summer rainfall. This highlights the ability for short-season spring varieties to produce adequate biomass in rapid time and become an economically viable grain crop. However, the mild summer conditions undoubtedly contributed to these yields, as it was unlikely the plants suffered severe heat stress during the critical post flowering, pre-grain set period.

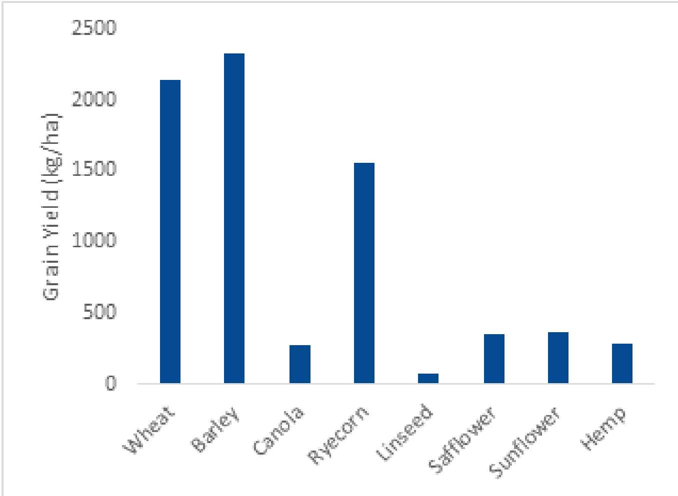

Figure 5: Grain yields (t/ha) from the Nutrien Small plot trial located at Green Range in 2021/22.

The canola, safflower, hemp, linseed, and sunflower failed to produce yields above 0.5t/ha. However, given the commodity price for some of these niche crop types and the low 2021/22 summer rainfall, it is likely that some of these crops could be economically viable. For example, hemp seed is currently worth $3000 t on farm, making a low-yielding crop economically viable in the Great Southern region.

Figure 6: Nutrien small plot trial at Green Range

The lucerne, millet, cowpea and lab lab failed to reach maturation; this was partly driven by the soil temperature requirements (+16 degrees) that drive germination being too high for the south coast. These crops could be a viable alternative off the costal fringe, especially given the lab lab and cowpea tolerance to heat stress and suitability to sandy soils.

General Discussion

This trial has demonstrated the viability for summer crops to be incorporated into profitable farming systems within the Albany region, and to be utilised to mitigate losses from waterlogging. The fact that viable summer crops were produced with the available soil moisture, without any additional rainfall or irrigation in the early growth stages should provide farmers with a greater degree of confidence when planting summer crops into a saturated soil profile. However, the impact of the summer cropping treatments on the 2022 winter crop and the overall summer-winter crop combined economics will provide a clearer perspective on how viable summer cropping is in Albany Zone.

MLA PDS Alternate forage crops for Southern WA

Hosts: Pyle Family, Smith Family and Metcalfe Family

Samantha Cullen, Membership Officer, SCF

Introduction

In 2020 Stirlings to Coast Farmers (SCF) began a project with Meat & Livestock Australia (MLA) looking at alternative forage crops for southern WA. The project is entering its final year in 2022. The aim of the project is to measure the benefit alternate summer forages, such as Pallaton Raphno, sorghum, millet, and long-season (winter) canola, can contribute to livestock carrying capacity and livestock weight gains. The alternate forage crops will be compared to traditional summer feed sources such as dry pastures and crop stubbles.

As summer rainfall events happen more frequently on the south coast there is an opportunity for producers in the high rainfall zone (HRZ) to take advantage of these events by growing summer forage crops. To improve grower decision making SCF set out to explore what species are appropriate in our area and what benefits they can bring to the farming system. The project looked at Pallaton Raphno, millet and sorghum in the 2021 season, and the learnings are presented below.

Second year trial sites included:

- Pyle-
  South Stirlings, cross bred lambs grazing Pallaton Raphno vs canola stubble
- Smith-
  Green Range, cross bred lambs grazing millet vs barley stubble
- Metcalfe-
  Manypeaks, yearling cattle grazing Bunker sorghum vs ryegrass pasture

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 HRZ systems.

PYLE SITE: PALLATON RAPHNO VS CANOLA STUBBLE

KEY MESSAGES:

- Pallaton Raphno had a higher nutritional value (NV) than the canola stubble control. This included a higher crude protein, digestibility and metabolisable energy.
- Excellent weight gain was achieved by lambs on the Raphno with 286g/head/day compared to 145g/head/day on the canola stubble.
- The Raphno at 4.05t/ha produced over 160% more biomass than the canola stubble pasture of 2.54t/ha.
- Lamb live weight gain was 7.66kg/ha/day for the Raphno, which was more than double the canola stubble at 3.57 kg/ha/day.

LOCATION- South Stirlings

SOIL TYPE- Sand

CONTROL- Canola stubble with a clover germinating underneath, 30ha, 670 lambs, 22.3 lambs/ha

VARIABLE- Pallaton Raphno, 59ha, 1580 lambs, 26.8 lambs/ha

Background

The demonstration compared two paddocks; a Pallaton Raphno stand and a regrowth canola stubble that contained germinated clover. After first trying Raphno in 2020, Pyle brothers, Tim and David, decided to plant another 60ha in 2021. A feature of this crop is its ability to thrive under grazing pressure. It can be grazed multiple times over summer and throughout the year depending on rainfall, grazing pressure, and pest management.

Method

In preparation for seeding, a knockdown spray was used and the paddock fertilised two weeks prior to seeding. The Raphno was planted on 20th September 2021 and a month later received a diamond back moth spray and 50L/ha of Flexi-N. Biomass cuts, soil samples and plant samples for nutritive value (NV) analysis were taken on 25th November, the same day lambs were weighed and introduced. At the conclusion of grazing, the canola stubble had been exhausted and the 670 sheep from the control mob were then added to the 1580 Raphno mob on the 17th December.

Four quadrant cuts were collected from the Raphno and canola stubble pasture to determine biomass prior to grazing. Nutritive values were analysed by Feedtest, Werribee, VIC. A proportion of the lambs were weighed from each group grazing the Raphno and canola stubble. The same numbers were weighed coming off the paddocks 22 days later.

Results and Discussion

Table 1. Pyle dry matter cuts before grazing

Forage	g of 0.1m² quad	t/Ha
Canola Stubble	25.4	2.54
Raphno	40.48	4.05

Table 2. Pyle Nutritional Value (NV) analysis of forages taken on November 25, 2021.

NV Analysis	Canola Stubble	Pallaton Raphno
Dry Matter (DM)	26.8 %	16.1 %
Moisture	73.2 %	83.9 %
Crude Protein	11.4 % of DM	16.6 % of DM
Acid Detergent Fiber	36.6 % of DM	20.4 % of DM
Neutral Detergent Fiber	54.0 % of DM	31.5 % of DM
Digestibility (DMD)	54.8 % of DM	82 % of DM
Digestibility (DOMD)	53.2 % of DM	76.3 % of DM
Est. Metabolisable Energy	7.8 MJ/kg DM	12.5 MJ/kg DM
Fat	3.6 % of DM	4.0 % of DM
Ash	8.3 % of DM	8.1 % of DM

Figure 1: Left, Pyle's 30ha Canola stubble control on the 25th Nov 2021. Right, the same crop 17th December 2021, when the control mob were removed.

Figure 2: Left, Pyle's 59ha Pallaton Raphno crop on the 25th Nov 2021. Right, the same crop 17th December 2021, when the control mob were added to this paddock.

Table 3: Pyle cross bred lamb liveweight gains grazing on a canola stubble compared to Pallaton Raphno at Takalarup in

Description	Canola stubble	Pallaton Raphno
Ha in paddock	30	59
Numbers (head)	670	1580
Stocking rate (lambs/ha)	22.3	26.8
Weight in (kg liveweight) or kg lwt	38.2	40.1
Weight out (kg lwt)	41.4	46.4
Weight gain (kg liveweight)	3.2	6.3
Average weight gain (grams/head/day)	145	286
Total weight gain (kg liveweight)	2,144	9,954
Total weight gain (kg livewieght/ha)	71.5	168.7
Value		
Store lambs @ $3/kg liveweight (at weigh in)	$114.6	$120.3
Finished lambs (weights out) @ $3/kg lwt (store condition) OR	$124.2	
Finished lambs @ 43% dressed weight @ 780 c/kg*		$155.6
Total value (above starting condition)	$6,432	$55,774
Revenue calculated per Ha (above starting condi-tion)	$214.40	$945.32

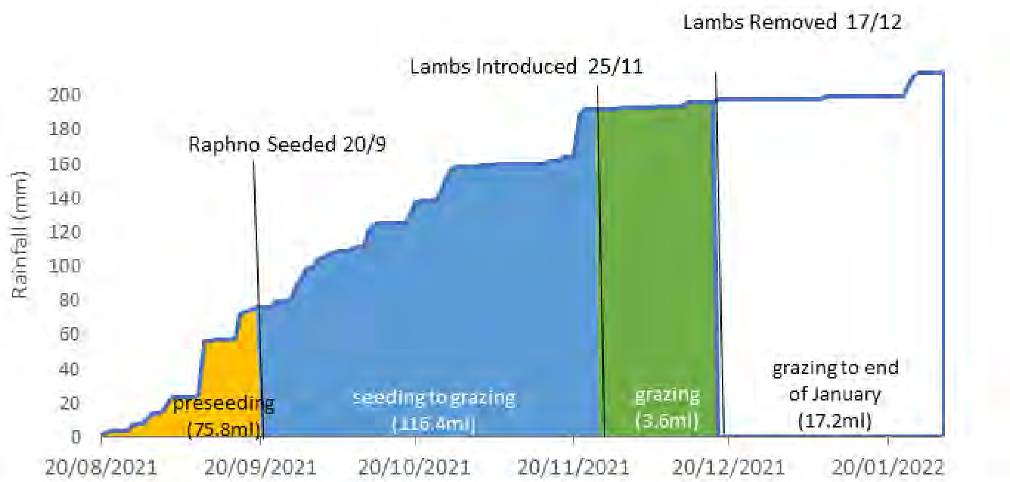

Figure 3. Summary of cumulative rainfall from August 20, 2021 until the end of January 2022. Data from Pyle's digital rain gauge located in the Raphno paddock.

Table 4. Pyle soil sample results taken November 25

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	21	23	Sand	97.5	1
Canola Stubble	0-10	5.8	0.1	26	28	Sand	97.5	1

The two paddocks grew vastly different biomass, with 2.54t/ ha for the control paddock and 4.05t/ha for the Raphno (Table 1). Nutritive value analysis revealed the Raphno was a much higher feed quality, possessing higher digestibility, metabolisable energy and crude protein than the canola stubble pasture mix (Table 2). It also had less acid detergent fibre (ADF) which is made up of cellulose and lignin which is the percentage that is undigestible.

