STIRLINGS TO COAST FARMERS

2022 TRIALS REVIEW

Hello,

Welcome to the Stirlings to Coast Farmers 2022 Trials Review Booklet. Last season was certainly one for the records book, with excellent conditions and grain yields. The good conditions brought with it the need for intense crop management, and then a long, slow harvest, which is probably still fresh in the minds of many members!

It is quite unbelievable that cereal crops sown well into September still yielded over 4 t/ha (page 28). A tribute to the extremely soft spring received along the South Coast. Winter wheats also proved their worth in 2022, on average yielding 1.5 t/ha more than spring wheat and spring barley in the hyper yielding awards paddocks monitored during the season (page 52).

With 20 projects to report on from the 2022 season, it has been a big effort from the SCF team to pull this Trials Review Booklet together, not just in the last couple of months in regard to report writing, but also trial management during the 2022 season. We hope you are as excited as we are with some of the trial results which showcase the productivity potential of this region. We also hope the information and data provides you with more confidence and tools to play any season that is thrown our way.

Thank you to all the members who have put their hands up to host trials. We hope you have garnered some good information from having a trial located on your properties. Thanks also for your involvement in field events, where many of you have extended your learnings directly to other farmers and industry representatives (the best form of learning!). Over the years, our host farmers have all contributed, in some part, to the record-breaking 2022 yields through their trials and information sharing. It's what it's all about!

It is now mid-May and seeding is well under way, if not nearly finished for some. Most of our 2023 trials have been sown with no hiccups, and SCF has some awesome trials kicking off this season, including a 5-year GRDC trial. This trial looks to find the 'sweet spot' between nitrogen use efficiency and profitability by focussing on rotations and nitrogen strategies. It'll be one to follow, with decent longevity.

We are still very focussed on making sure we stay true to the SCF Strategy and the Research & Development Plan priorities which were rated by you, our farming members. Our aim is to have at least one project addressing each of the top 10 priorities, and we are already close to achieving this with some more opportunities in the pipeline. We are also open to exploring funding for seasonal challenges faced by our members, so please always reach out with ideas/issues/opportunities. It's what we are here for!

Finally, thank you to Kathi McDonald and Samantha Jeffries from our communications team, who whipped our trials information into succinct articles easy to read and digest. We hope you enjoy them and find the information useful.

All the best for a cracking 2023 season, and hopefully I'll catch you for a yarn around an SCF trial site soon!

Best Regards,

Lizzie

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 2022. Without your contribution, the group could not complete our projects which benefit SCF members and the broader agricultural community

- FAR Australia / GRDC - HYC Trials - Hood Family
- FAR Australia / GRDC - HYC Trials - Allison Family
- FAR Australia / GRDC - HYC Trials - Preston Family
- Future Drought Fund - Drought Resilience - Pasture Forecasting - Gairdner (Walter Family)
- Future Drought Fund - Drought Resilience - Pasture Forecasting - Gnowellen (Hood Family)
- Future Drought Fund - Drought Resilience - Pasture Forecasting - Mount Barker (Mackie Family)
- Future Drought Fund - Drought Resilience - Pasture Forecasting - Palmdale (Pyle Family)
- Future Drought Fund - Drought Resilience - Pasture Forecasting - South Stirlings (Smith Family)
- GRDC - Clay Efficiency Trial - Goad Family
- GRDC - Clay Efficiency Trial - Webb Family
- GRDC - Early Sown Winter Wheat - Slade Family
- GRDC - Fallow Replacement Trial - Adams Family
- GRDC - HRZ Yield Constraints - Hilder Family
- GRDC - HRZ Yield Constraints - Slade Family
- GRDC - HRZ Yield Constraints - Thomson Family
- GRDC - HRZ Yield Constraints - Walker Family
- GRDC - HRZ Yield Constraints - Walter Family
- GRDC - Late Sown Cereal Trials - Green Range - Walker Family
- GRDC - Soil Amelioration Trial - Deep Ripping - Willis Family
- GRDC - Sub Surface Drainage - Cranbrook - Preston Family
- GRDC - Sub Surface Drainage - Perillup - Allison Family
- GRDC - Summer Cropping - Multi Species Trial - Walker Family
- GRDC - Summer Cropping - Single Species Trial - Curwen Family
- GRDC -National Risk Management Initiative Trial - Beech & Webster Family
- Grower Group Alliance - Legumes - Cranbrook - Preston Family
- Grower Group Alliance - Frost Management Site - Amelup - Amelup Estate
- Grower Group Alliance - Soilborne Pathogens - Woogenellup - Hunt Family
- Liebe Group / GRDC Stubble Architecture - Slade Family
- Liebe Group / Grower Group Alliance - AgTech Decoded - Cranbrook - Preston Family
- Liebe Group / Grower Group Alliance - AgTech Decoded - Mount Barker - Mackie Family
- Liebe Group / Grower Group Alliance - AgTech Decoded - Tenterden - Webster Family
- Liebe Group / Grower Group Alliance - AgTech Decoded - Woogenellup - Adams Family
- MLA - Producer Demonstration Sites - Alternative Forage Crops - Metcalfe Family
- MLA - Producer Demonstration Sites - Alternative Forage Crops - Pyle Family
- MLA - Producer Demonstration Sites - Confinement Feeding - Griffiths Family
- MLA - Producer Demonstration Sites - Confinement Feeding - Walker Family
- MLA - Producer Demonstration Sites - Confinement Feeding - Webster Family
- National Landcare Program - Optimising Pasture - Pyle Family
- National Landcare Program - Optimising Pasture - Walker Family
- National Landcare Program - Soil pH - On-the-go pH - Wiehl Family
- National Landcare Program - Soils Extension - Long Term Lime - Mackie Family
- National Landcare Program - Soils Extension - Ripping & Lime - Willis Family
- National Landcare Program - Subsoil Manuring - First Australian Farmland

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.

We would also like to thank . . .

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UNDERSTANDING FIELD TRIAL STATISTICS

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.

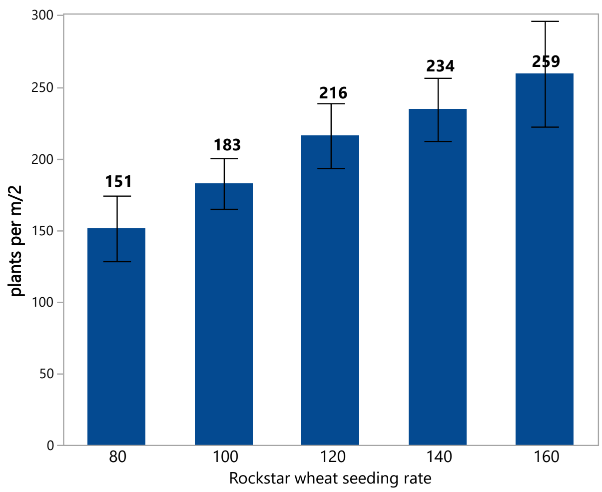
Table 1: Yield of five wheat varieties.

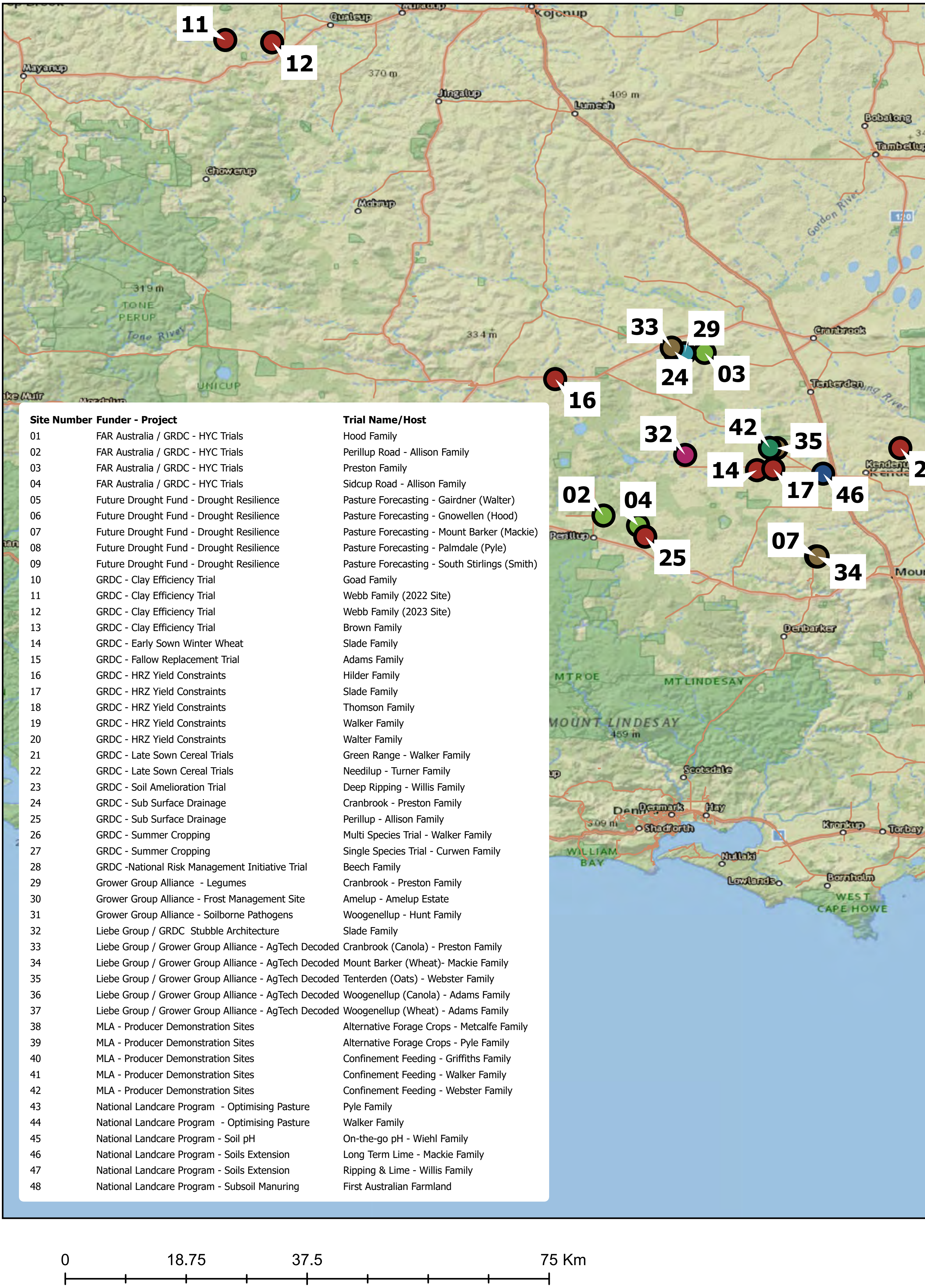
Treatment	Yield (t/ha)
Variety1	2.1[a]
Variety2	2.2[a]
Variety3	2.0[a]
Variety4	2.9[b]
Variety5	1.3[c]
P value	*<0.001*
LSD (P=0.05)	*0.6*

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.





Site Number	Funder - Project	Trial Name/Host
01	FAR Australia / GRDC - HYC Trials	Hood Family
02	FAR Australia / GRDC - HYC Trials	Perillup Road - Allison Family
03	FAR Australia / GRDC - HYC Trials	Preston Family
04	FAR Australia / GRDC - HYC Trials	Sidcup Road - Allison Family
05	Future Drought Fund - Drought Resilience	Pasture Forecasting - Gairdner (Walter)
06	Future Drought Fund - Drought Resilience	Pasture Forecasting - Gnowellen (Hood)
07	Future Drought Fund - Drought Resilience	Pasture Forecasting - Mount Barker (Mackie)
08	Future Drought Fund - Drought Resilience	Pasture Forecasting - Palmdale (Pyle)
09	Future Drought Fund - Drought Resilience	Pasture Forecasting - South Stirlings (Smith)
10	GRDC - Clay Efficiency Trial	Goad Family
11	GRDC - Clay Efficiency Trial	Webb Family (2022 Site)
12	GRDC - Clay Efficiency Trial	Webb Family (2023 Site)
13	GRDC - Clay Efficiency Trial	Brown Family
14	GRDC - Early Sown Winter Wheat	Slade Family
15	GRDC - Fallow Replacement Trial	Adams Family
16	GRDC - HRZ Yield Constraints	Hilder Family
17	GRDC - HRZ Yield Constraints	Slade Family
18	GRDC - HRZ Yield Constraints	Thomson Family
19	GRDC - HRZ Yield Constraints	Walker Family
20	GRDC - HRZ Yield Constraints	Walter Family
21	GRDC - Late Sown Cereal Trials	Green Range - Walker Family
22	GRDC - Late Sown Cereal Trials	Needilup - Turner Family
23	GRDC - Soil Amelioration Trial	Deep Ripping - Willis Family
24	GRDC - Sub Surface Drainage	Cranbrook - Preston Family
25	GRDC - Sub Surface Drainage	Perillup - Allison Family
26	GRDC - Summer Cropping	Multi Species Trial - Walker Family
27	GRDC - Summer Cropping	Single Species Trial - Curwen Family
28	GRDC -National Risk Management Initiative Trial	Beech Family
29	Grower Group Alliance - Legumes	Cranbrook - Preston Family
30	Grower Group Alliance - Frost Management Site	Amelup - Amelup Estate
31	Grower Group Alliance - Soilborne Pathogens	Woogenellup - Hunt Family
32	Liebe Group / GRDC Stubble Architecture	Slade Family
33	Liebe Group / Grower Group Alliance - AgTech Decoded	Cranbrook (Canola) - Preston Family
34	Liebe Group / Grower Group Alliance - AgTech Decoded	Mount Barker (Wheat)- Mackie Family
35	Liebe Group / Grower Group Alliance - AgTech Decoded	Tenterden (Oats) - Webster Family
36	Liebe Group / Grower Group Alliance - AgTech Decoded	Woogenellup (Canola) - Adams Family
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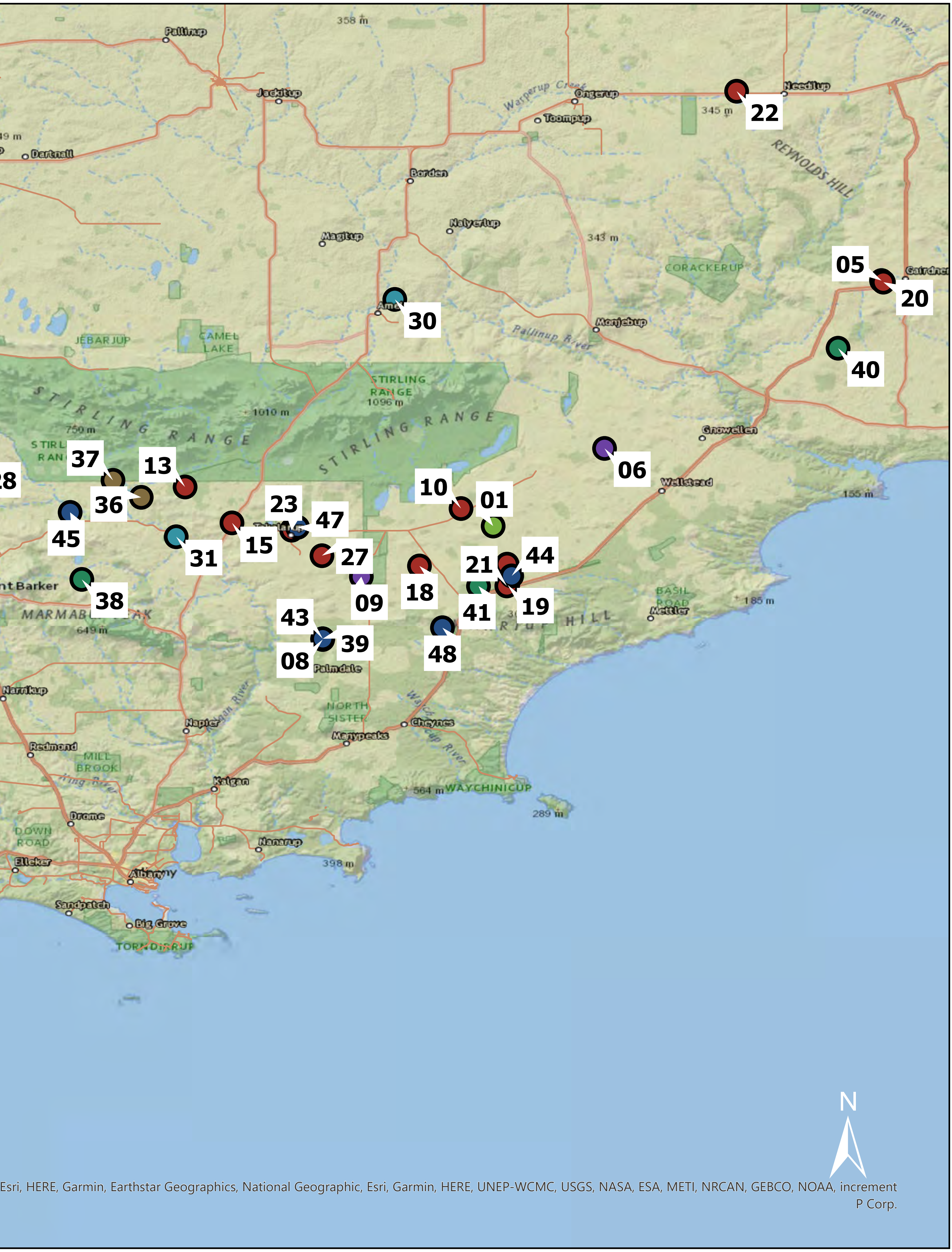
48	National Landcare Program - Subsoil Manuring	First Australian Farmland