At the commencement of grazing, lambs recorded average weights of 38.2kg and 40.1kg for the canola stubble and the Raphno, respectively. At the completion of grazing 22 days later, lamb weight gain averaged 145g/hd/day on canola stubble and 286g/hd/day on Raphno. This resulted in an extra 141g/hd/day produced on the Raphno, nearly double the average daily gain (ADG) of lambs on canola stubble. There were 670 lambs grazing the canola paddock that equated to 22.3 lambs/ha whereas the Raphno supported 26.8 lambs/ha (Table 3). David Pyle noted that the Raphno paddock was under stocked and ideally the stocking rate would have been above 30 lambs/ha.

At completion of the measured grazing period there was still plenty of biomass in the Raphno paddock (Figure 2). Lambs continued to graze the Raphno at a stocking rate of 38 lambs/ha for three weeks. That grazing pressure removed all leaf area from the Raphno. Seven weeks on David reported that the Raphno was looking good, roughly a foot tall, with blanket coverage. Unfortunately, they had a very dry summer, with only one 10mm rainfall event. However, that amount of rainfall was sufficient for the Raphno to respond and support another grazing event mid-March.

The comparison of feed types was only over 22 days of grazing. To determine the full value of growing Pallaton Raphno a rotational gross margin analysis would need to be made over the two years. Comparing the new system to the old land use. For example canola 2021, summer grazing values, barley 2022, compared to pasture 2021, Pallaton Raphno from September 20, 2021 to December 21, 2022.

Figure 1. Drone image of Pyle's Pallaton Raphno crop on November 29th, 2021.

SMITH SITE: MILLET VS BARLEY STUBBLE

KEY MESSAGES:

- The summer crop (millet) had a higher nutritive value (NV) than the barley stubble, higher crude protein, digestibility and metabolisable energy.
- There was a much greater biomass in the barley stubble 3.34t/ha compared to the 1.66t/ha of millet.
- Millet growth was highly variable and showed signs of heat and moisture stress before grazing.
- Lambs grazing the barley stubble were more profitable than the millet in the 2021/22 summer because of lower costs from utilising the existing stubble resource.

LOCATION- Green Range

SOIL TYPE- Sand

CONTROL- Barley stubble, 60ha, 120 lambs, 2 lambs/ha

VARIABLE- Millet, 80ha, 300 lambs, 3.75 lambs/ha

Background

The demonstration compared two paddocks; a millet stand and a barley stubble. After trying millet with some success in 2020, the Smiths planted another 80ha stand in 2021. A benefit of this crop is its fast growth and high yield along with its ability to germinate at soil temperatures of 15°C. Millet's ability to germinate at lower soil temperatures is important becuase it allows producers to sow earlier than other summer crops. By sowing millet earlier, producers can utilise greater soil moisture leading to earlier growth and biomass.

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

Method

Shirohie millet was sown on November 14, 2021 at 50mm spacing with no compound fertiliser. After a 72 day growing window biomass cuts, soil samples and plant samples for nutritive value (NV) analysis were taken. The lambs were weighed and introduced to the paddock on January 25. Four quadrant cuts were collected from the barley paddock while six were collected from the millet to determine biomass prior to grazing. Plant samples were also collected for NV analysis. Nutritive value samples were analysed by Feedtest, Werribee, VIC.

A proportion of the lambs were weighed from each group going onto the millet and barley stubble. The same lambs were then weighed coming off the respective forages a month later. Due to the dry summer the millet was starting to show signs of heat and moisture stress. At the conclusion of grazing both the millet and barley stubble had been exhausted.

Results and Discussion

Table 1. Smith dry matter cuts prior to grazing

Forage	g of 0.1m^2 quad	t/Ha
Barley Stubble	33.35	3.34
Millet	16.55	1.66

Table 2. Smith NV analysis of forages collected on January 25, 2021.

NV Analysis	Barley Stubble	Millet
Dry Matter (DM)	73.9 %	25.5 %
Moisture	26.1 %	74.5 %
Crude Protein	3.2 % of DM	11.1 % of DM
Acid Detergent Fiber	42.9 % of DM	30.4 % of DM
Neutral Detergent Fiber	77.0 % of DM	55.7 % of DM
Digestibility (DMD)	47.9 % of DM	66.3 % of DM
Digestibility (DOMD)	47.4 % of DM	63.0 % of DM
Est. Metabolisable Energy	6.6 MJ/kg DM	9.8 MJ/kg DM
Fat	2.1 % of DM	3.2 % of DM
Ash	3.1 % of DM	6.0 % of DM

Figure 1. Left, Smith's 80ha millet crop on the 25th Jan 2022. Right, the same crop 8th March 2022, after the lambs had been removed.

Figure 2. Left, Smith's 60ha barley stubble on the 25th Jan 2022. Right, the same stubble 8th March 2022, after the lambs had been removed.

Table 3: Smith cross bred lamb liveweight gains grazing on a barley stubble compared to Shriohie millet at Green Range

Description	Barley Stubble	Millet
Ha in paddock	60	80
Numbers (head)	120	300
Stocking rate (lambs per Ha)	2	3.75
Weight in (kg lwt) or kg of liveweight	42.7	41.6
Weight out (kg lwt)	48.8	46.5
Weight gain (kg lwt) per lamb	6.1	4.9
Average weight gain (grams/head/day)	145.2	116.7
Total weight gain (kg lwt)	732	1470
Total weight gain (kg lwt/ha)	12.2	18.4
Value		
Store lambs @ $3/kg lwt (at weights in)	$128.1	$124.8
Finished lambs @ 43% dressed weight @ 800 c/kg	$167.9	$160.0
Total value	$4,776	$10,560
Revenue generated per Ha	$79.6	$132
Minus costs – Cost of planting Millet @ $90/ha and Barley $0/Ha	$0	$90
Profit (calculated per Ha)	$79.6	$42
Profit (above starting condition)	$4,776	$3,360

Figure 3. Images of the millet at the Smith Producer Demonstration site taken on the January 25, 2021 showing varied plant health and biomass.

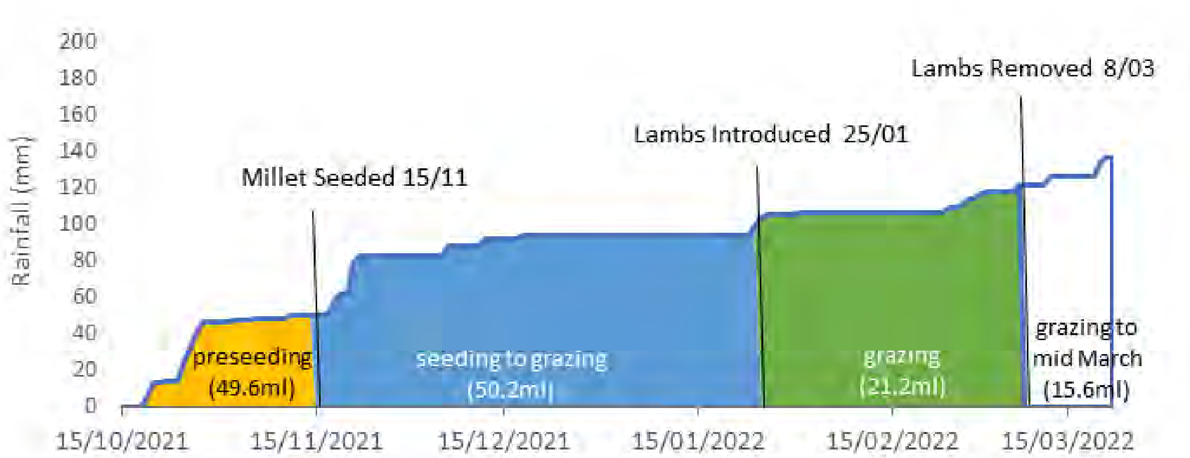

Figure 4. Summary of cumulative rainfall from October 15, 2021 until mid-March 2022. Data from a nearby digital rain gauge located off South Coast Highway.

Table 4. Smith soil sample results taken January 25, 2022.

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Millet	0-10	5.1	0.7	65	37	Sand	94.5	2.2
Barley Stubble	0-10	4.8	0.9	53	21	Sand	96.0	1.4

The 2021 sown millet was seeded into optimum conditions and received 30mm of rain one-week post seeding (Figure 4). Unfortunately, only 17mm of additional rainfall was recorded over the next five weeks until grazing commenced. As a result the millet showed signs of heat and moisture stress when grazing commenced, (Figure 3), resulting in variable plant health and biomass.

Pasture cuts revealed a much larger biomass available prior to grazing in the control barley stubble 3.34t/ha compared to 1.66t/ha of millet (Table 1). Nutritive value analysis revealed the millet possessed a much higher feed quality, with higher digestibility, metabolisable energy and crude protein than the barley stubble (Table 2).

At the start of grazing lambs recorded average weights of 42.7kg and 41.6kg for the barley stubble and millet, respectively (Table 3). On completion of grazing 42 days later, lambs averaged 145.2g/hd/day on the barley stubble and 116.7g/d/day on millet (Table 3). However, the average live weight gain in kg/ha/day was higher for the millet (430g/ha/day) compared to 290g/ha/day for the barley stubble. In other words, more kilograms of lamb were grown per hectare on the millet forage compared to the barley stubble. Higher live weight gain was due to the higher stocking rate and feed quality in the millet. It was a very dry summer in 2021/22, and more rainfall would have increased the millet production.

Table 5: Calculation of the sowing costs for the Shirohie millet crop at the Smith's Green Range property summer 2021/22. Seeding and spraying costs have been calculated at contract prices.

Description	Millet Costs ($/ha)
Seeding (contract)	*$ 50.00*
Glyphosate ($6/Lt)	*$ 12.00*
Spraying (contract)	*$ 8.00*
Seed (4kg/ha Millet)	*$ 20.00*
Total	*$ 90.00*

Summary

Although the millet produced $132/ha compared to the barley stubble $79.4/ha, additional costs were associated with planting the millet crop at $90/ha. Barley costs were zero since we assume the cropping enterprise has already paid for the costs of growing the barley. Therefore total profit was $37.6 higher in the barley stubble compared to growing millet over the 2021/22 summer (Table 3).

As mentioned earlier, it was a very dry summer which limited the potential millet growth. With greater biomass production, the revenue generated would be higher for the same sowing costs.

Summer cropping requires producers to consider the risks and rewards. We measured losses in 2021/22 compared to barley stubble, but the data generated will help local producers consider their options in future years. The results confirm why some producers on the south coast won't consider growing summer crops. Even optimistic summer cropping producers should ensure they have significant soil moisture before planting summer crops.