Pallinup
Jackitup
358 m
Ongerup
Toompup
Needilup
345 m
REYNOLDS HILL
Dartnall
Borden
Nalyerup
Magitup
343 m
CORACKERUP
Gairdner
Monjebup
Pallinup River
JEBARJUP
CAMEL LAKE
STIRLING RANGE
1096 m
1010 m
750 m
STIRLING RANGE
Gnowellen
Wellstead
155 m
BASIL ROAD
Mettler
185 m
MARMABUP ROCK
649 m
Palmdale
Narrikup
Napier
NORTH SISTER
Cheynes
Manypeaks
Redmond
MILL BROOK
Kalgan
564 m
WAYCHINICUP
289 m
Drome
DOWN ROAD
Nanarup
Elleker
Albany
398 m
Sandpatch
Big Grove
TORNDIRRUP
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FUNDED TRIALS

Increasing the effectiveness of claying in the Albany Port Zone

Hosts: Goad Family (Kojaneerup South), Webb Family (Kojonup) and Brown Family (Woogenellup)

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **If growers want to increase the efficiency of their claying operations, they need to adequately consider the following three factors:**
  - **the initial clay content within the non-wetting zone (0-15cm);**
  - **the clay fraction of the "clay" they are spreading; and**
  - **the incorporation depth to which they will work in the clay.**
- **Located on a deep sandy duplex soil, the Kojaneerup trial validated the need to achieve a soil clay content of at least 5% within the incorporation zone to adequately address non-wetting. A clay rate of 270 t/ha achieved this.**
- **The Scotts Brook trial showed that claying may be an effective amelioration technique to alleviate non-wetting on forest gravels. All three incorporated clay treatments outyielded the untreated control.**
- **Additional work should be undertaken to better quantify the claying versus tillage effect when incorporating clay on forest gravels. This will give growers further confidence in this relatively 'novel' practice.**

Background

Clay spreading adds clay enriched (>20% clay content) soil into clay deficient and water repellent topsoils. In very sandy soils, clay is incorporated to depths of <50cm, depending on the equipment available. The overall aim is to lift the clay content of the soil up to 5%. Claying topsoils reduces water repellence, water and wind erosion risk, increases water holding capacity, and has the potential to increase organic matter and carbon over time.

Claying has become a vital amelioration tool in the Great Southern region and along the South Coast of WA. The soils are typically sandy, low in organic matter, non-wetting and prone to wind erosion. Claying significantly increases grain yields on these sandy duplex soils by ameliorating one or more of these constraints (predominately non-wetting).

Based on the successful adoption of claying sands to alleviate non-wetting, growers with forest gravels are keen to assess the benefits of claying gravel soils (also alleviating non-wetting).

Methodology/Treatments

Two demonstration sites, located at Kojaneerup and Scotts Brook, had clay spread in the autumn of 2022 and were subsequently seeded with a cereal crop. The claying was applied with a contractors' equipment (CAT Scraper) at Scotts Brook and the farmer's own equipment ('SPREAD-IT' spreader) was used at Kojaneerup.

At the Kojaneerup site, three treatments were applied: a low (140 t/ha), a medium (270 t/ha) and a high clay rate (350 t/ha). Clay incorporation was completed with off-set discs to 100mm of soil depth. At Scotts Brook (site managed by Southern Dirt), the primary treatment variable was incorporation method; 'Plozza plough', Speed Tiller and off-set chisel plough, with these treatments incorporated to differing depths of 30, 15 and 10cm respectively. Prior to incorporation, the clay was spread at a consistent rate of 400t/ha across the site, with untreated zones left inbetween. In addition, a Plozza plough only area was done by the farmer as a comparison to measure the tillage effect.

Soil samples were taken at depths of 0-10, 10-20 and 20-30cm and soil organic matter (OM) levels collected before the clay was applied. This data formed the baseline to observe any changes that result from the claying and incorporation.

Plant counts were conducted prior to tillering to measure the plant establishment response to each treatment.

Harvest was conducted using the farmer's machinery, the yields of each plot were determined by analysing the harvest yield files with a statistical analysis conducted. Grain quality samples were analysed.

Results and Discussion

The initial clay percentage at Kojaneerup was 1.7% across the site to a depth of 20cm. Table 1 shows the resulting topsoil clay percentage after the clay had been applied at the three different rates. The resulting clay content is a factor of three elements, the initial clay percentage in the topsoil, the clay fraction of the clay to be spread and the incorporation depth to 15cm.

Table 1: Clay content increases with each rate of clay applied (Kojaneerup)

Clay application rate	350t/ha	270t/ha	140t/ha
Ameliorated topsoil clay %, incorporated to 150mm	7%	5.8%	3.8%
Increase in topsoil clay % from 1.7%	5.3%	4.1%	2.1%

Table 2: Clay content increases for each treatment (Scotts Brook)

Implement	Incorporation depth	Initial clay %	Resulting clay %	Change in clay %
Speed Till	10cm	4.4	10.7	6.3
Offset Chisel Plough	15cm	4.4	8.6	4.2
Plozza Plough	30cm	4.4	6.5	2.1

At Scotts Brook, the initial clay percentage in the topsoil was 4.4% which was quite high for a paddock that is to be clayed (Table 2), however, the soil had a high organic carbon (OC) percentage, ranging between 3.3 and 5%. Prior research conducted by DPIRD, showed that where OC was higher than 1.5%, the 5% threshold to alleviate non-wetting would likely be higher, due to a greater concentration of water repellent particles within the soil that are associated with the higher level of OC.

At the Kojaneerup site, plant establishment was significantly better where the resulting clay percentage was more than 5%. At the Scotts Brook site, plant establishment was significantly best in the clay incorporated by plozza plough treatment.

Barley yields at the Kojaneerup site showed significant yield increase in the two clay treatments (270t/ha and 350t/ha) that resulted in a final soil clay percentage above the critical threshold of 5% within the incorporated zone (Figure 1). In this trial, the yield penalty for not achieving 5% clay content (140 t/ha treatment) was more than 1 t/ha. These yield results highlight the importance of achieving the critical level of clay within the topsoil to alleviate the non-wetting and allow for unconstrained crop development in the early growth stages, while the root depth is still shallow.

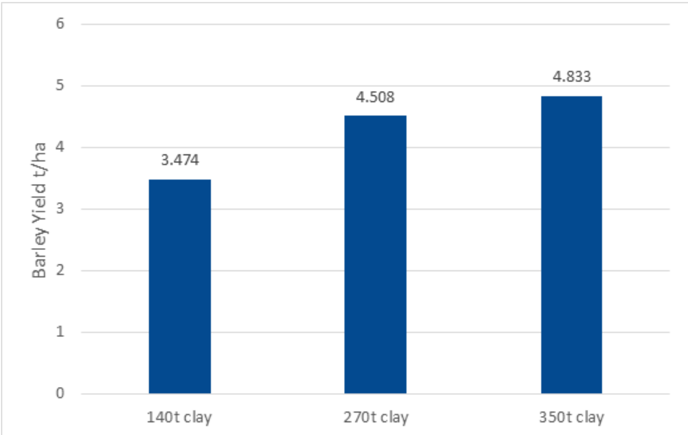

Figure 1. Average barley yields (t/ha) in response to three different clay rate treatments at Kojaneerup South.

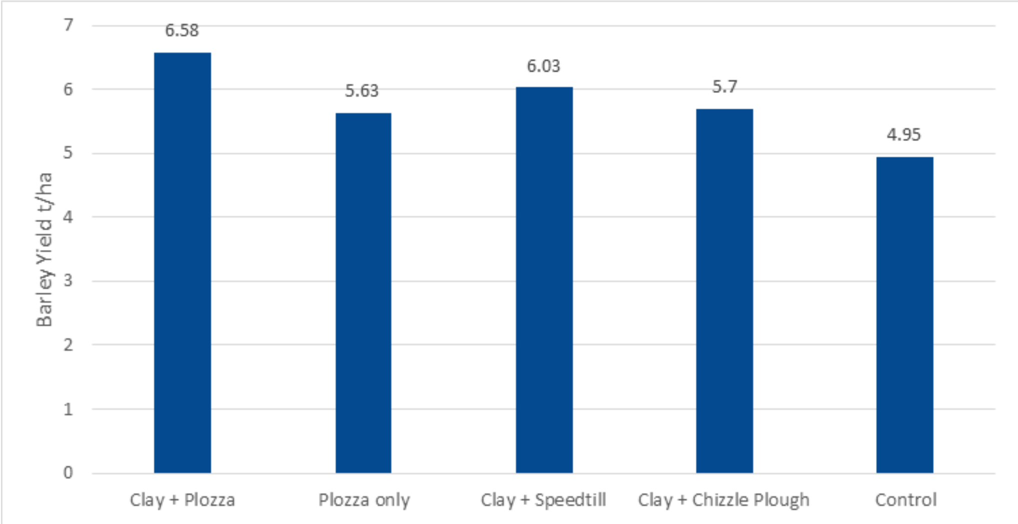

Figure 2. Average barley yields in response to clay incorporation and tillage treatments at Muradup.

The yield results from the Scotts Brook trial site showed that all three clay incorporation treatments outperformed the untreated control (UTC) (Figure 2). The UTC yielded an average of 4.95t/ha and the clayed treatments ranged from 5.7t/ha to 6.58t/ha. These yield improvements are significant enough to justify the expense of the claying incorporation process. In addition, the host farmer Plozza ploughed a part of the paddock where no clay had been spread prior, allowing some quantification of the tillage only yield impact. The yield results show that the clay with Plozza incorporation treatment yielded almost a tonne more than the Plozza plough only section and provides some indication that the claying is having an effect over and above that of the tillage.

Conclusion

Strategic tillage has been shown to be an effective short-term measure in alleviating non-wetting, while claying is a more permanent solution. The trial site at Scotts Brook should be monitored over subsequent seasons to see how the clayed treatments perform after the tillage effect has diminished. It is also important to consider the short-term nutritional effects the clay could be having on the yield results, especially given the high rate of clay that was applied (400 t/ha). It is highly probable that the clay itself has provided the crop with a nutrient boost that it would not have otherwise had. In the coming seasons, this nutritional boost from the clay will also diminish, allowing the long-term benefits of the clay to be observed in isolation.

Both sites will continue to be monitored in 2023. In addition to these sites, two new gravel soil claying trials have been included in the project. One located at Woogenellup and the other again at Scotts Brook (to be managed by Southern Dirt) with the aim to better quantify the benefits of claying on gravel soil, given these promising preliminary results.

Acknowledgments

Grateful acknowledgement to Southern Dirt for assistance with the Scotts Brook trial site and to GRDC (and the levy paying growers) for continued investment in the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Southern Dirt

Optimising profitability of high rainfall zone farming systems

Optimising profitability of high rainfall zone farming systems-survey, grower-scale demonstration trials and field days – 2022 Trial results

Hosts: Slade Family (Mount Barker), Hilder Family (Frankland River), Thomson Family (South Stirling), and Walter Family (Gairdner).

By: Lizzie von Perger, CEO, SCF & Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **Four nitrogen trials were sown in 2022, two into wheat and two into canola and each included treatments that increased in-season nitrogen fertiliser by between 25 and 50%. One trial also increased starter fertiliser by 50%.**
- **The results for all trials showed no conclusive, significant advantage (yield or protein) to increased nitrogen applications with the exception of a 1% protein increase at the Gairdner site.**
- **Lack of response is possibly a result of nitrogen leaching due to above average rainfall that fell consistently throughout the season in 2022.**
- **Farmer survey data associated with the project shows that regardless of the 2022 trial results, farmers have lifted nitrogen application on average by 20 kg/ha for wheat between 2019 and 2022.**

Background

This project commenced in 2019 with the aim of reducing the gap between actual and potential yields in wheat and canola in the high rainfall zone of WA. It was estimated at that time that the potential yield for wheat was in the range of 6-12 t/ha and 3-5t/ha for canola. However, at the commencement of this project (2019), current crop yields were only about 50% of these potentials at 2.7t/ha for cereals and 1.4t/ha canola (Robertson et al. 2016).

This investment aimed to contribute to the broader GRDC HRZ investment outcome that seeks to affect change so that by 2023, growers have increased the value of the cropping phase in the HRZ farming system by 10% through addressing both crop yield potential and the gap between potential and realised yield.

Methodology/Treatments

In 2022, four nitrogen nutrition demonstration trials were sown to either wheat or canola. The trials were located in Mount Barker, Frankland River, South Stirling and Gairdner. The trials aimed to determine if nitrogen was a limiting factor to production. NDVI (Trimble GreenSeeker), plant tissue N%, harvest yield and grain protein % were recorded for all treatments (except grain protein in canola).

Results

Gairdner Trial Results

The wheat grain yield results for the Gairdner trial site showed that the standard grower practice (control) yielded slightly higher (0.17-2.1 t/ha), indicating that for the 2022 season there was no yield gain for increasing the in-season N applied (Figure 1). There was a grain protein gain of approximately 1% in the two treatments where additional in-season N was applied (Figure 1). There was not, however, a significant grain protein advantage in applying more than 25% additional in-season N for 2022.

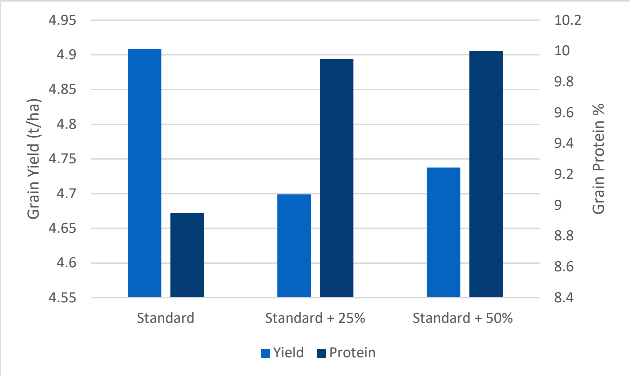

Figure 1: Average Gairdner trial site wheat grain yields and grain protein for each treatment, 2022.

Frankland River

For the Frankland River trial, yield results showed a 0.28 t/ha and 0.32 t/ha advantage for 25% and 50% of additional in-season N applied, respectively (Figure 2). Grain protein was only very marginally higher in the additional N treatments.

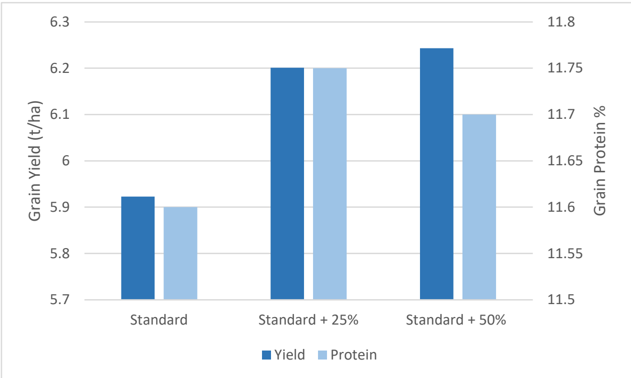

Figure 2: Average Frankland River trial site wheat grain yields and grain protein for each treatment, 2022.

South Stirling Trial Results

The canola yield results for the South Stirling trial site indicate that additional fertiliser, either starter, in-season, or both, did not result in a significant yield advantage for the 2022 season (Figure 3).

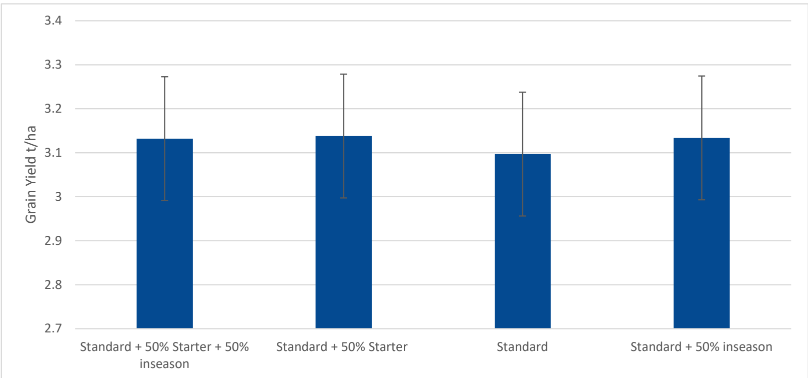

Figure 3: Average South Stirling trial site canola grain yields for each treatment, 2022.

Mount Barker Trial Results

The Mount Barker trial canola yield results show only a 0.15 t/ha yield advantage for the additional 50% (on top of standard grower practice) of in-season N applied for 2022 (Figure 4).

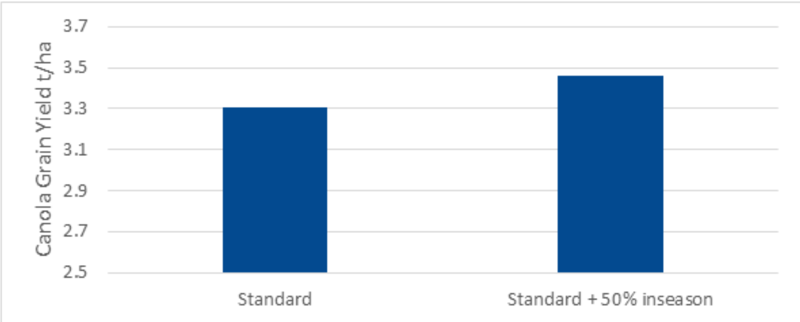

Figure 4: Average Mount Barker trial site canola grain yields for each treatment, 2022.

Discussion

The results showed no conclusive or significant advantage (yield or protein) to increased N applications, apart from protein at the Gairdner site. It should be noted that 2022 was an above average year and two factors may have been at play. The good root growth may have resulted in more existing soil N being scavenged from deeper in the soil profile in the control treatments, effectively equaling the additional N treatments. Or, due to consistent rainfall and some transient waterlogging, N applied may have leached from the profile before uptake by the plants (not giving the expected advantage).

The 2022 trials certainly don't make clear an optimal nitrogen strategy for growers in the high rainfall zone of the region. Given it is unlikely that N can be banked in the sandy soils typical to the southern region of WA, it also shows that the simple (but expensive) solution of additional N is not the sole driver of grain yield.

This is further complicated by the abundance of low protein wheat that is produced in the WA high rainfall zone. The 2022 trial at Gairdner showed no crop yield response to the additional fertiliser, however, there was a slight grain protein response. For this trial, the grain protein levels were still quite low across all three treatments, suggesting the paddock was under fertilised. Again, this could be potentially driven by nitrogen losses in season occurring before the applied fertiliser can be fully utilised. It is clear that nitrogen, whilst being critical to crop production within the high rainfall zone, is not the sole driver of canola and wheat yields.

The project survey results show that growers are increasing their nitrogen rates regardless, and anecdotal evidence from the region suggests that where yield potential is high and crops are looking good, growers have more confidence to push nitrogen rates up to as high as 200 kg/ha in wheat (Hyper yielding awards paddock data).

The full final technical report that collates all the data for this project can be found on the Stirlings to Coast Website: www.scfarmers.org.au/hrz-projects

Acknowledgments

Grateful acknowledgement to GRDC (and the levy paying growers) for continued investment in the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Summer sown cropping following excessive winter waterlogging

Locally relevant spring and/or summer sown cropping opportunities for grain growers following excessive winter waterlogging – South-Western Australia

Hosts: Walker Family (Green Range), Curwen Family (South Stirlings), Webb Family (Scotts Brook), Warburton Family (Kojonup) and Tyson Family (Wickepin).

By: Lizzie von Perger, CEO, SCF

KEY MESSAGES:

- **Extremely late (October) sown cereals can be profitable on the South Coast of WA when sown into a full soil moisture profile.**
- **Growing a summer crop may conserve more soil moisture than a chemical (bare) fallow.**
- **There was no negative impact in any of the trials/demonstrations of the summer crop on the productivity of the following winter crop.**
- **Summer forage crops can be profitable, or at least pay for themselves, if more than one grazing can be achieved.**

Background

The project was set up in response to the severe waterlogging experienced along the south coast of WA in 2021. SILO data shows that the entire Great Southern region received decile 8-10 rainfall for 2021, with the key seeding months of April-June receiving well above the 51-year average rainfall. In addition, the region had also received above-average rainfall for the 2019-2020 summer. As a result, growers attempted to sow crops very late or re-seeded paddocks that had failed with variable success. The seasonal conditions presented an opportunity to look at the agronomic and economic opportunities of summer crops to use the excess soil moisture and mitigate waterlogging in the following season and to understand the impact of summer crops on the following winter crop.

Methodology

In the summer period between 2021/22, six successful field trials were spread across the medium to high rainfall zones of the Central Wheatbelt, Great Southern and Southern Coastal regions of WA. Excessive winter waterlogging had occurred in the 2021 season across all trial locations. The field trials included:

- A small plot trial (led by Nutrien Ag Solutions) – multiple crop types for grain production
- Two multi-crop type farm-scale demonstration trials (led by SCF & Southern Dirt)
- Three single crop type farm-scale demonstration trials (led by SCF, Facey Group & Southern Dirt).

In 2022, cereals were either sown over the summer cropping sites or the already sown winter wheat & winter canola crops and were taken through to harvest.

Results and Discussion

Green Range Small Plot Trial – Winter Crop 2022

The grain yield of the barley, sown over the summer cropping treatments, varied from 7.73 to 8.44 t/ha. Although yields across the site were variable (but all still good), the key learning from the 2022 growing season is that there was no apparent negative impact of growing a summer crop on the following winter crop, when compared to the (bare) fallow treatment (Figure 1).

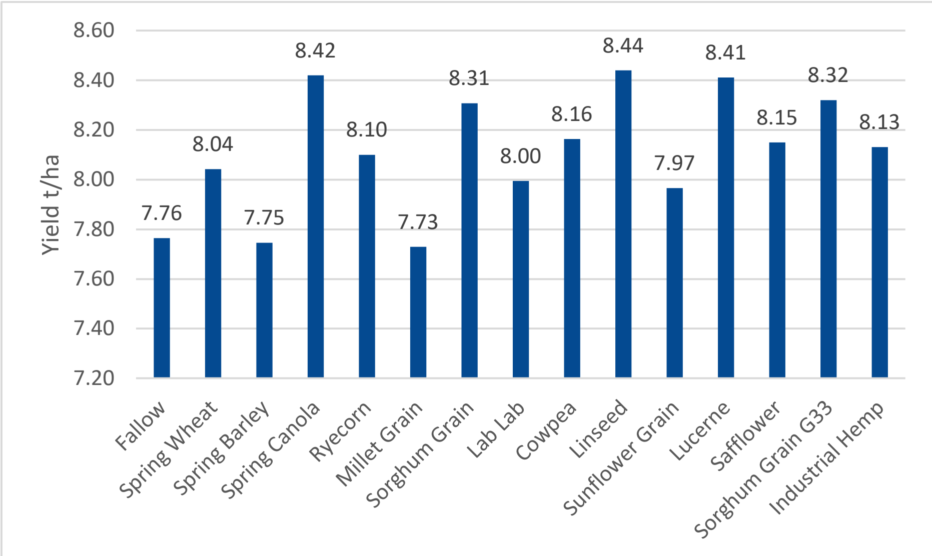

Figure 1: Grain yield (t/ha) for the barley sown over the Green Range small plot summer crop treatments, 2022.

Multi Crop Type Demonstrations – Scotts Brook & Green Range

Soil moisture (volumetric water content) data collected from both sites show that growing a summer crop increased the fallow efficiency i.e., there was more soil moisture in the soil profile for the following winter crop (Figure 2). This was particularly interesting given the dry summer over which the summer crops were grown. This may have been due to the summer crops providing soil cover and reducing evaporation and/or allowing rainfall that was received to better infiltrate into the soil profile rather than runoff.

The 2022 winter crop production at each of the multi crop type trials also highlighted that there was no significant yield disadvantage as a result of growing summer crops beforehand (Figure 3).

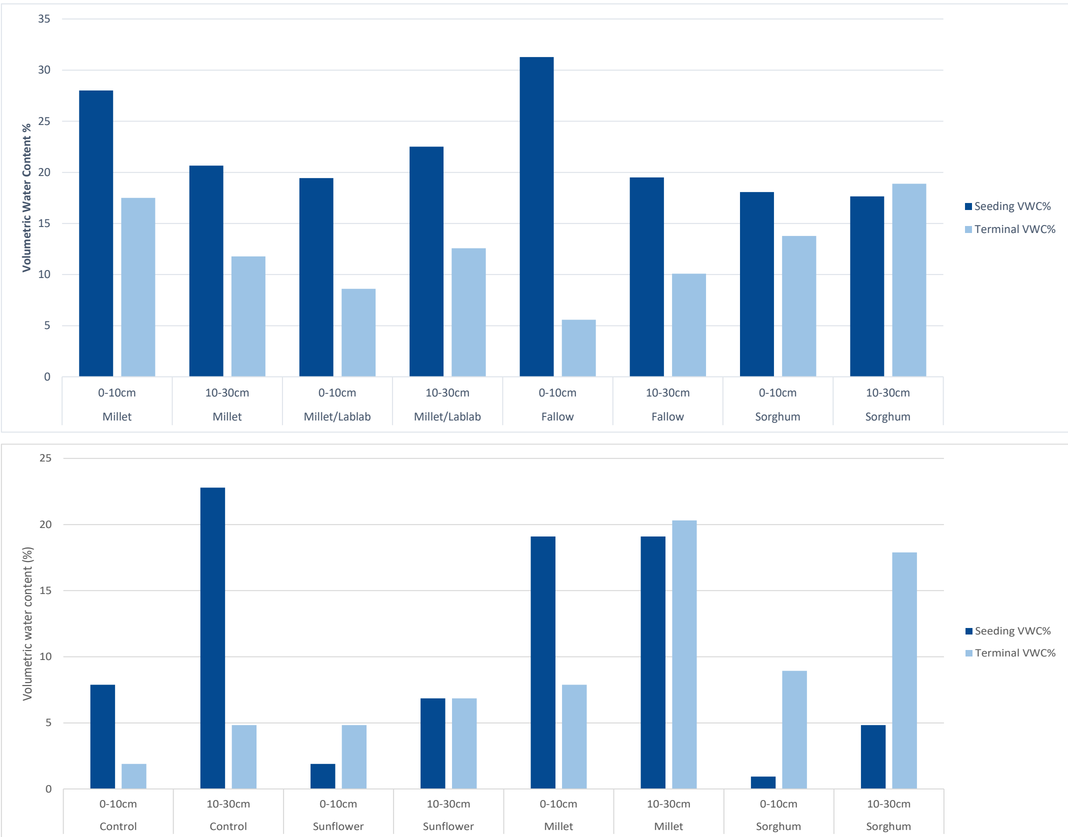

Figure 2: Starting and terminal volumetric water content percentage (VWC%) at Green Range (top) & Scotts Brook (bottom) for 0-10cm and 10-30cm soil depths, 2021/22.

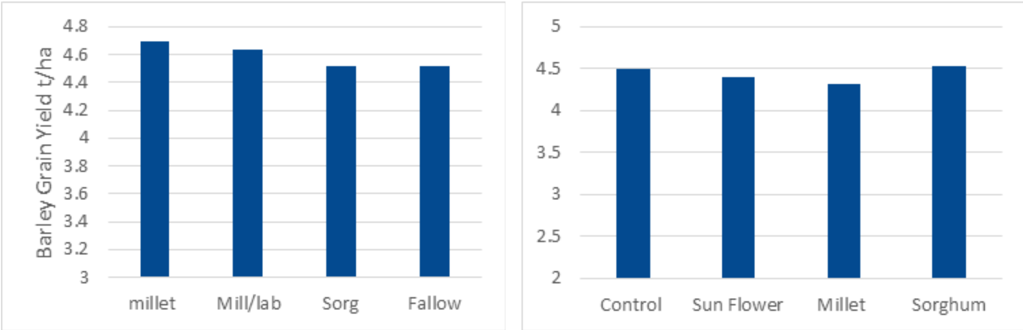

Figure 3: Grain yield (t/ha) for the barley sown over each of the summer cropping treatments at the Green Range demonstration (left) and winter wheat sown over each of the summer cropping treatments at the Scotts Brook demonstration (right), 2022.

Single Crop Type Demonstrations – Kojonup, South Stirlings and Wickepin

Each of the three farm-scale single crop demonstrations were sown with either winter canola or winter wheat, which were grazed and then taken through to harvest in 2022. Plant establishment and feed values were good across the board. Economic analysis completed showed that the grain yield was the driver of profit.

However, it could be argued that the grazing value of 90c/head/week was very conservative. The yield results from the harvest of the winter wheat at the Wickepin site, where two winter wheat varieties were grazed or ungrazed, shows that while selection of variety is important, grazing only had a minimal impact on yield (Figure 4).