METCALFE SITE: SORGHUM VS RYEGRASS PASTURE

KEY MESSAGES:

- The sorghum had a higher nutritional value (NV) than the ryegrass pasture, including safe levels of nitrate nitrogen and prussic acid.
- Steers achieved excellent weight gain on the sorghum, averaging 1kg/head/day.
- A small weight gain of 63.5g/hd/day was achieved by steers on the ryegrass with supplementation.
- Sorghum's greater water use efficiency and ability for quick regrowth allowed for multiple grazing events over summer and autumn.

LOCATION- Manypeaks

SOIL TYPE- Sand

CONTROL- Ryegrass pasture, 46ha, 89 weaner steers, ~2 steers/ha

VARIABLE- Sorghum, 34ha, 174 weaner steers, ~5 steers/ha

Background

The demonstration compared two paddocks; a sorghum stand and a senesced ryegrass pasture with supplementation. After observing other producers try sorghum, including a local feedlot that grew it under irrigation in 2020, Tim Metcalfe was interested in trialing the forage. He also viewed it as a great opportunity to make use of the remaining soil moisture after the wet 2021 winter.

Metcalfe's producer demonstration site investigated yearling steer growth rates on sorghum compared to senesced ryegrass pasture with silage and hay supplementation.

Method

The Bunker sorghum was planted on the 13th of November 2021, and received 30mm of rainfall nine days later. Other than being sprayed with a knockdown and insecticide, no other crop protection or fertilisers were applied. After a 69 day growing window biomass cuts, soil samples, nutritive value (NV), nitrate nitrogen and prussic acid (cyanide) levels were collected. The steers were weighed and introduced to the paddock seven days later after the prussic acid levels were confirmed safe. Four quadrant cuts were collected from each paddock to determine biomass prior to grazing. Nutritive value samples were analysed by Feedtest, Werribee, VIC.

A proportion of the steers were weighed from each group and selected to go onto the sorghum and ryegrass. The same number of steers were then weighed coming off the respective forages. Steers grazed the sorghum for 21 days before it was exhausted, whereas final weights were recorded 63 days after grazing the ryegrass. Each week the ryegrass steers received supplementation of four bales of silage and two bales of meadow hay.

Results and Discussion

Table 1. Metcalfe Dry Matter (DM) cuts before grazing

Forage	g of 0.1m^2 quad	t/Ha
Ryegrass	31.8	3.18
Sorghum	44.8	4.48

Table 2. Metcalfe Nutritive value analysis of the ryegrass and sorghum

NV Analysis	Ryegrass	Sorghum
Dry Matter (DM)	75.2 %	17.6 %
Moisture	24.8 %	82.4 %
Crude Protein	9.0 % of DM	10.0 % of DM
Acid Detergent Fiber	32.2 % of DM	30.8 % of DM
Neutral Detergent Fiber	61.7 % of DM	55.8 % of DM
Digestibility (DMD)	58.7 % of DM	69.2 % of DM
Digestibility (DOMD)	56.6 % of DM	65.4 % of DM
Est. Metabolisable Energy	8.5 MJ/kg DM	10.3 MJ/kg DM
Water Soluble Carbohydrates	4.0 % of DM	15.2 % of DM
Fat	3.0 % of DM	4.0 % of DM
Ash	3.7 % of DM	8.1 % of DM
Nitrate Nitrogen	-	220 mg/kg of DM
Cyanide (as Prussic acid)	-	<2.5 mg/kg

Figure 1: Sorghum paddock. Left pre-grazing, Right post grazing.

Figure 2: Ryegrass paddock. Left pre-grazing, Right post grazing.

Table 3: Metcalfe yearling steers liveweight gains from grazing sorghum and ryegrass.

	Ryegrass	Sorghum
Ha in paddock	46	34
Numbers (head)	89	174
Stocking rate (steers per Ha)	1.9	5.1
Weight in (kg lwt) or Kg of liveweight	311	395
Weight out (kg lwt)	315	416
Weight gain (kg lwt) per steer	4	21
Average weight gain (grams/head/ day)	63.5	1000
Total weight gain (kg lwt)	356	3654
Total weight gain (kg lwt/ha)	7.7	107.5
Value @ 490 c/kg lwt*		
Value in	$1,523.9	$1,935.5
Value out	$1,543.5	$2,038.4
Total value added	$1,744.4	$17,904.6
Minus costs: Silage & Hay x 6 bales for 9 weeks	$2,160	
Minus Costs: Cost of sowing Sorghum @$90/ha		$3,060
Profit or Loss per Ha	$-9/Ha	$436/Ha

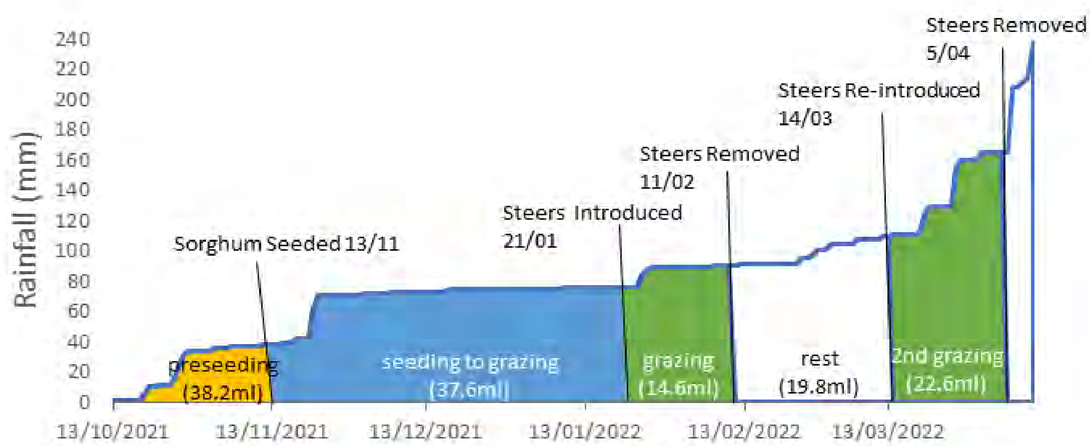

Figure 4. Summary of cumulative rainfall from October 13, 2021 until April 2022. at Metcalfe's digital rain gauge located next to the sorghum paddock.

Table 4. Metcalfe soil sample results taken on January 25, 2022.

Site Name	Depth	pH (CaCl2)	Al CaCl2 (mg/kg)	PBI + P Col	P Col (mg/kg)	Texture	Sand (%)	Clay (%)
Sorghum	0-10	5.2	0.1	14	15	Sand	96.6	1
Ryegrass	0-10	4.7	1.6	53	58	Sand	96.8	1

The 2021 sown sorghum had an ideal start receiving over 30ml in the first nine days post seeding. By the commencement of grazing the sorghum was over 1m high across most of the paddock (Figure 1 and 2). At the start of grazing the steers recorded average weights of 395kg and 311kg for the sorghum and the ryegrass, respectively.

After grazing Tim reported the steers on the sorghum had an average daily gain of 1kg/hd/day whereas the steers on the ryegrass had achieved just a little over maintenance with a small gain of 63.5g/hd/day. Steers on the sorghum were also given one bale of hay for roughage upon induction which they did not consume.

Pasture cuts revealed an extra 1.3t/ha was available on the sorghum paddock with 4.48t/ha available compared to 3.18t/ha in the ryegrass. Nutritive value analysis revealed the sorghum was a higher feed quality, possessing higher digestibility, metabolisable energy and crude protein than the senesced ryegrass pasture (Table 2). The sorghum was found to have a nitrate nitrogen level of 220mg/kg of DM, which is within the safe range of < 4500 mg/kg of DM and a prussic acid level of < 2.5mg/kg of DM also within a safe range of < 500 mg/kg (Table 5).

At completion of the measured grazing period Tim rested the paddock for just over a month and got a second three week grazing period from the sorghum (data not collected).

Update from May 9, 2022: Due to the excellent growing conditions, Tim reported another two succesful grazing events. Firstly, 93 heifers grazed the 34 Ha paddock between April 27 and May 5. On May 7, Tim placed 383 cross-bred lambs in the paddock, which will be trucked to the abottoir (Fletchers) on May 17. Data not collected.

Table 5. Level of prussic acid in forage (dry matter basis) and potential impact on livestock.

HCN, ppm (dry matter basis)	Effect on Livestock
0 - 500	Generally safe
600 - 1000	Potentially toxic, should not be the sole source of feed
> 1000	Dangerous to cattle do not feed

References

1.Rusche, Warren, “Level of prussic acid in forage (dry matter basis) and potential impact on livestock”, Prussic Acid Poisoning, Last modified November 18, 2021, extension.sdstate.edu/prussic-acid-poisoning.

Thank you to Lucy Anderton for reviewing this article for the Stirlings to Coast Farmers members and staff.

This Producer Demonstration Site is funded by Meat & Livestock Australia


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MORRIS

Farmer Trials

Metcalfe Alternate Forage Site: Hyola 970CL Canola

Kelly Gorter, Livestock Officer, SCF

Background

At the end of September 2020, Tim Metcalfe seeded a 34ha paddock to Hyola 970CL winter type canola to take advantage of excess soil moisture at the family's Manypeaks property. The crop was planted at 4kg/ha and had a grass (500ml/ha of Clethodim) and insecticide spray (300mL/ha Affirm) to control the Diamondback moth in November. The paddock also received 100kg/ha of urea in November, before the cattle started grazing on the 24th of December 2020.

From then, the paddock sustained 130 days of grazing by steers, with further grazing by ewes with lambs at foot and then weaner lambs to graze it out completely. Steers were weighed regularly during and after the grazings. The option to carry the crop through to harvest was open, but with patches of waterlogging from the decile ten rainfall year reducing plant growth, the decision was made to continue utilising the excellent grazing potential instead.

A second paddock of canola was also seeded in combination with some oats at the end of February, after seeing the early vigour and success of the main paddock. This was also grazed regularly by steers with great success, although weight gains and grazing dates were not recorded.

Method

The crop was seeded in late September 2020. One hundred weaner steers weighing 350+kg were introduced gradually to the paddock from the 24th of December. To allow their rumen to adjust, they were brought into the paddock for a few hours each day in increasing intervals and taken out overnight. Hay was supplied consistently throughout the transition and the grazing period but was not utilised sufficiently until it was moved closer to the water point. Signs of vitamin B1 (thiamine) deficiency prompted the movement of the hay point and this then rectified the issues. The steers were weighed regularly during their time on the canola and were taken off on the 23rd of February after 61 grazing days.

The paddock was then rested until the 19th of March when a slightly bigger mob of 150 steers were brought on for 43 days to the 1st of May. This time the paddock was split approximately in half with temporary fencing, with the steers rotationally grazed in 2 week blocks on each half. It was then rested for a month before the steers came back on for 26 days to the 26th of June. This was the last grazing by cattle, with a mob of ewes and lambs being brought in after this.