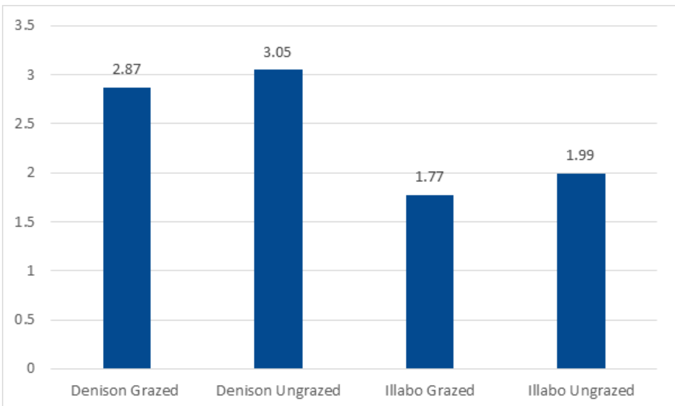

Figure 4: Grain yield for the winter wheats (Denison and Illabo), both grazed and un-grazed, at the Wickepin (WP) demonstration, 2022.

Conclusion

The results from the 2021/22 summer phase of this project highlight the viability of these crops in tough conditions and indicate that the risk of seeding summer crops could be significantly lower than the currently held consensus. A key learning from the 2022 growing season is that there was minimal impact of the summer crops on the following winter crops. It should be noted that 2022 was a very good season.

The final technical report for this project, compiling all the results, can be found on the SCF Website: www.scfarmers.org.au/summer-cropping

Acknowledgments

Stirlings to Coast Farmers would like to acknowledge Facey Group, Southern Dirt, Fitzgerald Biosphere Group, Nutrien Ag Solutions and Farmanco for assistance and collaboration in this project. Grateful acknowledgement also goes to GRDC (and the levy-paying growers) for investment in this project.

Impact of stubble height on cropping systems in the Western region

Host: Slade Family (Mount Barker).

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **The performance of strip & disc systems in the High Rainfall Zone (HRZ), compared to the more standard draper front & tyned seeder practice, will be assessed between 2021 and 2024.**
- **In 2022, the strip & disc treatments did result in a slight yield advantage. However, the high stubble loads led to a series of in season management issues i.e., spray efficacy.**
- **By 2024, this project will provide growers with key knowledge on stubble architecture and how this interacts with management variables, such as weed & disease control.**

Background

Stirlings to Coast Farmers (SCF) is taking part in a GRDC state-wide investment managed by the Liebe Group which commenced with the 2021 harvest and will run through until December 2024 (3 growing seasons).

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 utmost importance to ensuring the success of a continuous cropping system. However, the performance of the strip and disc system in high rainfall zones is still up for debate, with high stubble loads, increased weed pressure and slow stubble residue turnover rates needing to be considered.

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 stubble management systems.

Methodology/Treatments

The trial, located west of Mount Barker, is centred around four different stubble architecture treatments:

- Stripper front + disc seeder (strip & disc)
- Stripper front + speed tiller + disc seeder (strip & disc with tillage)
- Draper front high cut + disc seeder (draper-high & disc)
- Draper front standard cut + tyne seeder (draper & tyne – standard practice)

In 2022, the plots were seeded with canola, with the previous crop being barley in 2021. In 2021, all the harvest treatments were conducted with a draper front, with a standard cut height.

In 2021, baseline soil, biomass, yield, grain quality, weed, and stubble residue measurements were collected, so that changes throughout the time span of the project could be observed. In 2022, a broad range of variables that interact with stubble management were measured and will continue to be measured throughout 2023 and again in 2024. These include:

- Soil moisture - increases water infiltration and decreases evaporation.
- Weed germination due to levels disturbance.
- Soil structure
- Disease burden and carryover
- Hair pinning of stubble at seeding
- Herbicide tie up in stubble.
- Harvest weed seed control options.
- Pre-emergent herbicide efficacy

Notable Results - 2022

Seeding and plant establishment

Seeding canola into high barley stubble loads on a paddock with a history of non-wetting posed a significant issue. The 2021 barley crop produced an average yield of 7.4t/ha across the plotted area, which resulted in an extremely high stubble load at the time of seeding the 2022 canola crop (Figure 1).

The main effect of the high stubble load was inconsistent plant establishment and poor plant development. In particular, the heavy stubble cover resulted in an extremely staggered plant establishment in the stripper front plots where tillage was not applied. This was likely due to a combination of lack of sunlight and poor seed/soil contact due to the heavy residue cover on the ground. By contrast where the tillage was applied to the stripper straw, the emergence was more uniform (Figure 2).

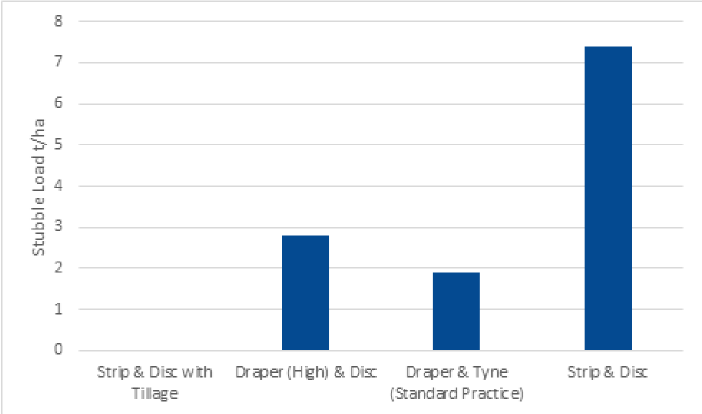

Figure 1. Stubble load (t/ha) at the time of seeding the 2022 crop.

Crop Nutrition

During the rosette stage, it was noted that the speed tilled plots looked to be slightly nitrogen deficient, with a touch of purple and yellowing in the leaves. This was likely a result of nitrogen tie-up early in the growing season resulting from the high residue load that was incorporated into the top 15cm of the soil profile by the tillage. By placing >6t/ha of stubble residue into the topsoil, the subsequent change in the C:N ratio likely resulted in nitrogen immobilisation, which occurs when the C:N ratio of the decomposing matter goes past net 30.

Spray efficacy

The results of the spray efficiency testing showed that there was a statistically significant difference (P=0.0064) between the stubble height treatments. 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

Figure 2. Heavy stubble residue leading to uneven plant emergence compared to a more even emergence in tilled plots with low residue.

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. This was probably due to an increased influence of the wind due to the boom being set 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 a greater variability in the spray coverage at ground level (Figure 3).

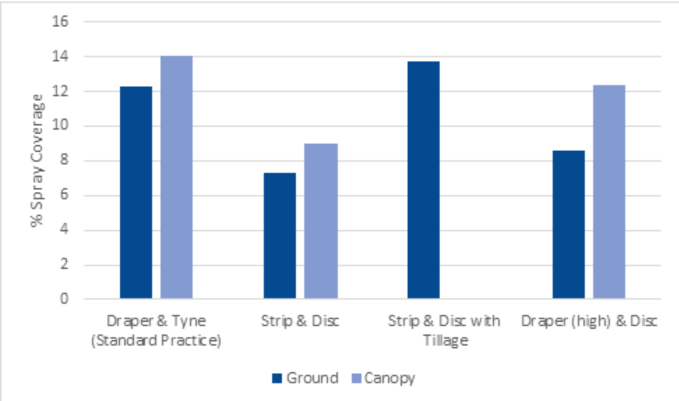

Figure 3. Pre-seeding spray efficacy (% coverage) for each treatment.

Harvest Yield & Grain Nitrogen %

The yield results show that the plots that were seeded after stripper front use at harvest the year before, performed better than those that had been previously harvested with a draper front, despite the poor plant establishment in the plots where the heavy residue impacted plant establishment (Figure 4).

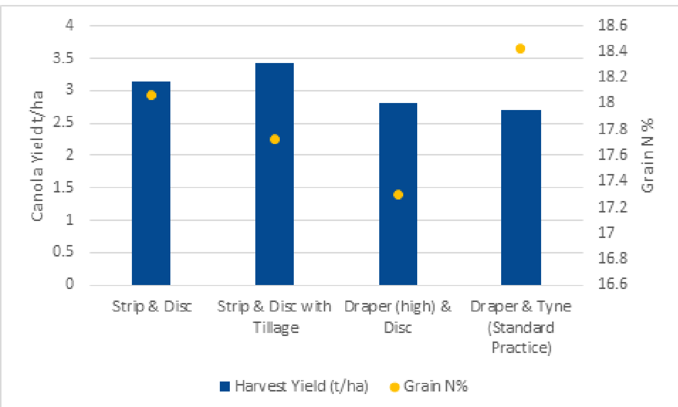

Figure 4. Canola yield (t/ha) and grain nitrogen (N) % for four different stubble architecture treatments for the 2022 season.

The strip and disc treatment yielded on average 3.14t/ha despite the poor plant establishment, while the strip/disc with tillage resulted in an average yield of 3.42t/ha. The higher yield where tillage was undertaken is representative of the good initial plant establishment and even plant growth development within these plots. Both plots seeded into the draper cut stubble yielded less than those seeded into the stripper front stubble. The standard practice control, which utilised draper front cut at approximately 12cm and tyne seeder was the worst performing plot treatment. However, the tyne seeder was loaned, and due to time constraints was not set up properly to interrow sow between the existing narrow row spacings (6.6 inch). As a result there was a lot of hairpinning and bulldozing of stubble residue.

Grain quality was largely uniform across all plots, with each making the CAN1 classification. Interestingly, there was a variance in grain nitrogen %, calculated from the grain protein using the nitrogen to protein ratio of 5.49, as outlined by the Canadian Grains Commission. The strip & disc with tillage plots had a lower grain nitrogen % compared to plots where tillage was not applied (Figure 4). This could be a symptom of the immobilisation of nitrogen resulting from the tillage.

Conclusion

The 2022 season was the first full season in the project where the crop was carried from seeding to harvest and allowed us to assess the carryover impact of the various stubble treatments. While the strip & disc treatments did result in a slight yield advantage, the high stubble loads led to a series of in season management issues. These management issues are likely to be exacerbated in the 2023 wheat crop with the high stubble loads of both the canola and previous year's barley yet to break down. The next two seasons will allow us to examine the long-term viability of a strip and disc system within the HRZ over a full rotation, where nutrition, disease and weed management pressures are likely to increase over time.

Acknowledgments

Stirlings to Coast Farmers would like to thank the Liebe Group for the opportunity to partner in this project, and GRDC (and the levy paying growers) for investing in the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

LIEBE GROUP

Harvest Losses

Hosts: Various farmers throughout SCF membership area.

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **Across the board losses were generally low.**
- **Front losses were a lot more variable and had a wide range of contributing factors.**
- **There is greater improvement to be made in front losses.**
- **Machine losses could be rectified easily within the paddock, whereas front losses could not.**
- **There appears to be a level at which losses cannot be improved, and as a result, the percentage of yield lost on low yielding crops is higher.**
- **Environmental factors play a much greater role in harvest losses than growers often factor in.**

Background

Stirlings to Coast Farmers took part in a GGA-led, GRDC investment that aimed to determine the current level of grain losses through the harvest process, including front and machine losses. This project was rolled out across the state and utillised the Bushel Plus system to ascertain the level of losses, with a focus on reducing losses in field. The 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.

Methodology

Across the five port zones 200 paddocks/machines were measured across a range of crop types to form a rigorous data set. Of the 200, 39 were captured within the Albany Port Zone (APZ) over the 2021 and 2022 harvests. Losses were measured on all common crop types, machines and fronts, across a range of yields. Losses were recorded using the Bushel Plus system and app, with growers able to make adjustments.

In 2022/23, SCF measured 12 participating crops that covered cereals, pulses, and oilseeds, all of varying yields and varieties. The academic consensus on acceptable harvest losses varies widely, however, 3% machine losses for cereals, and 1% for canola are widely accepted, with losses on pulses ranging from 5-20% depending on variety.

Results and Discussion

Harvest losses measured in 2021 in the APZ were within optimum range, and losses measured in 2022 were even lower again. However, this was more likely due to the higher yields (diluting the issue) rather than improved set-up. Compared to the rest of the state, the APZ losses were highly variable.

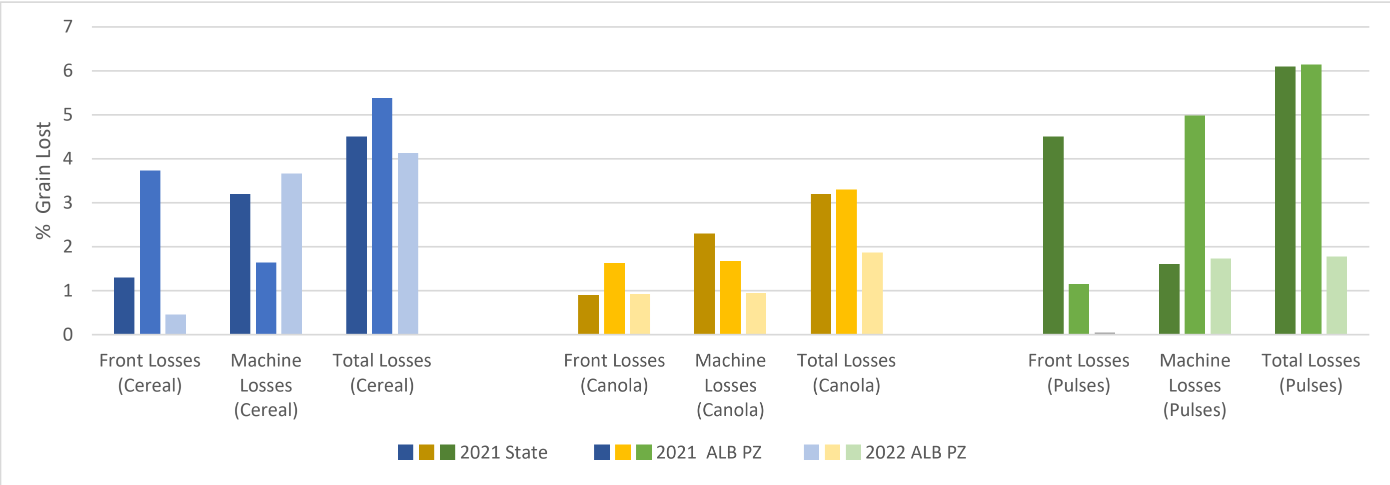

Figure 1. Average cereal, canola and pulse loss % attributed to front, machine and total for 2021 & 2022.

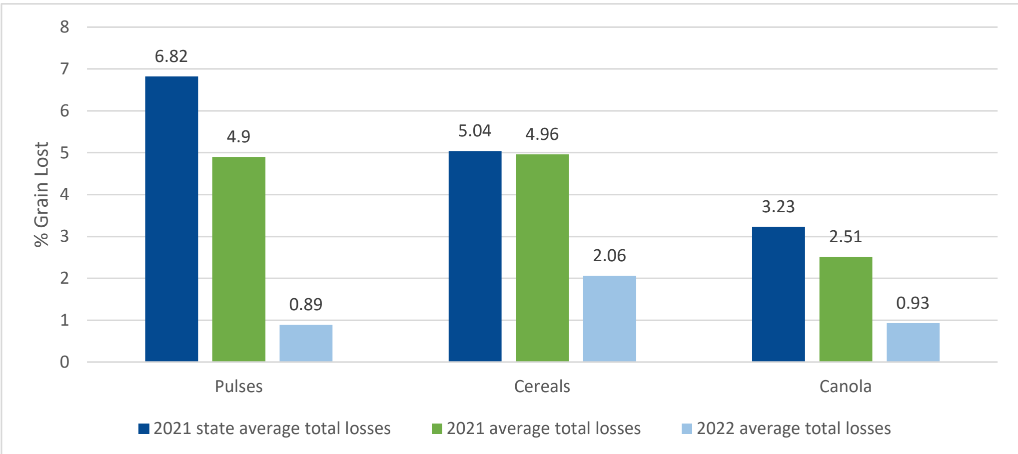

Figure 2. Average cereal, canola and pulse total loss % for the state and AP2 (2021) and APR (2022).

Conclusion

Although there appears to be continuing improvement, we can assume optimum seasonal conditions and high yields in 2022 played a role in this, essentially diluting the amount of grain lost. However, through ongoing extension and engagement with growers about the importance of measuring and minimising harvest losses, there is still scope for improvement within the Great Southern area. The Bushels plus system can be borrowed from SCF by members for future harvests.

Acknowledgments

Grateful acknowledgement to project lead GGA as well as GRDC (and the levy paying growers) for continued investment in the project.

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

GROWER GROUP ALLIANCE

Investigating late winter and early spring cereal cropping opportunities for grain growers following autumn waterlogging in Southwest Australia

Hosts: Walker Family (Green Range) and Turner Family (Needilup).

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **Two late-sown cereal small plot trials were implemented in the Albany Port Zone in 2022. Each included three times of sowing (between Aug-Sept), two wheat and three barley varieties, and two nitrogen strategies.**
- **Each time of sowing was seeded into a full soil moisture profile, with waterlogging present in some cases.**
- **Planet barley was behind in growth stage compared to the Maximus barley, Rosalind barley and the wheat varieties; however, this did not impact negatively on final yield.**
- **There was no significant yield or quality difference between the short season and main season varieties selected. Yield response to the nitrogen strategies was also variable.**

Background

The South Coast grain growing region of Western Australia is prone to waterlogging events that severely impact grain production. Waterlogging can reduce wheat yields in this region by up to 37% (Zhang et al, 2004). In the Albany Port Zone in 2021 and Esperance Port Zone in 2021 and 2022, large areas of crops remained unplanted well into July and August. This was due to crop failure or highly waterlogged soils making the paddocks non-trafficable for seeding machinery/equipment.

This one-year investment aimed to provide growers and advisors along the South Coast of WA with greater confidence to make decisions on whether to sow a cereal crop later in the growing season (late winter, early spring) after crop failure, or when there is an inability to seed, due to early season waterlogging. It also aimed to provide some data on what varieties (short or main season) and nitrogen fertiliser strategies might be required for later sown crops.

Methodology/Treatments

Four small plot trials, with similar treatments and trial designs, were implemented along the South Coast of WA in 2022. Two of these were in the Albany Port Zone (Green Range and Needilup) and two in the Esperance Port Zone (Munglinup and Condingup). Each trial site included:

- Three times of sowing (late August, mid-September, Late-September)
- Two wheat (Vixen and Scepter) and three barley (Maximus, Planet and Rosalind) varieties
- Two nitrogen treatments (High - 80 units of nitrogen, Low - 40 units of nitrogen)

The trials were sown by experienced trial providers and were monitored throughout the growing season. Measurements for each treatment across each time of sowing included:

- Plant establishment (plants/m2)
- Growth stages

- Harvest yield (t/ha)
- Grain protein (%)

Results and Discussion

The results presented below are for the two Albany Port Zone sites, located in Green Range and Needilup.

Plant establishment

At the Green Range trial site, plant counts were adequate across all treatments and times of sowing with limited variability. At the Needilup site, although plant counts were good in general, plant counts were noticeably higher in the second time of sowing. Across all trial sites, there was no relationship between plant counts and higher yields.

Growth Stages

Maximus barley caught up with Rosalind barley and Scepter wheat, and in most cases, was not far behind Vixen wheat. This was not the case for Planet barley, which was behind in growth stage for most sites in comparison to the other two barley varieties (Figure 1 & 2).

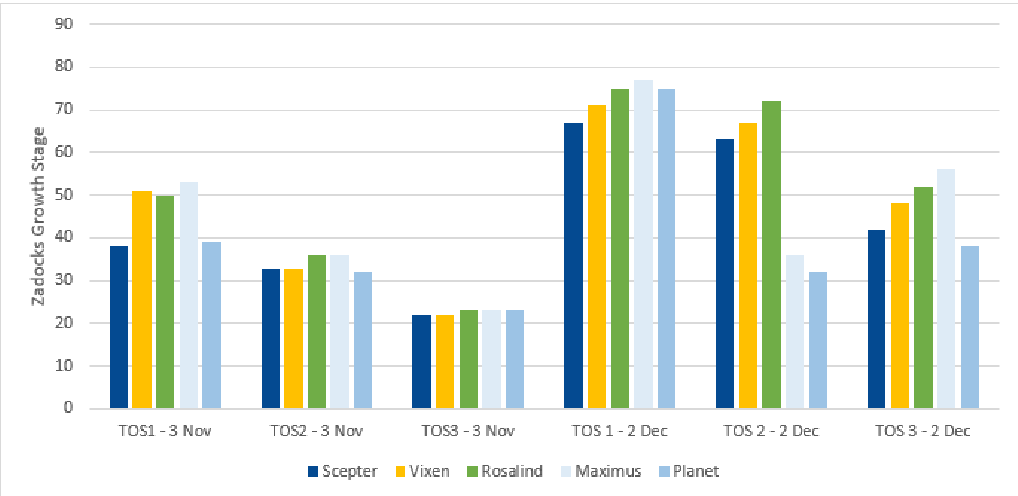

Figure 1. Average growth stage (Zadoks scale) for each variety at two dates (3 Nov & 2 Dec) within the growing season at the Green Range trial site, 2022.

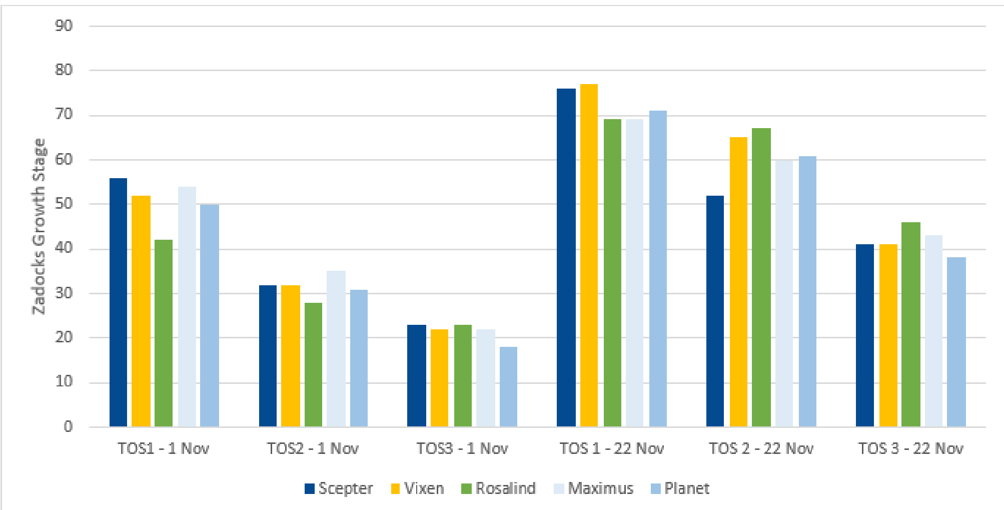

Figure 2. Average growth stage (Zadoks scale) for each variety at two dates (3 Nov & 2 Dec) within the growing season at the Needilup trial site, 2022.

Harvest Yield

At the Green Range trial site, there was a strong decreasing trend in yield with the later times of sowing across all varieties and nutrition treatments (Figure 3). In some cases, the yield difference between the second and third time of sowing was minimal i.e., Maximus (L), Rosalind (L) and Scepter (L). It is likely that in these treatments the second time of sowing yield was held back by limited nitrogen. It should also be noted that there was some bird damage in both the second and third times of sowing, mostly in the Rosalind and Maximus plots.

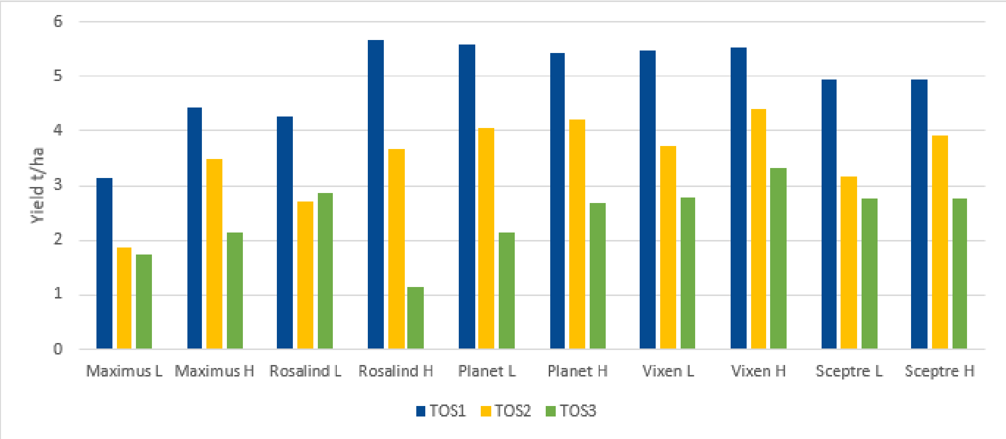

Figure 3. Average harvest yields for each treatment across each TOS at the Green Range trial site, 2022.

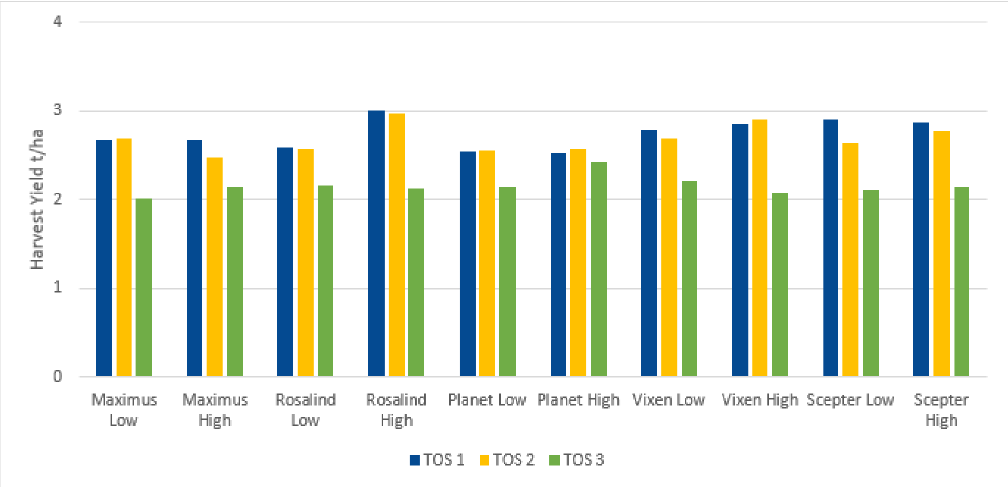

Figure 4. Average harvest yields for each treatment across each TOS at the Needilup trial site, 2022.

Table 1: Average yield at all sites with TOS2+3 expressed as a percentage of TOS 1 yield.

Crop type & location	TOS1 Yield (t/ha)	TOS2 as a % of TOS1 Yield	TOS3 as a % of TOS1 Yield
Green Range Barley	4.74	69.6%	46.5%
Green Range Wheat	5.22	72.7%	55.7%
Needilup Barley	2.67	99.0%	81.8%
Needilup Wheat	2.87	96.3%	74.8%

The average cereal yields for the Needilup site were significantly lower than all other sites (Figure 4). This site did not receive the rainfall between August and December that the other three sites received. Interestingly at this site, the first and second time of sowing treatments were more similar in yield compared to the third time of sowing, and overall, there was only approximately a 1 t/ha yield difference between the highest and lowest yields across all treatments and sowing times (Table 1).

Grain Protein

Grain protein at the two sites ranged between 9 and 13%. Green Range protein % was lower than the Needilup site, particularly for the Planet barley and the wheat varieties. At this site, grain protein did not significantly differ with increased nitrogen application, however, the increase in protein was noticeable in the lower yielding third time of sowing treatments (Planet barley and wheat). This points to the higher yields diluting the protein %, making a case for increasing nitrogen fertiliser rates in the earlier sown treatments. At the Needilup trial site, grain protein showed variable results between the high and low nitrogen fertiliser rates. It was somewhat apparent in the wheat that the third time of sowing had higher protein than the first and second. This was not a trend that occured in the barley.

Conclusion

The trial sites implemented as part of this project have demonstrated the adaptability of cereal cropping systems along the South Coast of WA. The data gathered from each trial site shows that seeding cereals in late-winter and/or early spring was profitable in the favourable conditions of 2022. To further increase confidence in late sowing decisions, many growers are keen to understand how cereal crops sown late into adequate moisture may yield when the season finish is warmer and drier, given 2022 was a particularly wet season with a soft finish. More trial work will be conducted in 2023 to further validate the productivity of late sown cereals.

Acknowledgments

These trials are part of a GRDC investment led by Stirlings to Coast Farmers (SCF), in partnership with Fitzgerald Biosphere Group (FBG), Southeast Premium Wheat Growers Association (SEPWA), South East Agronomy Research and Nutrien Ag Solutions.

Closing the Economic Yield Gap for Grain Legumes in Western Australia

SCF Component – Demonstration of impact of sowing time and row spacing on faba bean disease and productivity.

Host: Preston Family (West Cranbrook).

By: Lizzie von Perger, CEO, SCF

KEY MESSAGES:

- **In a wet year, sowing legumes earlier is likely to be more profitable.**
- **Higher legume yields may be achieved with narrow row (25mm) spacing, compared to a wide row spacing (50mm).**
- **PBA Bendoc faba beans can significantly outyield PBA Amberley faba beans.**
- **The improved disease rating in PBA Amberley may not decrease disease loading in a high-pressure environment or translate to yield improvement (in comparison with PBA Bendoc).**
- **PBA Bendoc faba beans yielded higher than lupins when sown in April but lupins outyielded both varieties of faba beans at a later time of sowing (June).**
- **Faba bean seeding rates as low as 120 kg/ha can still result in more than 20 plants/m2 (20-25 recommended) and do not impact on grain yield compared to a higher seeding rate (180 kg/ha).**

Background

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. Lupins were added to the trial design to allow SCF to compare the productivity and profitability of the two pulse crops in the trial.

Faba beans require more protection from disease than any other common broad-acre crops 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 wanted to know if sowing later lowers the disease pressure and reduces the number of fungicide applications.

The small plot trial looked at the interaction between row spacing, disease levels and sowing times. The wider the row, the lower humidity is, 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.

Methodology/Treatments

The small plot trial was located in West Cranbrook. The six treatments were sown at two separate sowing times and included:

- PBA Amberley faba beans sown on 25mm tyne spacing
- PBA Amberley faba beans sown on 50mm tyne spacing
- PBA Bendoc faba beans sown on 25mm tyne spacing
- PBA Bendoc faba beans sown on 50mm tyne spacing
- PBA Jurien lupins sown on 25mm tyne spacing
- PBA Jurien lupins sown on 50mm tyne spacing

Living Farm seeded the first time of sowing (TOS) on April 22nd, 2022, and second TOS on June 9th, 2022. The SCF R&D team completed most of the trial site observations during the growing season which included:

- Plant counts
- Disease ratings
- Nodulation scoring
- Lodging scoring
- Grain harvest

Best practice agronomic management for growing pulse crops was undertaken to ensure other factors did not impact on the experimental variables of sowing time, row spacing and crop type/variety. These agronomic factors included plant nutrition, rhizobium inoculation, herbicide control and fungicide management.

Results & Discussion

Plant counts

The PBA Amberley cultivar resulted in a slightly higher plant establishment compared to the PBA Bendoc across both row spacings. This could have come down to seed size and weight, given the plots were planted to kg/ha rate rather than a targeted seeds/plants per m^2. Plant numbers at the post germination stage did not have a significant impact on final harvest yield.