Results & Discussion

Tim has been very pleased with the results from this canola, particularly its resilience and ability to come back after a heavy graze. He acknowledges that the first grazing could have occurred earlier, around the second week of November, as the canola started to wilt and dry off slightly after that, however animal availability deferred that grazing. From sowing in September to first grazing in late December, the Metcalfe's received approximately 188mm of rain with 90mm of that falling in November alone, giving the canola a rare but exceptional start. When it came to grazing, Tim followed recommended protocols of transitioning the steers onto the brassica carefully over 4-6 days, allowing them to graze for 2-3 hours each day from mid-morning onwards and gradually increasing the number of hours each day until being permanently left on. Cattle tend to consume the majority of their daily intake in the early morning, so allowing them to do this on a "normal" pasture in the morning, ensures they enter the canola with a full rumen, reducing the risk of gorging and related health issues when they do get the taste for the new feed.

The first herd of steers averaged 1kg/ head/ day of growth in this first summer grazing period to give 6100kgs of weight gain across the herd. The area received approximately 64mm of rain in that first grazing period. It is common for livestock to undergo a lag phase in weight gain when first introduced to a brassica as their rumen adjusts and they develop a taste for the plant. This is likely to explain the difference in weight gains between the grazing periods. After a couple of steer deaths due to vitamin B1 (thiamine) deficiency causing

polioencephalomalacia (PEM), Tim realised that the hay that had been provided at the end of the paddock to balance the diet was not being consumed readily, so it was moved closer to the water point (dam). This greatly increased consumption and rectified any signs of developing PEM in the other steers.

The second grazing in March/ April saw more rain and greater weights gains of 1.7kg/head/day for a total of 10,965kg of weight gain across the herd. This equates to 322.5kg liveweight production per hectare. Steers had been grazing the other canola/oat paddock before re-introduction so were not backgrounded this time and the re-located hay, closer to the water point, prevented a reoccurrence of PEM. The hot wire temporary fencing also promoted a more even graze.

The third and final grazing by cattle was again with a herd of 150 steers from the 1st of June to the 26th of June. The canola received a huge 240mm of rain in May, allowing for a shorter rest period before this grazing which managed a 1.5kg average daily liveweight gain across the herd. The 5,850kg growth coupled with the 6,100kg from the first grazing and 10,965kg from the second gave a staggering 22,915 kg of LWG or 673kg/ha.

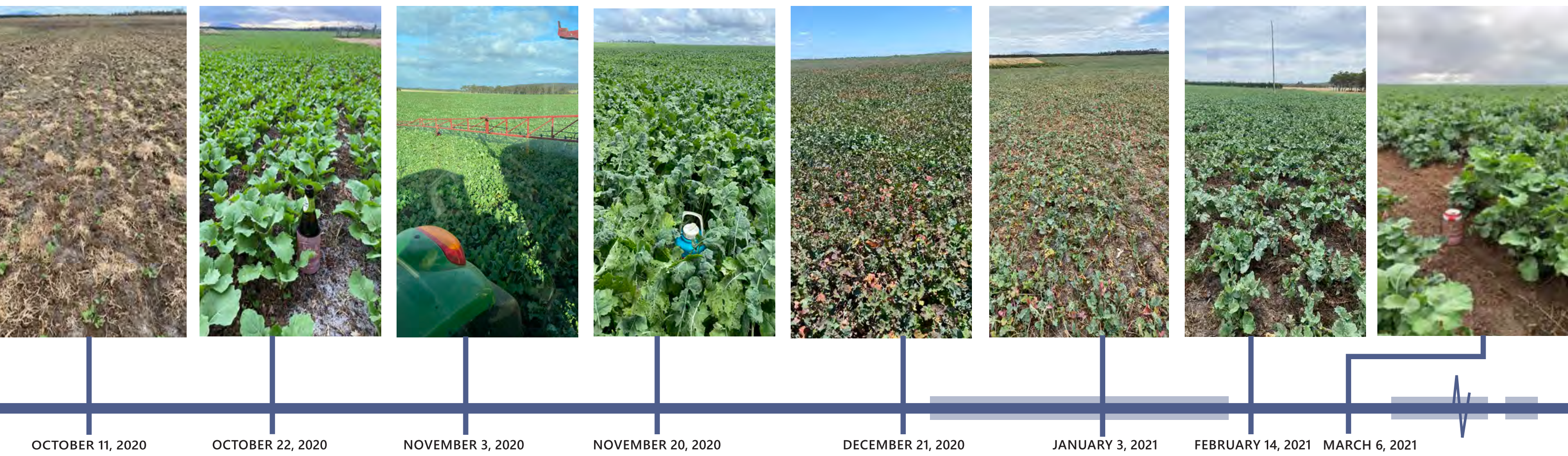
At this stage the Metcalfe's had the opportunity to either control the grasses and lock up the crop to take it through to grain harvest or to continue to graze it for the rest of the season. Due to a portion of the paddock being affected by water logging and after seeing great results grazing it, they decided to continue it as a fodder crop, this time grazing with sheep. No further data was collected, but the sheep were used to graze the canola out completely.

Conclusion

The Metcalfe's have been really pleased with the performance of the Hyola 970CL canola and will certainly give it another go in the future. Rainfall during establishment and over the summer months was exceptionally favourable, albeit relatively uncommon. This gave the canola an excellent start and assisted with quick recoveries after grazing. The cattle weight gains achieved were exceptional, with related metabolic issues being easy to rectify with suitable provision of supplementary roughage. If repeating the crop again, Tim has said he may try to keep on top of the grasses slightly better to give the opportunity to carry the crop through to harvest if desired. Overall, a great first result of growing and grazing Hyola 970CL winter type canola over summer.

TABLE 1: Rainfall recorded at Manypeaks from September 2020 to August 2021.

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug
Rainfall (mm)	57	21	89	21	15	47	45	98	239	122	92	88



Soil Wetter Comparison at Palmdale

Nathan Dovey, CEO, SCF

Key messages

- Barley yield increased from the untreated control (UTC) by 420kg/ha using 3L/ha of 'Aquifer®'and 560kg/ha using 3L/ha of 'SE14®', on the poorest yielding section of the trial.
- Yield differences from other sections, including two separate high performing areas, were not significantly different to the control.
- 2021 was a very wet season with 808.8mm of rainfall recorded by the on-farm weather station.
- The sandplain soil is typically non-wetting and would benefit from clay application and incorporation.

Background and trial aims

Local farmers in the Takalarup and South Stirlings areas have predominantly sandplain soil types (grey sandy duplexes) that are often acidic and non-wetting. Spreading clay and incorporating from 0-40cm has successfully ameliorated these constraints. However, clay spreading is costly and takes a long time to implement, with some growers ameliorating only one paddock per year. Therefore, even growers with a dedicated annual claying program are looking for short-term, cost-effective solutions to alleviate non-wetting topsoil. Short term solutions are desired until more expensive, but longer-term, amelioration such as claying can be undertaken.

Growers and agronomists know that SE14 has been most effective at alleviating non-wetting topsoil on forest gravel soils. Data for other soil types, like sandplain soil, is limited or variable. Therefore, growers are conducting their own on-farm experiments to measure yield differences and calculate returns on investment. Previous research has indicated that if one wetting agent effectively overcomes non-wetting, other formulations and brands are also likely to be effective. Farmers constantly evaluate their input costs, and wetting agents are no exception.

Treatments

1. Untreated Control
   Cost per hectare: $0.00
2. 3 Lt/ha SE14® applied in-furrow
   Cost per hectare: $15
3. 3Lt/ha Aquifer® applied in-furrow
   Cost per hectare: $25

Method

The grower seeded the treatments in three 36m wide replicates in 1.8 km strips on a pale deep sandy paddock. The paddock suffered from severe waterlogging in 2021. Philip Honey (SCF Smart Farms Coordinator) divided the strips into different yielding zones to analyse the data separately based on yield performance and eliminate sections of the trial affected by inundation or other waterlogging effects (Fig 1). The presented yield for each yield performance zone is the average of yield monitor data for the length of the performance zone. DPIRD biometrician Andrew VanBurgel then analysed the raw data to determine if the observed grain yield differences were statistically significant.

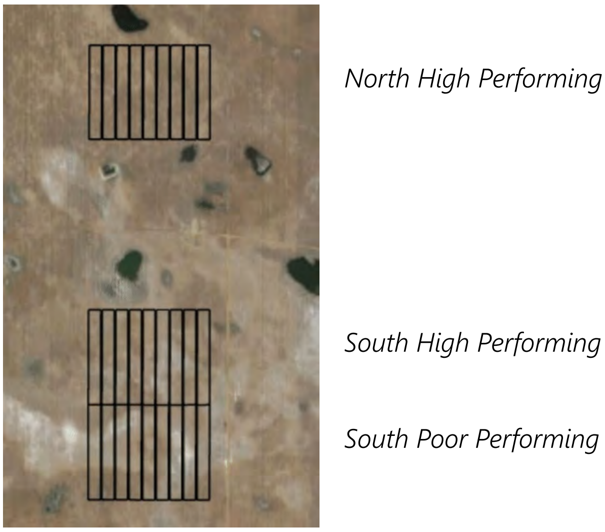


Figure 1: Example of how the non-wetting trial was divided into three separate yield performance zones determined from the harvest yield data (Takalarup, 2021).

Table 1: Change in profit ($/ha) from wetting agent applications compared to the untreated control. 'Whole Plots' refer to the treatment means calculated from the entire 1.8km strips, and 'Poor Performing' relates to the means calculated from the poor yielding sub-section of the 1.8km strips.

Treatments	Whole Plots	Profit ($/ha)	Poor Performing	Profit ($/ha)
	Revenue ($/ha) - Wetter Costs	Revenue ($/ha) - Wetter Costs		
UTC	$ 1,347.50	$ -	$ 1,034.00	$ -
3Lt/ha SE14®	$ 1,394.00	$ 46.50	$ 1,163.00	$ 129.00
3Lt/ha Aquifer®	$ 1,362.75	$ 15.25	$ 1,134.50	$ 100.50

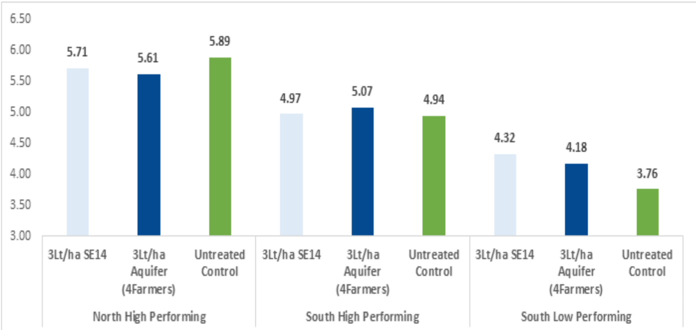


Figure 2: Barley grain yield (t/ha) by "Performance Zone" from the Palmdale wetting agent comparison trial in 2021. "Performance Zones" are categorised on the raw yield data obtained from the harvest yield monitor.