Disease Assessments

The crop disease assessments (at flowering) showed the disease burden to be evenly and randomly distributed between plots from the same TOS (Table 1) and there was no advantage between row spacing or the variety. It is interesting that these results contradict the idea that seeding on 500mm alleviates disease pressure somewhat, although this might have been due to the high disease pressure in the trial i.e., row spacing may have had more of an impact where disease was lower. There was a significant disease difference in the faba beans between TOS1 and TOS2. TOS2 had less disease, however, was waterlogged, accumulated less biomass, and was seeded in cold and wet weather that then continued throughout winter. These conditions were not conducive to disease growth.

Nodulation Scoring

Table 1 - Small plot legume average disease assessment score

Legume	TOS1	TOS2
Faba beans- Amberley	2.84	1.00
Lupins- Jurien	0.915	1.17
Faba beans- Bendoc	2.98	1.47

In the trial, nodulation score assessment averages showed no significant difference between faba bean varieties across both times of sowing (Table 2). There was, however, a significant difference in nodulation between the two times of sowing for both faba beans and lupins. For TOS1, averages were between 4-5 (adequate to abundant scores). And for TOS 2, these were 1.2 and 1.8, much lower – most likely a symptom of the waterlogging and less time available for nodulation.

Table 2 - Small plot trial legume nodulation scores by TOS

Legume	TOS1	TOS2
Lupins - Jurien	4	1.8
Faba Beans - Bendoc	5	1.2
Faba Beans - Amberley	4.6	1.7

Grain Yield

All three crop types generally yielded better on the narrow row spacing, compared to the wide row spacing, and the first time of sowing yielded higher than the second time of sowing (Figures 1 and 2). Most growers in the region sow their legumes on wider row spacings, which does result in messing around with seeding gear at an already busy time, as it is believed this reduces the disease pressure. This was not represented in this trial and warrants further investigation. If further work does confirm that standard (narrow) row spacings yield higher, it may make legumes a more attractive prospect (profitable and practical) for many growers.

Overall, PBA Bendoc significantly out yielded PBA Amberley, which claims to have better disease resistance. As such, it is likely that the yield advantages between the crop types were not primarily driven by disease.

Both faba bean varieties outyielded the lupins in the first time of sowing. This was reversed for the second time of sowing (Figures 1 & 2).

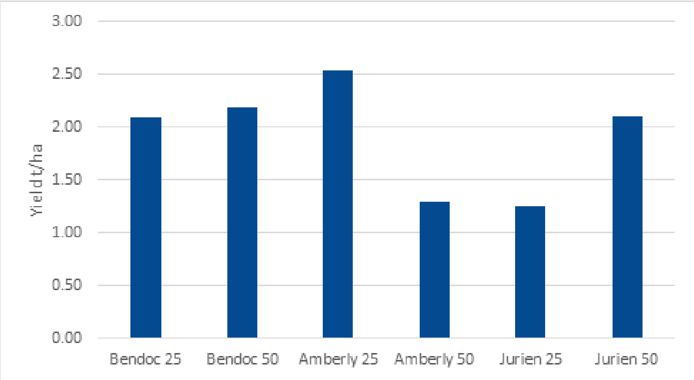

Figure 1: Small plot trial yields by variety and row spacing for TOS1

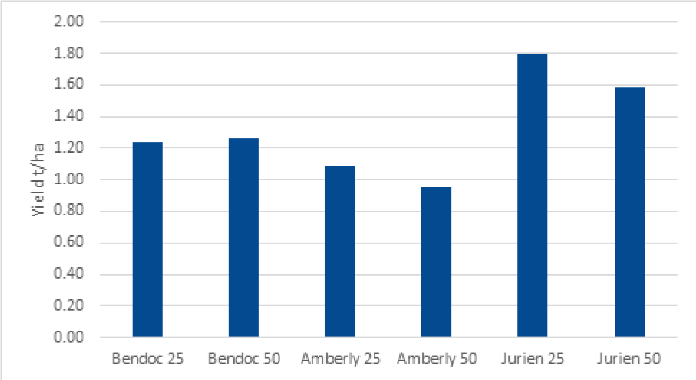

Figure 2: Small plot trial yields by variety and row spacing for TOS2

Conclusion

At the beginning of 2022 the trial location experienced a wet, slow start to the growing season. This particularly impacted on the TOS2 treatment which struggled to get going and was therefore affected more by waterlogging, yielding much less overall than TOS1. This indicates that an earlier time of sowing for legumes, particularly in a wet year, is likely to be more profitable.

Narrow row spaced treatments yielded better than the wide row spaced treatments and PBA Bendoc yielded better than the PBA Amberley. Both results were somewhat surprising and warrant further investigation.

Acknowledgments

Grateful acknowledgement to GRDC (and the levy paying growers) for investment in the project and to Living Farm for trial management.

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Understanding return on investment of sub-surface water management options for waterlogged areas in the Western Region (Albany Port Zone)

Hosts: Preston Family (West Cranbrook) and Allison Family (Perillup).

By: Philip Honey, Smart Farms Co-ordiantor, SCF

KEY MESSAGES:

- **Yield gains from implementing sub-surface drainage at the Cranbrook Sub Surface Drainage Demonstration site equated to a net 1.23 – 1.28 t/ha yield increase in 45Y28 canola in 2022.**
- **Yield gains from implementing sub-surface drainage at the Perillup Sub Surface Drainage Demonstration site equated to a net 1.46 t/ha yield increase in 45Y95 CL canola in 2022.**
- **Sub-surface drainage is a waterlogging management solution that requires substantial upfront investment from growers, with fully "installed" costs typically estimated around $13,500 - $15,000/km.**

Background

Waterlogging is a common problem within the southwest region of Western Australia, 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. Left unmanaged, waterlogging can lead to soil structural decline and has the potential to create nutrient deficiencies & toxicities (such as Iron & Manganese toxicity), cause root death/reduced plant growth, or worst case, result in death of the plant.

Methodology/Treatments

Two subsurface demonstration sites have been established in the Albany Port Zone, with demonstration sites established West of Cranbrook (2021) and at Perillup (2022). At each demonstration site, Drainage Downunder installed 100mm slotted pipe at depth in the pre-selected trial area. The process involves running a mechanical chain-saw-styled trencher through the ground sub-surface to leave a trench, inserting the slotted pipe into the ground, and then in-filling above the pipe with Limestone caprock to allow water permeability. The drainage was designed with GPS elevation data, to ensure that there was sufficient fall in the pipe to allow the water to flow freely without impediment. Each trial site comprises of sub-surface drainage (slotted pipe) installed at depth across a minimum of 2 hectares. A control region prone to waterlogging (no-pipe installed) and a non-waterlogging site located upslope are utilised within the same paddock, to enable the ability to do a comparative yield analysis.

Results and Discussion

West Cranbrook Site:

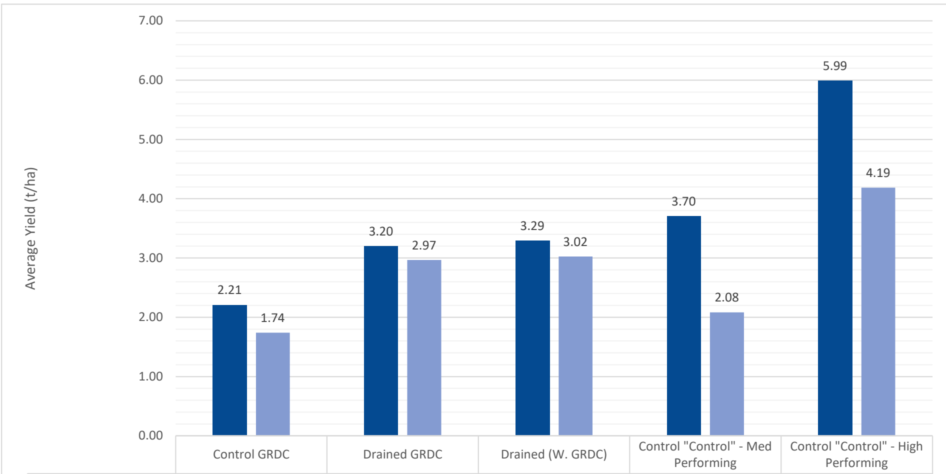
2022 was the second year of field measurements for the Cranbrook demonstration site, with seasonal conditions finishing above average rainfall. Annual rainfall equated to 569mm for the year, with a growing season rainfall recorded of 454mm. Overall, the 2022 growing season rainfall levels led to waterlogging conditions being experienced in the control section of the drainage trial.

Drone imagery captured on the 5th of October 2022 visually captured a significant reduction in healthy biomass in the control region, and relatively healthy biomass levels were visible where drainage had been installed (red lines) as shown in Figure 1. At the ground level, water pooled at

Figure 1: Drone imagery capturing waterlogging conditions experienced on 5th October 2022, and a visible reduction in plant health evidenced in the control region, to the left of the drainage lines.

the surface in the control plot, and the canola plants had significantly lodged.

In mid-December 2022, the paddock was harvested by the Preston family. Overall, Canola yields were approximately 1.25 t/ha higher in the drained regions (2.97 – 3.02 tonnes/ha) compared to the control treatment (1.74t/ha). Two additional areas were also assessed at harvest where there was no drainage installed and where it was deemed 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 non-waterlogging high-performing areas, then there is a potential yield opportunity of up to 1.17t/ha more yield potentially available. Unfortunately, the previously planned 'medium performing' soil didn't perform as well as the previous year, recording a yield value of 2.08 tonnes to the hectare, which was below the recorded yield values in the drained site (Figure 2).



	Control GRDC	Drained GRDC	Drained (W. GRDC)	Control "Control" - Med Performing	Control "Control" - High Performing
2021 (Barley - Flinders)	2.21	3.20	3.29	3.70	5.99
2022 (Canola - 45Y98)	1.74	2.97	3.02	2.08	4.19

Figure 2: Final yields (t/Ha) obtained at the Preston Sub-Surface Drainage Site at Cranbrook in 2022.

Trials Site 2: Perillup

2022 was the first year of measurements for the recently installed demonstration site at Perillup, with rainfall values exceeding 709mm for the year, and 534mm for the growing season. Soil conditions for sowing were relatively dry despite the previous seasons' rainfall, and germination was patchy initially dependent on soil type within the paddock. Overall, rainfall typically tracked below the median 20-year average until late July, where the season turned around and tracked above median conditions. Given the cool conditions leading from spring into summer, the canola crop experienced optimal finishing conditions, with desiccation occurring in late November/early December, and harvesting beginning just prior to Christmas.

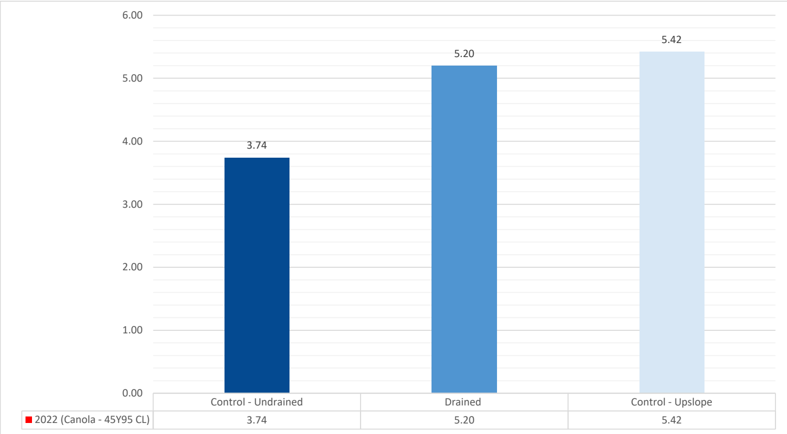


Figure 3: Final yields recorded at the Perillup Sub Surface Drainage Demonstration Site for the 2022 growing season.

The 45Y95 CL canola was harvested 20th December 2022 and yield data analysed for the drained region, undrained control and upslope (non-waterlogging) control within the paddock. Yield benefits for installed sub-surface drainage medium overall were positive, with 5.2t/ha yield recorded in the drained, and 3.74 tonne/ha recorded in the undrained control. The upslope control located nearby, within the same paddock yielded slightly higher than the drained, achieving a final average yield of 5.42 tonnes to the hectare.

Conclusion & Future Opportunities

The use of Sub Surface Drainage has once again shown a positive effect on final yields obtained for the 2022 growing season, despite a relatively dry start and a wet, cool finish. Yield differences were positive for the Preston site, expressing a 1.25 t/ha canola yield benefit, and a 1.46 t/ha canola yield benefit at the Allison family farm between drained and undrained regions of the paddock.

Taking into consideration previous yield increases from 2021 barley (47% yield increase) and combining it with the 2022 canola yield increase (72.5%) against the undrained treatments, the Cranbrook demonstration site shows significant positive potential yield benefits (circa 59%) from implementing sub-surface drainage across two above-median rainfall seasons. Initial, first-year yield increase responses at Perillup indicate that yield increases of circa 39% are possible.

As noted in the previous annual report, with installation costs in the order of approximately $13,500 - $15,000 per kilometre fully installed (purchase of pipe & limestone rubble, installation charges)*, getting the installation locations of pipework perfected will continue to be critical to ensure that the economic efficiency of subsurface drainage is maximised.

Prior back-of-envelope calculations for applying drainage to the remaining waterlogged regions of the West Cranbrook site estimated that there is a potential payback period of approximately 3.8 years to occur, pending a median barley grain sale price ($250/t) being achieved and similar yield differences as occurred in 2021 at the Cranbrook demonstration site. Utilising the same calculations comprising of a median canola price ($580/t) for 2022 and utilising the same neighbouring yield opportunity values, there could be an assumed $32,201 'lost yield opportunity' due to waterlogging, equating to a 1.52 years (canola) payback period on investment, with the same pricing/yield assumptions. Whilst installation comes at a cost, it certainly does raise some questions as to what the potential payback period might be for other areas within the region.

* Pricing is based upon a wide range of factors including area drained, drained soil types, availability of drainage pipe, freight and availability of limestone rubble, access to machinery and associated mobilisation/installation costs.

Acknowledgments

Grateful acknowledgement to GRDC (and the levy paying growers) for investment in the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Soilborne pathogen identification and management strategies for winter cereals

Host: Hunt family (Woogenellup).

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- The low pathogenic load at the site over the two years of the project meant visible plant symptoms were minimal.
- PREDICTA® B is critical to identifying the risk posed by soil pathogens.
- There are very few treatments available for soil pathogens. Informed decision making on appropriate rotations is the best tool for minimising yield loss.

Background

Soilborne pathogens and disease pose a significant risk to crop production in the southern region of WA. It has been estimated that soilborne diseases cost Australian grain growers over $370 million each year. In Western Australia, rotations are already tight and there is limited non-host crop options. On top of this, soilborne diseases are often hard to detect in the field as their symptoms mirror those of common nutrient and environmental stressors. To further complicate identification, many of the observable crop symptoms can be similar between different pathogens and plant parasitic nematodes. Seasonal conditions can also either exacerbate or suppress the in-crop symptoms of soilborne diseases.

The main diseases detected in the Western Australian grain growing region are rhizoctonia root rot, crown rot, root lesion nematodes (RLN), and an increased risk of cereal cyst nematode (CCN) and take-all.

Methodology/Treatments

As part of an investment from the GRDC, Stirlings to Coast Farmers established a trial site in Woogenellup, in a paddock which the farmer suspected had soilborne pathogen issues. This site was monitored over two growing seasons, with the aim to provide opportunities for growers and agronomists to learn about the pathogens, their diseases, diagnosis, and management options.

In 2021, the treatment plots were seeded with various crop types (barley x 2, wheat and vetch) or left as fallow. In this year, one of the barley treatments were sown with Uniform (the other not) and the wheat was also sown with Uniform.

The two treated plots for 2021 focused on rhizoctonia management, where Uniform was applied at 300ml on the fertiliser.

In 2022, the whole site was seeded with wheat (no Uniform).

Table 1: Live plant assessment of disease in 2022 for each treatment over-sown in year two with wheat, Woogenellup.

2021 Treatment (over-sown with wheat in 2022)	Rhizoctonia solani	Crown Rot	Nematodes
Wheat Untreated	Not detected	Not detected	
Barley Untreated	Not detected	Not detected	860 per gram of root
Vetch	Not detected	Not detected	1947 per gram of root
Wheat Treated	Not detected	Not detected	
Barley Treated	Not detected	Not detected	

Results and Discussion

Pathogenic load – PREDICTA ® B and live plant sampling

The baseline pathogen load at the start of the 2021 season was measured via PREDICTA® B. The 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. By the end of the 2021 season there had been no change in the pathogenic load within the soil. It was suspected that the extremely wet season in 2021 limited pathogen activity, and that a greater differential would be observed in 2022 when the plots were over sown with wheat.

In 2022, there were slight changes in the loading of the soilborne pathogens, however, each pathogen load was classified as low. The results were also inconclusive as to whether the 2021 Uniform treatment or the vetch break crop reduced the presence of rhizoctonia.

Live plant sampling

The 2022 live plant samples showed minimal pathogen presence, which reinforces the lack of visible symptoms seen in the paddock (Table 1). The two above average rainfall seasons, particularly early in the plant's growth stages, likely suppressed pathogenic activity leading to very low infection rates.

Conclusion

Although the host farmer suspected that there had been a presence of soilborne disease in the paddock, the pre-season PREDICTA® B samples revealed minimal pathogens within the treatment areas. This trial highlights the difficulty in measuring and identifying soil pathogens in the field. While it is critical that farmers can visually identify soilborne pathogens, environmental conditions can often supress the symptoms, complicating the issue. For example, in the last two seasons there was above average rainfall, particularly in the early part of the growing season. Increased rainfall reduces the visible symptoms of many soil pathogens that impact root growth, as ample water is available within the reduced root area. Also, when early season infection occurs, it is unlikely that symptoms will be visible without removing plants and inspecting roots, as bare patches from diseases such as Take-All are yet to be visible.

The fact that soil pathogens can co-exist also makes identification incredibly difficult without testing plants or at the very least removing suspect plants and examining the roots. The workshops held as part of this project and run by DPIRD pathologists, allowed farmers to learn how to identify root symptoms, where they suspected pathogens might exist. However, pre-season PREDICTA® B testing is the only way to be certain of soil pathogen activity within a paddock. These tests are critical in identifying the risk of soilborne pathogens, which can allow farmers to make rotational decisions to prevent yield loss.

Acknowledgments

Grateful acknowledgement to project lead GGA as well as GRDC (and the levy paying growers) for continued investment in the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

GROWER GROUP ALLIANCE

Post-seeding Ripping

Host: Williss Family (South Stirlings).

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **The deep ripping implemented in 2021 (pre- and post-seeding) was effective in reducing the soil strength (soil compaction) in both 2021 and 2022, however, no significant difference between ripping timing was observed.**
- **Post-seeding ripping significantly reduced barley yields in 2021, with the highest yields observed in the pre-seeding ripping treatments.**
- **The benefits of ripping were observed in all ripped treatments, regardless of timing, in the following canola crop in 2022.**
- **If post-seeding ripping is to be undertaken, seeding a lower-value crop or attempting to rip between wide sown legumes may be a better option.**

Background

This project was undertaken to build on the extensive work that has been conducted to determine how deep ripping can be best implemented to improve crop production in Western Australia. Deep ripping is an effective amelioration technique on the sandplains, and sandy duplex soils common to the lower Great Southern region of Western Australia. Deep ripping has become a best practice agronomic tool on these responsive and easily compacted soil types.

However, the window in which deep ripping can be effectively implemented whilst minimising erosion risk is narrow and varies depending on when the season break occurs. As a result, most deep ripping is currently being implemented in the narrow window after the autumn break and prior to seeding, or opportunistically after a late summer rain event. Given there is a tendency to sow earlier in the WA HRZ, the ideal window for deep ripping is shrinking further, forcing farmers to choose between risking wind erosion by ripping prior to the seasonal break or to delay seeding.

This trial investigated whether there is an opportunity for deep ripping to take place outside the narrow window prior to seeding.

Methodology

The post season ripping trial was located at Takalarup, on a shallow sand over clay duplex soil. The ripping treatments were implemented post-seeding in 2021 and each treatment was replicated twice and randomised, with extra control and tramline buffer plots to bolster the baseline data. The 2021 treatments included:

- Nil ripping (control)
- Pre-seeding ripping (standard practice)
- 1-week post-seeding ripping
- 3-weeks post-seeding ripping
- 6-weeks post-seeding ripping

Measurements were undertaken in the 2021 (barley) crop and the following 2022 (canola) crop and included:

- Soil Strength (CP200 cone penetrometer)
- Plant establishment and tillering (counts)
- Plant biomass (dry matter t/ha)
- Harvest yield (t/ha)

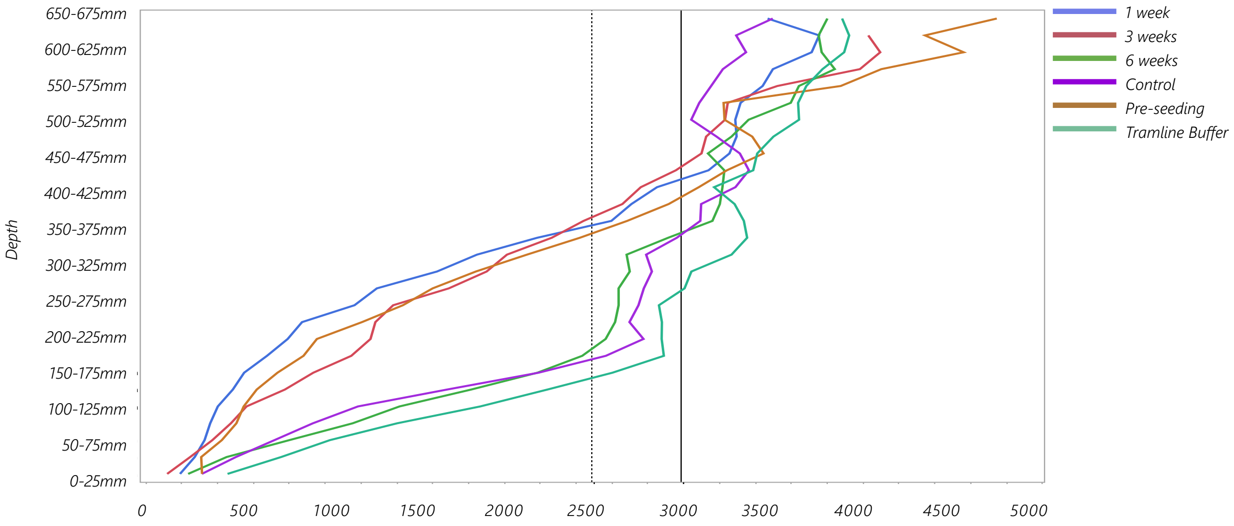


Figure 1: Graph of mean soil strength (kPa), 2022

Results and Discussion

The results described below are predominantly for the 2022 season only as 2021 results were included in the 2021 Trials Review Booklet.

The penetrometer data collected in 2022 found that all ripping treatments were effective in reducing soil strength (Figure 1) and there was no advantage in the effectiveness of deep ripping to reduce soil strength when conducted post seeding as opposed to pre-seeding. This corresponded to the 2021 penetrometer data.

Although the 2021 results showed the post-seeding ripping treatments significantly reduced the plant and tiller counts, there was no significant difference in the establishment of canola in 2022 between the previous year's ripping treatments. The biomass results in 2021 echoed those of crop establishment, with the biomass being significantly reduced in the post-seeding ripped treatments. It should be noted that each plot was subject to yield limiting waterlogging, which likely reduced the yield potential of all the plots.

Barley yields in 2021 were significantly reduced in the post-seeding ripped treatments (Figure 2), with the barley yielding highest in the pre-seeding ripped treatments (standard practice). In 2022, there appeared to be some influence of the ripping treatments on canola yields (Figure 3). Although it is not statistically significant, all four of the ripping treatments outyielded the untreated control, suggesting that the deep ripping is still having positive influence on yield, one year on. There was no significant difference when comparing the ripping treatments, suggesting that the timing of the deep ripping had no ongoing influence on yield.

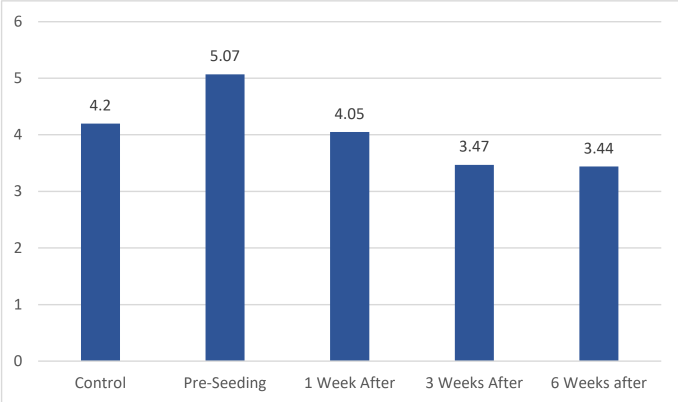


Figure 2: Barley yield t/ha for each treatment, 2021

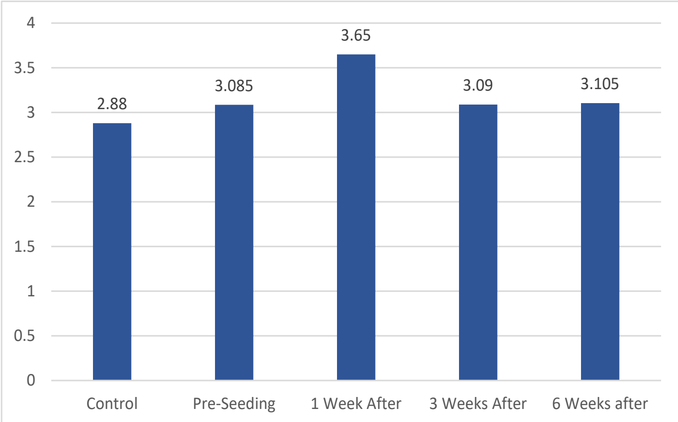
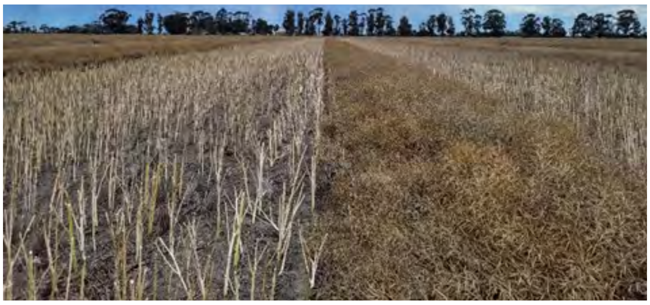


Figure 3: Canola yield t/ha for each treatment, 2022

Conclusion

While the yield advantage resulting from the deep ripped treatments in 2022 was rather small (200-600kg/ha of canola) the high commodity price of canola ($850/t) resulted in an economic advantage of between $170 and $510/ha. This economic gain in 2022 largely offsets the losses resulting from the crop damage sustained in the barley in the 2021 season (730kg/ha) where the barley price was approximately $300/t. Given that the effects of deep ripping to depths of 500mm often last four seasons, it is likely the ripped plots will continue to outperform the control area, driving additional economic benefits from the



2022 - Canola pre-seeding rip treatment

2022 - Canola un-ripped control

deep ripping for a couple of years to come. This makes the post-seeding deep ripping an economically viable strategy; however, it is not as profitable as pre-seeding deep ripping.

It should be noted that the economic return from the deep ripping post-seeding, and the ability to recoup the losses sustained in the first season would be dependent on the value of the commodity that was planted in that initial season.

Finally, there may be some other in-season ripping opportunities that could be explored i.e., ripping between rows of wide sown legumes, or ripping before seeding late sown cereals.

Acknowledgments

Grateful acknowledgement to GRDC (and the levy paying growers) for continued investment in the project.

The impact of frost over different crop types and sowing time

Host: Amelup Estate (Amelup)

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- The Amelup frost trial site was subjected to 20 frost events between June and October, with the most significant events on 31 June, 24 & 25 September 2022.
- For TOS1 (sown 28 April 2022), all cereals were impacted by frost. Most severely impacted were the spring wheat (Scepter) and mid-spring wheat (Rockstar) at 59% and 47% damaged grains respectively. Denison wheat (long spring) was significantly less impacted with 24% damaged grains. The damage was also represented in the harvest yields.
- All cereals (with exception of oats) yielded higher in TOS2 (sown 6 June 2022), demonstrating the significant impact of frost on the earlier sown treatments.
- Oats yielded well irrespective of the time of sowing, clearly demonstrating their tolerance of frost.
- Canola and lupins yielded well in TOS1, demonstrating that their indeterminate flowering nature can assist with recovery from frost, especially with a soft finish. Both yielded less in TOS2, however, this was due to the cooler daytime temperatures and waterlogging impacting the establishment and early biomass production, rather than frost.

Background

In WA the impact of frost on grain yield is estimated to be on average $400 million dollars a year. The GRDC invested in a project led by the Grower Group Alliance (GGA) with the purpose to extend and apply the outcomes of previous Research and Development investments relating to frost, and to build knowledge that will inform grower and advisor decisions relating to pre-season planning, in-season management, and post-frost event responses.

The Stirlings to Coast Farmers-led trial at Amelup was one component of this larger extension investment. This trial aimed to assess a range of crop types and cultivars over two times of sowing, with the purpose of evaluating the frost risk of the different cultivars when planted early or late in the season, and ultimately how this affected yield.

Methodology/Treatments

The trial site selected by Stirlings to Coast Farmers was in Amelup, in a frost-prone, low-lying area of the property, which is typified by a rolling topography, and is next to the Pallinup River which acts as a cool air sink.

A range of crop types and cultivars were assessed over two times of sowing to highlight the value to crop phenology with the optimum sowing time. The trial included three wheat varieties, two barley varieties, and one oat, lupin, and canola variety.

The first time of sowing was on the 28th of April, for the cereal varieties this sowing time would be considered early for a standard 'mid-spring' variety. Whilst the second time of sowing, 6th June would be considered 'late' and be a very conservative approach to avoiding critical frost windows.

The eight treatments were replicated three times at each time of sowing with each plot size being 10m x 2m.

Living Farm managed the small plot trial with Stirlings to Coast assisting with trial observations and assessments.

Results and Discussion

In 2022, the Amelup site was subjected to 20 frost events between July and October. These 20 events varied in severity, however, there were three particularly significant events, occurring on the 31 of June, 24 of September and 25 of September, where temperatures fell below -3 degrees for periods of more than 4 hours.

Floret Sterilisation Results

TOS1 was significantly impacted by frost, with the floret sterilisation testing showing an impact across all of the cereal treatments. The damage ranged from 59% in Scepter to 4% in oats (Table 1). Given the distributed frequency of the frost events across the site in 2022, there was a high likelihood that each crop type would be impacted by frost. Interestingly, the Denison wheat suffered significantly less frost damage than the Rockstar and Scepter wheat. Denison, which is a long spring variety, has a prolonged vegetative stage, which resulted in the flowering window (GS60-70) avoiding the most severe frost events by flowering later. Rockstar and Scepter wheat, which flower earlier in the season, were both very susceptible to frost in this trial. This was a valuable extension tool, highlighting the importance of selecting cultivars that will most effectively avoid flowering in the key frost windows for a given region.