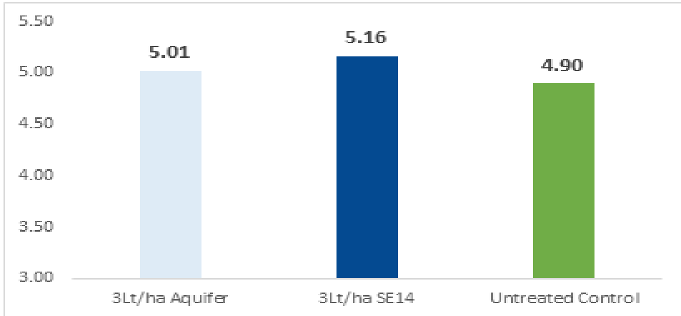


Figure 3: Average barley yields (t/ha) of the three wetting agent treatments (Takalarup, 2021). Treatment means were determined by averaging the harvest yield monitor data over the 1.8km paddock strip lengths

2021 Season Summary

In 2021, 808.8mm of rainfall was received on the property measured via an on-farm weather station 2km from the trial site. Based on the nearest Bureau of Meteorology (BOM) station the 2021 season was a decile ten rainfall year.

Results & Discussion

The mean yields of performance zones (Figure 2) highlight the variability of the wetting agent responses in the 2021 Palmdale trial site. None of the treatments were statistically different, including the "poor performing" area. Although not statistically significant, we calculated the additional revenue from using the wetting agents.

The whole 1.8km plots were also not statistically different between treatments. However, a basic economic calculation was completed to quantify the modest increase in yield relative to the cost (Table 1). The 2021 season was exceptionally wet, and the impact from non-wetting soils may have been minimised compared to a drier rainfall year.

These 2021 results suggest that the response to wetting agents is greater in the poor performing soil types compared to the higher-performing areas. If a grower wanted to reduce the costs of wetting agents, they might consider only applying products to poorer soil types, which could be determined by merging multiple yield maps or other paddock mapping information such as satellite imagery.

The 4Farmers product, Aquifer®, was cheaper than SE14® to apply but had a lower return on the responsive soil types. Given SE14® has been on the market longer and has more data to support its efficacy, there is not enough evidence to recommend changing products. However, the results from Aquifer® were positive enough to continue measuring its effectiveness against SE14®. Other factors such as ease of handling and mixing compatibility with Flexi-N, fungicides or trace elements could also influence using one product over another.

The data generated from the 2021 trial warrants further investigation on similar soil types in a drier season. Drawing conclusions based on one season of data is a risky strategy. Repeating the treatments on more paddocks and in different rainfall seasons would give greater confidence to the conclusions drawn.

Conclusion

Applying wetting agents to sandplain soils generated extra profits for this grower despite the very wet season. However, the wet season added more variability to the yield data, which reduces confidence in the results. Based on the available evidence, the continued use of SE14® on this sandplain soil is justified while also comparing it to untreated control or other products on the market. With additional data like this trial, growers should be more confident about the benefits of using wetting agents and which circumstances lead to higher returns from wetting agent usage.

Future Trials

Assessing the Economic Benefits of Confinement Feeding

Kelly Gorter, Livestock Officer, SCF

Summary

Commencing in November 2021, this project is centred around peer-to-peer learning between a group of ten core producers who are all interested in confinement feeding sheep. Six of these core producers will be site hosts, having data collected on their systems. Project learnings will be shared with SCF members and the wider farming community via articles, case studies and video summaries.

Background

Confinement feeding is a sheep management strategy that is gaining a lot of traction and interest. It involves confining sheep to sacrificial paddocks or purpose built pens, to protect paddocks from over-grazing in late summer/ autumn and reduce the time spent supplementary feeding stock. Although the theory may be similar to that used for feedlotting, it differs in that all classes of sheep may be confined, with the purpose being to maintain animal weights, not increase them. Containing sheep to a smaller area or at an increased stocking rate in sacrificial paddocks, reduces the energy expended in travelling to find food or water. Essential roughage is supplied either ad lib in the pens or in a mixed feed ration, along with access to good quality water. Deferred pastures have a reduced grazing pressure, amassing a greater biomass from early rains and setting them up for improved carrying capacity and value throughout the season.

Costs involved with transitioning to a confinement feeding system are highly variable. There are many different forms of confinement feeding, from large mobs in large sacrificial paddocks, through to purpose-built pens for mid-sized mobs. Feed may be fed straight on to the ground, in troughs or in raised troughs mounted on posts. Feed can be anything from a full mixed ration made in a tub grinder down to a simple single grain ration with ad lib hay or straw bales fed in the pen. Fencing and feed system costs may also come with a requirement for new or additional equipment to suit the system and additional animal health treatments. Given the tremendous variability between farms, it is hard to quantify the economics of confinement feeding systems as a whole, therefore this project will focus on the feed aspect only.

Methodology

This two-year project is a Producer Demonstration Site (PDS) sponsored by Meat & Livestock Australia (MLA) and the MLA Donor Company. It will see the core group sharing their thoughts and experiences, discussing different setups, hearing from industry experts, and creating a network of support for peer-to-peer learning amongst each other. These core producers farm from Gairdner to Frankland River, with a great range of confinement setups between them. In each year, three of the group members will be site hosts, with findings from their property contributing to the collective learning. Feed samples will be tested from the grain, hay and straw they plan to feed in confinement, with these results being used to formulate a balanced ration suitable for the class and pregnancy status of the sheep. Ewes will be condition scored on entry to confinement as well as when exiting, with target condition scores set and expected to be achieved with the balanced ration. Pasture cuts will be taken to demonstrate the extra pasture growth achieved by deferring grazing through confinement of animals past the season break. These figures will then formulate the economic analysis component of the project, putting a figure on the cost and value of confinement feeding. The group will meet at least twice annually and communicate regularly to share their experiences.

Going Forward

The first workshop for the project was held in March 2022, with producers getting to meet each other, share their experiences and hear from industry experts about animal health, nutrition, and site selection considerations. A video will also be produced to capture and summarise a site visit, along with a summary video and written case study on one of the demonstrated confinement feeding systems at the end of the project.

MLA MEAT & LIVESTOCK AUSTRALIA
Producer Demonstration Site

This Producer Demonstration Site is funded by Meat & Livestock Australia

Increasing the effectiveness of claying soils in the Albany Port Zone

Kathi McDonald, Communications Manager, SCF

Project Aim

Stirlings to Coast Farmers (SCF), in collaboration with Southern Dirt, were recently awarded a project from the GRDC looking at improving the efficiency of claying soils in our region. The overall outcome is that:

"By 2024, growers spreading, or intending to spread, clay will have increased ability to assess on-farm clay sources and have methods to better monitor clay application rates."

Background

Many of our members have experienced the transformational productivity benefits of spreading clay on sandy soils, including improved water and nutrient holding capacity, reduced non-wetting expression and increasing soil organic carbon. For over 15 years, local growers have been refining their methods of applying and incorporating clay in their paddocks to improve their soil fertility permanently. Depending on the methods employed and the amount of clay spread, the costs can be $500-$1500/ha.

SCF researchers believe that improvements can be implemented by growers and contractors that would significantly improve the clay spreading efficiency. For example, a 20% improvement in clay spreading efficiency could save $300/ha for growers applying high volumes.

The main area of focus for this project will be improving knowledge of the clay quality growers are spreading and calculating and measuring claying rates to optimise the amount distributed per hectare. We know that clay pits are selected strategically for the most efficient spreading of the clay in the paddock. We also understand that once the topsoil and overburden have been removed, growers feel obligated to use the clay in that clay pit because of the dollars invested in uncovering the product. In some cases, spreading the wrong clay can be detrimental to paddock fertility and be challenging to reverse, although this is rare on our south coast sand plain soils.

Methodology

The two primary components to this project are the hands-on workshops and the grower demonstration sites. The workshops will feature DPIRD soil scientist David Hall, who has been an industry-leading researcher for clay-spreading in the Esperance region for over two decades. They will cover the following aspects:

- Can the limitation be reduced by incorporating clay-rich subsoil?
- What type of clay is available on my farm and is this suitable?
- How much clay-rich subsoil is required?
- What changes to management are required after clay is added?

Growers and contractors will learn about the local clay types and the hierarchy of clay quality which can be determined by soil testing or visual assessment. We believe that improving the machinery operator's ability to assess the clay visually will improve their allocations per hectare. Given the expense of claying, there is no point in spreading more clay than required. The workshop will help growers understand the basic theory of the clay percentage they should be aiming to achieve in their "new" soil and how many tonnes of clay it will take to complete the aim.

The project's second component is the grower demonstration sites measuring the benefits obtained from clay spreading. SCF will host one demonstration site on our sandplain soils, and Southern Dirt will host a site at Muradup on a forest gravel soil. The demonstrations will be installed before seeding this year so we can gather production, soil and clay quality data over the next two growing seasons.

Finally, SCF will investigate a simple and easy to follow method for measuring the amount of clay spread on a grower's paddock. Once we have refined our technique, we will publish the process and distribute it to local members and growers while making it available to interested parties through our website.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Southern Dirt

Drought resilience dashboard for southern WA

Kathi McDonald, Communications Manager, SCF

Project Aim

To provide an enhanced local weather forecasting and a centralised dashboard to enable farmers to make better business decisions and improve their farm's resilience to climate change:

- This project will install weather stations, soil moisture probes and digital rain gauges in southern WA and integrate the data into a dashboard to maximise farmer usage and understanding.
- Increasing the data collected will improve the accuracy of weather forecasting at a local level.
- Soil moisture probes will enable farmers to measure the water stored in the soil and determine how risky it would be to grow a summer crop or cut fertiliser applications late in the season.

Background

Enhanced local weather forecasting and a centralised dashboard will enable farmers to make better decisions & improve their farm's resilience to a changing climate. Once farmers are armed with better forecasting, they will make better input decisions (fertiliser & herbicides) for either cropping or livestock enterprises. Real-time data is beneficial but predicting pasture growth rates or cropping yields is the ultimate project goal to help build resilience and optimise productivity without negatively affecting our soils, water systems and vegetation.

Summer rain can be utilised via stored soil moisture for the upcoming winter crops. In some environments, growing summer fodder crops can generate income directly or provide feed for livestock in the form of silage, grain, or hay. The stored feed gives farmers fodder in the bank, which can be utilised during dry winters. Additionally, summer crops offer an alternate way to increase cropping diversity into farming systems. For example, Cowpea is a summer legume that can grow nitrogen and provide grain for feed.

Weather & climate data collected over time will become more helpful to landholders and reduce sub-optimal decisions. Poor decisions might be avoided if the complexity of the scenario is better understood through quantified data to complement farmer experience and intuition.

Drought resilience dashboard

In summary, the dashboard will host;

- Pasture forecasting for five locations in the Great Southern
- Soil moisture probe information
- Weather forecasting for 20 locations in the Great Southern (Note: weather forecasts will extend beyond the SCF region)
- Drought resilience resources (information materials).

The project will build on similar work conducted in NSW. To see how the dashboard will look, visit www.farmingforecaster.com.au. To keep up to date with project activities, head to the SCF website – https://www.scfarmers.org.au/drought-resilience.

This project is supported by SCF, throuhg funding from the Australian Government's Future Drought Fund.

Australian Government
Department of Agriculture, Water and the Environment

Future Drought Fund

Frost, now and in the Future

Nathan Dovey, CEO, SCF

Stirlings to Coast Farmers are pleased to be a part of a larger Grower Group Alliance led project examining agronomic factors for frost risk mitigation.

Trial Objectives

1. Within a sowing window, compare the relative frost susceptibility of wheat, barley, oats and break crops in frost prone landscapes.
2. To develop across a sowing program the most stable and profitable cereal production in frost prone landscapes.

Hypothesis

Wheat is as profitable as barley, oats and break crops when phenology matches the optimum sowing time.

Methodology

Site Selection

A trial site has been selected on a frost prone soil type in a low lying part of the landscape at Amelup. The site was chosen due to the host farmer observation that the paddock is frosted most years.

Treatment List

Trt No.	Crop Type	Variety
1	Wheat	Denison
2	Wheat	Rockstar
3	Wheat	Scepter
4	Barley	Rosalind
5	Barley	RGT Planet
6	Oat	Bannister
7	Canola	HyTTec Trident – Hybrid TT
8	Lupin	Jurien

Trial layout

TOS 1													TOS 2											
Buffer	B2	O1	B1	W3	W2	W1	Buffer	Buffer	C1	L1	Buffer		Buffer	L1	C1	Buffer	Buffer	W2	W1	W3	O1	B2	B1	Buffer
Buffer	O1	W3	W2	B1	W1	B2	Buffer	Buffer	C1	L1	Buffer		Buffer	L1	C1	Buffer	Buffer	B1	O1	B2	W3	W1	W2	Buffer
Buffer	W1	B1	O1	W2	B2	W3	Buffer	Buffer	C1	L1	Buffer		Buffer	L1	C1	Buffer	Buffer	W3	W2	B1	W1	O1	B2	Buffer

wheat, B = barley, O = oat, C = Canola, L = Lupin

The trial will have two sowing times to highlight the value of matching crop phenology with the optimum sowing time. Living Farm will manage the small plot trial at Amelup, with SCF assisting with some of the trial observations and assessments. Senior research scientist Rebecca Smtih from Living Farm will be presenting at the trial site during the 2022 growing season. Keep an eye out for what should be an excellent field walk later this year.

This project is supported by the GGA and GRDC

Clay Rate x Incorporation Demonstration 2022-24 - Western Dairy

Nathan Dovey, CEO, SCF

Background

Although clay spreading sandy soils has been an established practice in broadacre cropping for over two decades, the practice has had limited up-take in the dairy industry. At a recent Western Dairy Inc. Board meeting, there was a great deal of interest to see investment into improving soil fertility through changes in organic matter (OM), plant emergence & establishment, phosphorus retention, and non-wetting through the addition of clay and then incorporating it. Improvements in soil condition and nutrient use efficiency also have the potential to reduce nutrient loss to waterways and the environment, so the project is being supported by Healthy Estuaries WA. The Western Dairy Board felt that the adoption of clay spreading could help dairy farmers be better custodians of their fragile soils through better nutrient use efficiency and early pasture growth.

A preliminary demonstration was completed by a dairy farmer in Denmark who noted improvements in pasture growth since applying clay two years ago. The same farmer, Andrew Jenkins, will host a demonstration site from 2022-24, managed by Stirlings to Coast Farmers (SCF), with a second demonstration site being set up at Scott River, managed by a private agronomist. Stirlings to Coast Farmers were asked to tender for the project given our experience managing similar style projects and the relevance to our mixed farming members. Members grow pastures on their previously clayed paddocks in rotation with crops, but quantitative pasture growth and composition changes have not been previously collected.

Methodology

The trial will include demonstration strips with four treatments - 0%, 1%, 3%, and 6% clay of the finished soil (after incorporation and measured at 10cm mixing depth). Percentages of clay in the finished soil rather than application rates will be used on the recommendation of DPIRD soils researcher, Glenn McDonald, as all clays are not equal in actual clay content. To determine the amount of clay required based on the clay content of the original soil and the clay content of the donor clay, we will use the clay calculator tool developed by David Hall (DPIRD).

For simplicity, the paddock will be seeded by the host farmer to whatever is being sown over the bulk of the paddock (i.e. rye, clover, cereal mix or similar) and rotationally grazed as per the usual practice on the property. Pre-work baseline sampling will determine starting nutrition levels and any other constraints while also calculating the starting clay content of the original soil.

Baseline sampling will include comprehensive soil testing at 0-10cm, 10-20cm and 20-30cm and measure the following:

- Phosphorus Buffering Index (PBI),
- Phosphorus Retention Index (PRI),
- Phosphorus (Colwell),
- Phosphorus (CaCl2-extractable)
- Potassium (Colwell),
- Sulfur (KCl 40),
- Organic Carbon (Walkley-Black),
- Nitrate Nitrogen,
- Ammonium Nitrogen,
- Electrical Conductivity,
- pH (water),
- pH (CaCl2),
- Texture,
- Boron,
- Trace Elements (DTPA) - Copper, Zinc, Manganese, Iron, Magnesium, Exchangeable Cations,
- Sodium,
- Aluminium

Other project observations and assessments will include:

- Soil sampling for clay content in years two and three of the demonstration.
- Comprehensive tissue testing from July-September during peak grass growth periods
- Plant emergence
- Plant density conducted pre-grazing in early winter and mid-spring. Glenn McDonald from DPIRD will measure using drone technology.
- SCF will ground-truth density with tools such as plate meters and pasture biomass cuts.
- Grass and pasture composition

Trial Design

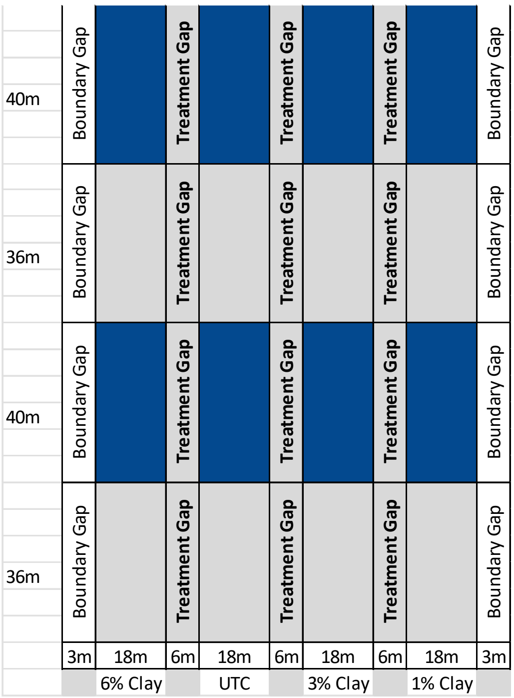


Figure 1: Diagram of the proposed Denmark Clay trial hosted by Andrew Jenkins. The blue highlighted section will be incorporated with a speed tiller to a depth of 15cm. Clay treatments were installed on April 2022.

Field Walk

Local Dairy farmers will invite SCF members to view the demonstration site during the 2022 season. We will invite DPIRD soils researchers Glenn McDonald, David Hall and Tom Edwards to discuss the process of determining optimal clay rates and the potential of adopting claying spreading to dairy farming systems. Initial results and observations from the clay applications will also be presented and discussed.

This project is a part of Healthy Estuaries WA – a State Government Royalties for Regions program that aims to improve the health of our South West estuaries.

Department of Water and Environmental Regulation
Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA
HEALTHY ESTUARIES WA
Western DAIRY
Dairy Australia

Closing the economic yield gap for grain legumes in Western Australia

Nathan Dovey, CEO, SCF

Trial objectives

This project involves a small plot trial being managed alongside a farm-scale demonstration site. The objectives for these two trials are;

Small Plot Trial - Demonstrate the effects of different sowing times and row spacings on the level of disease and profitability in faba beans and lupins.

Farm-Scale Demonstration - Compare three different Faba bean sowing rates to determine the optimum plant density required to optimise grain yield at West Cranbrook.

Background

Stirlings to Coast Farmers (SCF) consulted local growers and agronomists to determine the current pulse research requirements. A plan was devised to expand the local agronomic knowledge of Faba beans. Faba beans are the preferred pulse crop in the Frankland River/Tenterden region because they have the greatest waterlogging tolerance. Many growers are replacing lupin hectares with faba beans because they are more profitable. Adding lupins to the trial design will allow us to compare the productivity and profitability of the two pulse crops in the small plot trial.

Faba beans require more protection from disease than any other common broad-acre crop grown in Western Australia (WA). In 2021, local Frankland farmers recorded up to five different fungicide applications during the season to protect faba beans from chocolate spot *Botrytis fabae*. Local growers and advisors want to know if sowing later lowers the disease pressure and reduces the number of fungicide applications. The accepted downside to sowing later is a lower yield potential, but recently, growers have seen extraordinary yields from later sown crops, especially wheat & barley. The project will investigate whether a later sown faba bean crop may have less disease while maintaining profitable yields in the Frankland/Tenterden region.

The small plot trial will investigate the interaction between row spacing, disease levels and sowing times. The wider the row, the lower humidity in the crop canopy, which means the causal agent of Chocolate Spot (*Botrytis fabae*) is less likely to infect faba bean plants successfully. However, most growers have 25-30cm row spacings in WA to suit other crops (wheat, barley and canola) and need considerable motivation to sow faba beans with wider spacings. A small number of WA growers have separate seeders to plant faba beans at wider spacings, but it is not common practice.

Farm-scale demonstrations are included in the project design to give growers greater confidence in the viability of Faba beans at a paddock level in the HRZ. For example, small plot trials are typically located in a part of the paddock that will not get waterlogged, which means observers don't get to assess faba beans' tolerance to the constraint. Although faba beans don't 'like' to be waterlogged, they are the most tolerant pulse crop to saturated soils. Broad-scale paddock strips allow growers and researchers to observe the crops' strengths and weaknesses across paddock as opposed to small research plots which are generally more uniform in soil conditions.

Methodology

Small plot Trial

The small plot trial will be managed by Living Farm (Trials Contractor & Grower Group) and grown on the Preston family's property at West Cranbrook. The six treatments measured in the two separate sowing times are:

1. Amberly faba beans sown on 25mm tyne spacing
2. Amberly faba beans sown on 50mm tyne spacing
3. Bendoc faba beans sown on 25mm tyne spacing
4. Bendoc faba beans sown on 50mm tyne spacing
5. Jurien lupins sown on 25mm tyne spacing
6. Jurien lupins sown on 50mm tyne spacing

The two sowing dates will be one month apart, with the first sowing date planned for late April. SCF will complete as many of the trial site observations as possible to reduce the costs. To ensure essential factors for growing pulse crops (nutrition, rhizobial inoculation plus herbidide and fungicide management) do not impact our experimental variables of sowing time, luxury applications of these will be applied across the whole trial.

The most challenging factor is managing the fungicide applications since they require six independent visits to the trial site to control the disease. Once the first sowing date needs spraying at the start of flowering, the trial contractors will be spraying the trial site every three weeks until October, aiming to provide the best disease protection possible.

Farm-Scale Demonstration

The Preston family are experienced lupin growers trying faba beans for the first time in many years. The paddock was seeded on the 6th of April with 50mm spacing after Mark and Neil Preston blocked every second tyne on their seeding bar. The paddock seeding rate of Amberly faba beans was 150kg/ha. After consultation with Mark Preston, SCF decided to do two seeding strips each of:

- 120kg/ha
- 150kg/ha
- 180kg/ha

The SCF research team will measure plant emergence and potential disease differences over the 2022 growing season. The final grain yield of the farm-scale trial will be determined from the harvest yield monitor data and analysed by Phil Honey (SCF Smart Farms Coordinator).

Impact of stubble height on cropping systems in the Western Region

Hosts: Slade Family

Dan Fay, Project Officer, SCF

Key messages

- The project will assess the performance of strip and disc systems, in the High Rainfall Zone (HRZ).
- The project will look at how differing stubble architectures and management systems effect a wide range of agronomic variables.
- By 2024 this project will provide growers with key knowledge around stubble architecture to improve crop productivity.

Background

Stirlings to Coast Farmers (SCF) are taking part in a GRDC funded state-wide project managed by the Liebe group. The project explores the effect of stubble architecture and stubble management systems on crop production.

Stubble architecture plays a key role in the cropping cycle. Stubble management, as part of the fallow management of crop, can have a profound impact on the following seasons crop performance, as well as the long-term health of the soil.

Stubble residue interacts with crop productivity through a two-fold effect, its physical structure and its interaction with the soils and environment. In the last three decades there has been a strong move towards stubble retention, to improve groundcover, retain nutrients and cycle carbon, however this is not without it drawbacks.

Stubble plays a key role in providing ground cover during the fallow period to protect soils from wind and water erosion, increasing infiltration and managing weed burdens.

Strip and disc systems have become increasingly popular particularly in the low and medium rainfall regions where preserving soil moisture is of the upmost importance to ensuring the success of a continuous cropping system. However, the performance of the strip and disc system in high rain fall zones with higher stubble loads is still up for debate.

This trial will take an extensive look at different stubble management and stubble architectures and how they interact with a wide range of variables, to provide growers with a comprehensive insight into how to best optimise your stubble management system.

Trial design and method

The trial is centred around four different stubble architecture treatments: Stripper front + speed tiller + disc seeder, stripper front + disc seeder, draper front standard cut + tyne seeder, and draper front high cut + disc seeder. The stripper front will only be used in the seasons in which cereals are grown, while the seeding implements, and stubble management portions of the treatment plots will be utilised every year.

The 2021 harvest was implemented utilising both a draper front and a stripper front to establish the treatment plots for the following season. Baseline soil, biomass, yield, grain quality, weed, and stubble residue was collected, so changes throughout the time span of the project can be observed.

Within this project we will measure a broad range of variables that interact with stubble management including the following:

- Soil moisture - increases water infiltration and decreases evaporation
- Weed germination due to levels disturbance
- Soil structure
- Disease carryover
- Hair pinning of stubble at seeding
- Herbicide tie up in stubble
- Harvest weed seed control options
- Lack of cultivation below seed, if moving to disc seeding
- Fire risk over summer
- Pre-emergent herbicide efficacy

- Nitrogen inefficiency when top spreading into straw
- Frost risk

Spray efficiency

Spray efficiency testing was conducted across each trial plot as part of the pre-seeding knockdown in 2022. The testing measured spray contact as a percentage at canopy and ground level. Testing aimed to evaluate the effect the differing stubble architecture has on the efficacy of spraying. The sprayer was set up with the nozzles to be 50cm above the stubble canopy to ensure maximum coverage.

The average canopy height for each stubble treatment varied. The stripper front/speed tillage treatment had a canopy height of 0cm. The standard draper cut, high draper cut, and stripper front treatment had an average stubble canopy height of 14cm, 24.8cm and 65.3cm, respectively.

Interestingly, the stubble canopy height reduced over the fallow period by 17% in the high draper cut and 17.3% in the stripper front treatment plots, without grazing or stubble management. This reduction in canopy height was due to the loss of vigour and the beginning of stubble breakdown. Whilst the standard draper cut had no evidence of change in stubble canopy.

Table 1: Average spray coverage percentage by treatment and spray zone, as well as the average canopy height by treatment in centimetres.

The results of the spray efficiency testing showed that

	Draper/ Standard	*Stripper*	*Stripper/Till*	*Draper/High*
Ground (%)	*12.27*	*7.32*	*13.72*	*8.62*
Canopy (%)	*14.08*	*8.97*	*Not applicable*	*12.34*
Ave Canopy Height (cm)	*14.0*	*65.3*	*0*	*24.8*

the stubble height treatment had a statically significant effect (P=0.0064) on the spray coverage. The draper front/ standard cut and speed-tiller treatment resulted in the greatest spray coverage at ground level. The improved spray coverage is ideal for eradicating summer grasses. However, the stubble mass acted as a barrier for spray contact where the stubble height was higher. Interestingly, the stripper front treatment had a lower percentage of spray coverage at the canopy level. The spray paper (used for coverage assessment) was "streaked" rather than the consistent "course" blot that is targeted for knockdown sprays. We think this was due to an increased influence of the wind because the boom was higher (canopy + 50cm) on the stripper front plots. This increased boom height, coupled with greater average stubble height from the stripper front plots, led to the greater variability in the spray coverage at ground level (Figure 1).

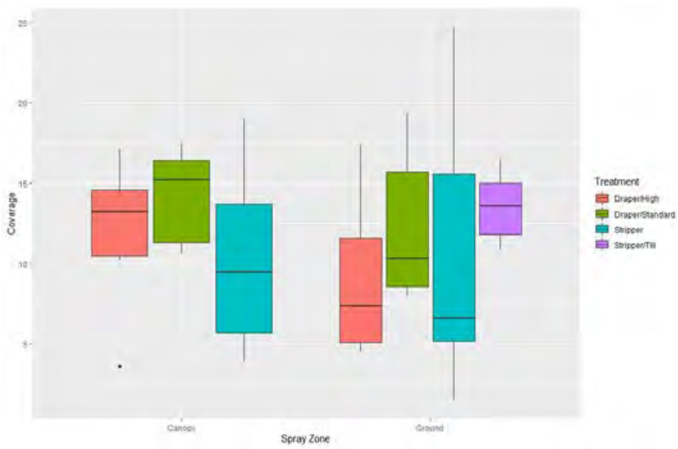


Figure 1: Box plot of the spray coverage percentage achieved in the different stubble height treatments in April 2022 at West Kendenup.

Other Trials

Waterlogged barley responds to Foliar Flexi-N

CSBP

While heavy, early rains can lead to significant losses of N applied at seeding, in-season foliar applications of Flexi-N can produce very good responses on waterlogged crops. 2021 was one of the wettest seasons on record at South Stirling, making it a good opportunity to analyse different nitrogen (N) strategies on a barley crop in a waterlogged paddock.

The year started with 103 mm of rain from January to March followed by 573 mm of rain during the 'growing season' - April to October. The crop established well but had to contend with waterlogged conditions right from sowing on May 6.

Nitrogen treatments included applications banded at seeding, early tillering (June 17), and at the start of stem elongation (July 13).

Yield

The site was very responsive to N. Applying increasing N rates post-seeding took yield from 4.7 t/ha (14N only at seeding) to 8.5 t/ha (217N spread across seeding, early tillering, and stem elongation) (Figure 1).

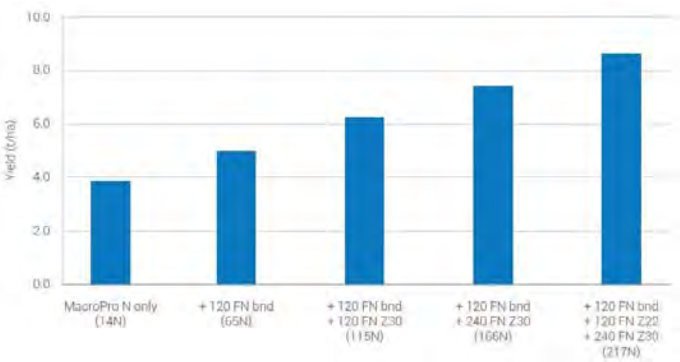


Figure 1. Yield increased with in-season Flexi-N (FN) applications.

Nitrogen use efficiency

With the early wet conditions, it was unsurprising that N applied at seeding was less effective than post-seeding applications.

In-season N applications had a nitrogen use efficiency (NUE) about double that of applications at seeding (Figure 2).

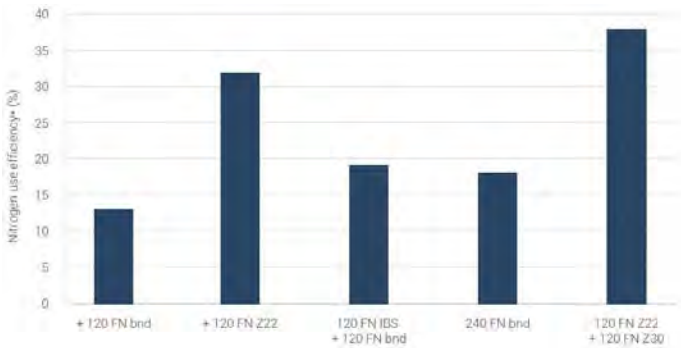


Figure 2. Crop recovery of nitrogen from Flexi-N (FN) applied at 120 and 240 L/ha banded (Bnd), early tillering (Z22), incorporated by seeding and banded (IBS + Bnd) or early tillering + early stem elongation (Z22 + Z30).

Figure 3. Trial site photo taken on August 4 highlighting the effectiveness of in season Flexi-N applications. Left 240L/ha Flexi-N banded; Right 120 L/ha applied at early tillering and start of stem elongation.

CSBP

Supplying manganese to wheat crops effectively

Summit Fertilizer

Trial background

In recent years growers in the southern regions have been increasingly applying manganese (Mn) to crops. It's applied in various ways and forms, and at rates ranging from 0.5kg to 8kg/ha. According to Summit Area Manager, Albany, Mark Ladny, there is a real lack of local information surrounding Mn nutrition. With more samples going through Summit's inSITE testing program indicating marginal Mn levels, a trial was set up on Gunwarrie Farms at Frankland River to investigate best practice.

Aims:

- Evaluate Mn supply effectiveness from various source products through plant tissue analysis;
- Assess yield and quality benefits from the various Mn application methods and sources; and,
- Investigate residual Mn in the soil post-harvest.

Soil test results for the site are given in Table 1 and treatments detailed in Table 2. Aside from the Mn treatments applied by Summit, the site was managed by Gunwarrie Farms as per paddock practice. The area had a decile 10 growing season rainfall of 692 mm, 214mm above average. The site was a gravelly loamy sand sown to Kinsei wheat on 25/05/2021 at 90 kg/ha.

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	Org C %	EC dS/m	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg
0-10	6.2	54	222	11	102	24	4.0	0.2	39	1.5	1.1	0.9	1.3
10-20	5.1	37	172	6	40	13	1.8	0.1	8	1.0	1.1	0.5	0.6
20-30	5.4	5	123	4	42	10	0.6	0.0	4	1.0	0.3	0.1	0.3

Table 1. Soil test results.

	Treatment (Mn kg/ha)		Establishment Fertiliser Banded (kg product / ha)	Total applied (kg/ha) N	P	K	S	Mn
1	Mn0		145 MAP, 50 MAXam, 40 MOP, 10 Urea	140	33	38	15	0
2	Mn0.5	Foliar	145 MAP, 50 MAXam, 40 MOP, 10 Urea	140	33	38	15	0.5
3	Mn1	Blend	3 $MnSO_4$, 145 MAP, 45 MAXam, 40 MOP, 10 Urea	140	33	38	15	1
4	Mn1	Compound	25 MAP & Mn, 125 MAP, 40 MAXam, 40 MOP, 10 Urea	140	33	38	15	1
5	Mn2	Blend	7 $MnSO_4$ 145 MAP, 45 MAXam, 40 MOP, 10 Urea	140	33	38	15	2
6	Mn2	Compound	50 MAP & Mn, 100 MAP, 30 MAXam, 40 MOP, 15 Urea	140	33	38	15	2
7	Mn3	Blend	10 $MnSO_4$, 145 MAP, 40 MAXam, 40 MOP, 20 Urea	140	33	38	15	3
8	Mn3	Compound	75 MAP & Mn, 80 MAP, 20 MAXam, 40 MOP, 20 Urea	140	33	38	15	3
9	Mn7	Blend	23 $MnSO_4$, 145 MAP, 30 MAXam, 40 MOP, 15 Urea	140	33	38	15	7
10	Mn7	Compound	175 MAP & Mn, 40 MOP, 30 Urea	140	33	38	15	7

Table 2. Trial treatments. Sources of Mn were foliar, fully compounded fertilizer and fertilizer blend

In-season:85kg/ha Urea and 35kg/ha MOP applied 08/06/2021, 90kg/ha Urea 07/07/2021, 70kg/ha Urea 17/08/2021
1L/ha Mantrac applied 24/06/2021 to foliar treatment

Results

Whole shoot samples collected on 27th July 2021 showed all treatments exceeded the Mn deficiency benchmark of 15mg/kg for wheat at this growth stage. There was a significant trend of increasing tissue Mn concentration with increasing Mn rate ($p<0.01$). This trend was more pronounced in treatments that received the MAP-MnSO4 blend than the MAP & Mn compound.

Grain yield was lowest (7.47t/ha) when no Mn was applied. Yield was highest (8.33t/ha) when 7kg Mn/ha was applied as the MAP & Mn compound. Despite this, there was no statistically significant increase in yields with increasing Mn rates.

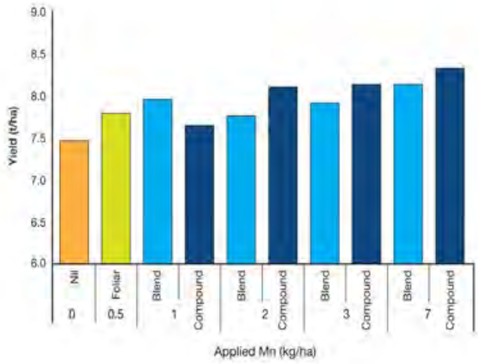


Figure 1. Individual treatment yields.

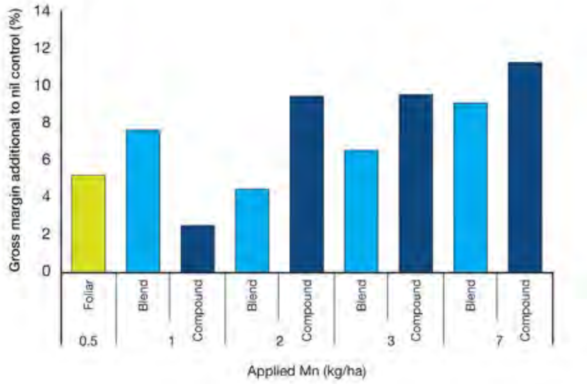


Figure 3. Individual treatment gross margin percentage additional to the nil control demonstrated profitability increased with increasing Mn rates. The compound was more profitable than the blend.

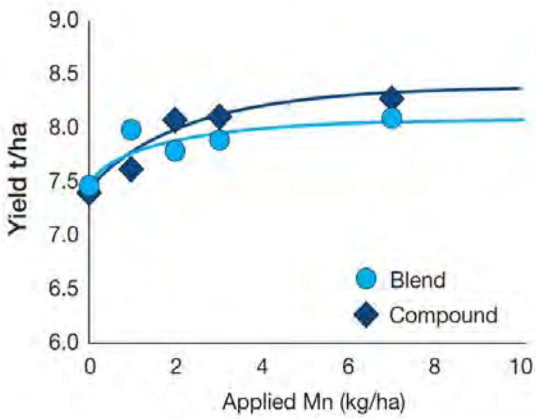


Figure 2. Yield response to Mn applications as blend (circles) and compound (triangles).

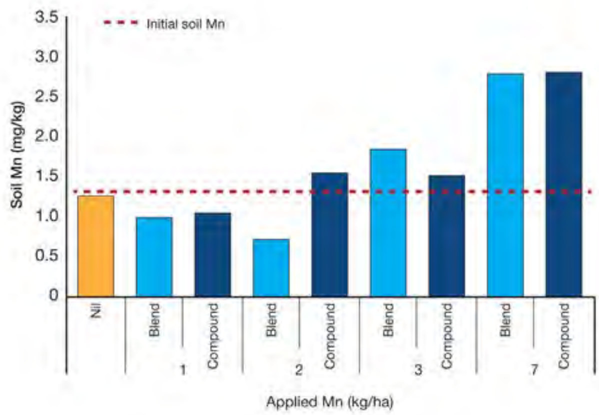


Figure 4. Soil Mn concentrations post-harvest.

The application of the MAP & Mn compound resulted in marginally higher yields than the application of the MAP-MnSO4 blend. Grain protein was consistent across the trial, ranging between 9.9-10.6% .

With consistent protein, high hectolitre weights and low screenings across the trial, all treatments achieved ANW1 grade. Consequently, indicative returns were a direct result of yield. Applying 7kg Mn/ha as the MAP & Mn compound was the most profitable fertiliser treatment with an indicative gross margin of $2510/ha, 11% more profitable than the nil Mn control (Figure 3).

Soil Mn concentrations post-harvest indicated residual Mn increased with increasing Mn applications (Figure 4.).

SUM21.19 key messages

- Plant tissue analysis indicated the crop accessed Mn from all fertiliser sources.
- Plants that received a MAP-MnSO4 blend had higher tissue Mn concentrations than plants that received the MAP & Mn compound.
- There was no statistically significant increase in yields with increasing Mn rates.
- The application of the MAP & Mn compound resulted in marginally higher yields than the application of the MAP-MnSO4 blend.
- Under 2021 conditions, the most profitable treatment was 7kg Mn/ha of MAP & Mn, which had an indicative gross margin 11% greater than the nil control, however rates this high are not recommended unless yield potential is high or soil conditions favour oxidation and strong Mn fixation.

SUMMIT FERTILIZERS

Did you work for The Grain Pool?

This year, CBH is celebrating 100 years of trading grain by its Marketing and Trading division, previously known as The Grain Pool of Western Australia.

To celebrate this milestone, CBH is hosting an event for former employees and Board Members of The Grain Pool in Perth during September.

Get in touch to register your interest.

Former employees and Board Members of The Grain Pool who have not yet been contacted are encouraged to register their interest in attending via email to **melissa.osborne@cbh.com.au**

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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 2021. Without your contribution, the group could not complete our projects which benefit SCF members and the broader agricultural community

- Williss Family- GRDC Ripper Gauge Demonstrations
- Preston Family- GRDC Hyper Yielding Crops - Seeding rate trial
- Ashton Hood & Family- GRDC Hyper Yielding Crops - Seeding rate trial
- Jon Beasley (Frankland River Grazing)- GRDC Hyper Yielding Crops - Seeding rate trial
- Williss Family - GRDC Hyper Yielding Crops - Re-seeded Planet barley trial
- Michael Webster & Family- GRDC Non-wetting Soils Mitigation
- Pete Van Zeyl (First Australian Farmland) - Non-wetting soils mitigation
- Slade Family- National Landcare Program (NLP)- Round 2, Smart Farm Hosts
- Adams Family- NLP Round 2, Smart Farm Hosts
- Pete Van Zeyl (First Australian Farmland) - NLP Round 4, Sub-soil manuring project
- Preston Family- GRDC Sub-soil Drainage
- Pyle Family- Meat & Livestock Australia (MLA), Producer Demonstration Site Host
- Metcalfe Family- MLA, Producer Demonstration Site Host
- Smith Family- MLA, Producer Demonstration Site Host
- Wiehl Family - NLP, Round 3, On-the-go soil pH project
- 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
- Williss Family- NLP, Round 3 Soils Extension, Lime and Ripping Trial
- Kellie Shields (Gunwarrie)- GRDC Hyper Yielding Crops, Small Plot Site
- Hunt Family - GRDC/GGA Soil Pathogens Demonstration site
- Walker Family - GRDC Summer Cropping Project
- Curwen Family - GRDC Summer Cropping Project
- Slade Family - GRDC/Liebe Stubble Height Project

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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