Table 1– Mean floret sterilisation results from TOS1 at Amelup (n=3). Letters that differ indicate significant differences between crop treatments. Heads were harvested on the 24/10/2022

	Count-Damaged grain		**Count-Total Grain**		**% Damaged Grain**	
Denison Wheat				b	24	b
Rosalind Barley	6	bc	27	de	22	b
Bannister Oats	3	c	85	a	4	c
Rockstar Wheat	14	a	30	cd	47	a
RGT Planet Barley	5	bc	27	e	20	b
Scepter Wheat	18	a	31	bc	59	a

Yield Results

The TOS 2 yields for barley, oats, lupins and canola were largely unaffected by frost damage (Figure 1). The difference in canola and lupin yields between TOS1 and TOS2, is a result of the June time of sowing, rather than frost. In June, the canola and lupins struggled to put on biomass with the cold temperatures and some waterlogging.

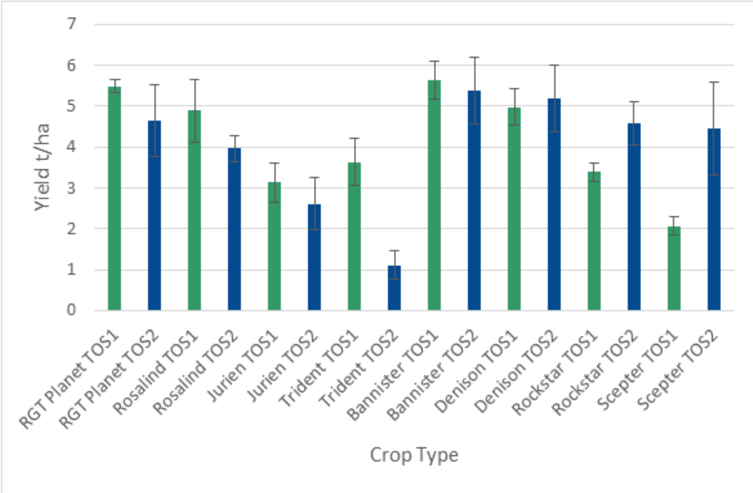


Figure 1- Mean grain yield results from the frost trial site. (n=3).

All barley and wheat varieties yielded higher in TOS2 than they did in TOS1. This highlights the benefit of seeding these varieties later in the season to avoid high frost-risk windows. Although June 6 would be considered a very late and sub-optimum time of sowing, any loss in yield potential, in this case, was made up for by reduced frost damage.

A key learning is that Bannister oats yielded well irrespective of the time of sowing. Oats have a natural level of frost tolerance that allows them to produce a viable seed even when subjected to numerous frost events. The adaptability of oats to the time of sowing, and inherent frost tolerance makes oats a viable crop option for frost mitigation.

Conclusion

The critical risk period for frost in cereals is between GS61 and GS71 (flowering), where yield impacts are particularly severe. Frost during this flowering period causes sterilisation to the floret, resulting in bleached heads, and florets where grain development will not occur. As a result, frost during the flowering period is most directly linked to yield loss.

As demonstrated well in this trial, slow-maturing wheat varieties such as Denison can be utilised on frost-prone paddocks to minimise the risk and impact of frost events. The quick and mid-maturing spring varieties of wheat (i.e., Scepter and Rockstar) when sown early are very frost prone as demonstrated by the treatments sown on the 28th of April (TOS1), which were severely damaged by frost.

Alternatively, shorter spring varieties of both wheat and barley can be seeded later in the season to delay flowering beyond a point in the year where frost events are less prevalent. Whilst this trial showed that there was no yield penalty resulting from the delayed sowing date in the cereal varieties (soft finish), June sowing of wheat and barley has a potential to expose the crop to heat stress, and drought risk. On a more localised scale, however, delayed sowing on the reliably frost-prone areas of the farm could be a beneficial risk mitigation technique. This would effectively balance the on-farm risk of frost versus late season heat/drought stress.

Using different cultivars of cereals with differing maturity lengths is another option. By spreading out the flowering window, the risk of a complete wipe-out due to a serious frost event is greatly reduced.

Finally, planting crops such as oats, which have a high frost tolerance or lupins and canola which have a longer flowering window can effectively reduce frost risk. In this trial, both the oats and the lupins were minimally affected by frost, irrespective of the sowing date. These crop types can also be strategically planted in frost-prone areas to reduce the operation's overall frost risk.

Acknowledgments

Grateful acknowledgement to project lead GGA as well as GRDC (and the levy paying growers) for continued investment in the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

GROWER GROUP ALLIANCE

Drought resilience dashboard for Southern WA

By: Philip Honey, Smart Farms Co-ordinator, SCF

KEY MESSAGES:

- Enhanced local weather forecasting and a centralised dashboard were produced to enable farmers to make better business decisions and improve their farm's resilience to climate change.
- The project included the installation of weather stations, soil moisture probes and digital rain gauges in southern WA and integrated the data into a dashboard to maximise farmer usage and understanding.
- Increasing the weather data collected from local locations will continually improve the accuracy of weather forecasting at a local level (through machine-learning).
- 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.

As an example, 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.

Introducing Climate Great Southern

Launched in 2022, Climate Great Southern hosts the following information publicly available to farmers in the Great Southern Region of WA:

- Soil moisture monitoring & pasture forecasting information for five locations in the Great Southern – Gairdner, Gnowellen, Mount Barker, Palmdale & South Stirlings.
- Weather forecasting for 20 additional locations, including Amelup, Green Range, Kendenup, Kojaneerup South, Many Peaks, Narrikup, Perillup, Wellstead & Woogenellup,
- Drought resilience resources (information materials).

To learn more about the project's activities, visit *www.climategreatsouthern.com.au*

Acknowledgements

This project was support by SCF, through funding from the Australian Governments Future Drought Fund.

Australian Government

Future Drought Fund

AgTech Decoded – Growers critically analysing the role of new technologies in on-farm decision-making.

Hosts: Adams Family (Woogengellup), Mackie Family (Mount Barker), Preston Family (Cranbrook) and Webster/Beech Families (Tenterden).

By: Philip Honey, Smart Farms Co-ordinator, SCF

KEY MESSAGES:

- Surveyed growers utilise, on average, 7 different pieces of digital technology/applications, with weather records & climate information the most readily used.
- Technology and applications which lead to direct insights and clear management actions will be the most adoptable.

Project Background

The AgTech decoded project aims to increase engagement in local R&D through the direct use of growers' own farm data and digital tools to rapidly and economically address agronomic issues and reduce the yield gap. Growers across the Stirlings to Coast Farmers & Liebe group regions have increased their knowledge of how modern digital technologies and analysis methods can be utilised to address locally relevant research issues.

The objective of this project was to critically assess the ability of modern data analytics to address farming system challenges and improve in-season decision-making when faced with a variable climate.

Methodology

Five paddocks across the Stirlings to Coast Farmers membership were analysed in 2022 by CSIRO tools such as Agricultural Production Systems sIMulator (APSIM) - Next Generation, to determine each paddock yield potential, in combination with additional farmer data such as weather & soil moisture monitoring readings, farm records (soil tests, chemical & fertiliser applications and seeding records). Satellite imagery was used in conjunction with farm records to measure and monitor variation across the landscape. Growers' experiences with technologies were captured by surveys to identify current technologies utilised and feature-set gaps.

Technology workshops were also delivered in Albany & Dalwallinu during March 2023 where growers were surveyed on their farm data usage, data types collected on-farm and general mobile/web farm application usage. This information was tabulated, graphed, and reported by CSIRO staff to gain a better understanding of data usage for decision making, and ultimately what is the barriers to success or successful implementation on-farm.

Discussion & Conclusion

Data analytics is increasingly being seen as an important tool for farmers to improve their enterprises. Modern technology including real-time soil moisture sensors and satellite imagery, when combined with in-season paddock data and evaluated with advanced analytic techniques, has the potential to change the face of farmer-driven R&D in Australia.

Traditionally, growers would utilise information from numerous in-field trials and demonstrations to support their on-farm decisions. With the integration of modern sensors, models, and satellite technology, it is now possible to gain information more quickly and efficiently with the addition of real-time and historical paddock data. The technology will be able to provide near real-time outcomes for better decision-making so that growers do not have to wait until the end of an R&D program to apply the learnings.

The farm-host survey and workshop components which utilised collected farm data showed that combining the datasets with powerful tools beyond their current forms could near-accurately identify potential yield estimates, allowing the opportunity for farmers to hone their inputs as seasonal conditions change, optimising their efficiencies & outputs.

The workshop surveys and report produced by CSIRO also showed that agricultural technology is pervasive, and results from this project demonstrate that farmers are willing adopters of new technology. Each grower surveyed throughout the SCF & Liebe membership was using at least 7 technology pieces, which could include yield maps, soil moisture sensors and weather monitoring sensors. Other technology, such as earth observation (satellite) imagery and insights provided by crop models were also considered but were not as widely used. Importantly, the surveys show that the technologies adopted served a clear purpose and provided intelligence to the farmer that was valued and influenced a management decision. Across all technologies, growers wanted the technology to be supported, either through a consultant or through a service offering provided by the company.

The findings in the CSIRO-led report agree with earlier surveys of farmer adoption of technology and align with the concepts associated with technology acceptance models. That is, the adoption of the technology highlights the importance of perceived useability and perceived ease of use (Pierpaoli et al. 2013).

- The most highly valued, and used technology was Delta T; a tool that utilises weather information and assists with the decision of when and when not to spray a herbicide. The purpose of the tool is clear, and it is relatively easy to use.

- Compare this to a soil moisture probe for example, which can assist with the decision of when sow a crop, the decision to plant a certain area to a particular crop type, or the decision to apply nitrogen. All of these decisions will require local context and considerable nuance, therefore, the information and action arising from the information is less clear than that provided by Delta T.

To that end, the survey showed that grower's requests are remarkably straightforward and clear. That is, they would like to know when and where the biotic and abiotic stresses are likely to occur on their farm, and how they should manage these constraints given prevailing weather and climate forecasts. They would like to know the decisions they should make given these abiotic and biotic stresses. The information should be presented in a readily digestible manner, preferably on a single platform or dashboard.

The CSIRO report also showed that the ability to define the grower's needs with such clarity following expositions of technology, workshops and surveys is unique. It suggests that technology has improved in the last decade. It is also clear that much of the technology shows promise but is at the early stages of evolution and adoption. Agricultural technology companies and researchers must work more closely with growers to develop the technology into a useful product. These useful products must provide intelligence on farm attributes that growers value and deliver the outputs in a form that farmers can readily consume. The technology must be supported by a service network, to ensure the technology services the real needs of the industry. The implication is that if technology were genuinely useful, farmers would be prepared to pay for a service. This last insight contradicts some studies about farmers' willingness to pay, but it could be that the technology delivered to date has not been able to fulfil farmers' needs, and this influences their desire to pay for technology.

Acknowledgements

Stirlings to Coast Farmers would like to thank the Liebe Group for the opportunity to partner in this project, and the Grower Group Alliance and Australian Government's Future Drought Fund for investing in the project.

Hyper Yielding Crops – Benchmarking and Awards

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- In 2022, the Hyper Yielding Crops (HYC) project awards paddocks were made up of 7 cultivars of wheat and 3 of barley, highlighting the diversity of high performing wheat options.
- Winter wheat cultivars out-yielded the spring wheat cultivars by an average of 1.5 t/ha.
- Wheat (6.14 t/ha) outyielded barley (5.99 t/ha), however, there was less variability in barley yields across the benchmarked paddocks.

Background

The FAR hyper yielding crops awards project is currently in its third season, and growers are building on the results of the 2020 and 2021 seasons to continue to push yields and productivity within the HRZ of WA. The HYC awards and Focus paddock trials are developed in tandem with the HYC innovation centres. This project allows growers to utilise environmentally specific agronomic management practices developed within the innovation centres, as well as peer-to-peer learning opportunities provided by the innovation group meetings, to further improve broadscale yield performance through benchmarking regionally relevant data. This in turn informs the research conducted at the HYC innovation sites. As the diagram below demonstrates, the four elements of the project work in tandem to build a more productive and adaptive farming system within the WA HRZ (Figure 1).

Methodology

There were 12 barley paddocks and 13 wheat paddocks entered in the awards program for the Albany Port Zone in 2022. They represented a large swathe of the lower great southern, ranging from Gnowellen in the east to Frankland River in the west and Scotts Brook in the North.

Of the barley awards paddocks, all but two were Planet, with the other two being planted to Maximus and Laperouse.

There was a greater varietal variation in the wheat paddocks with both winter and springs wheat grown. Some farmers had entered a wheat paddock in the awards for three seasons in a row, allowing us to gather data on how wheat farming systems adjust season-to-season.

All input and yield and grain quality data was collected from each of the paddocks.

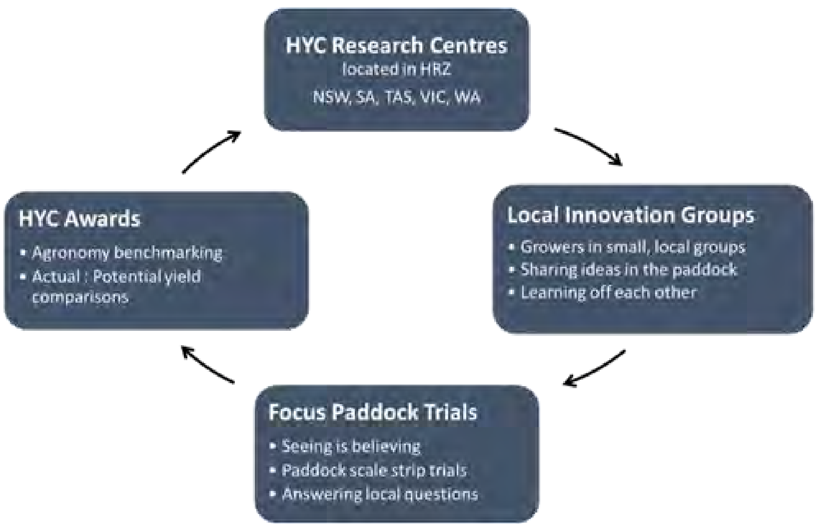


Figure 1. Flow chart describing how each component of the Hyper Yielding Crops project work together to provide better information to growers on improving yield in high rainfall regions.

Results and Discussion

Barley

The barley yields for the top 25% of benchmarked paddocks averaged close to 8t/ha whereas the remaining 75% yielded an average of 5.5t/ha (Figure 2). All the Planet barley paddocks in east and west sub-groups suffered from severe net-type net blotch, which likely impacted the yield performance of these crops. The barley paddocks in the more northern regions were not impacted to the same extent. In cases of severe infection, yield penalties were often compounded by lodging and brackling. This is a result of the disease pressure leading to early grain fill, which, when coupled with the delayed harvest due to the wet finish, resulted in loss of turgor pressure and ultimately, the crops fell over.

Despite the management issues that plagued the 2022 barley crops, the yield average of 5.99 t/ha shows the production that can be achieved in favourable conditions. However, the critical grain set period for the vast majority of the benchmarked barley paddocks occurred in early September, which was not optimal for yield production given that it was still quite wet, and the solar radiation was limited. This highlights the potential to seed barley later in the season, in the lower Great Southern environment to maximise available solar radiation during critical grain set period.

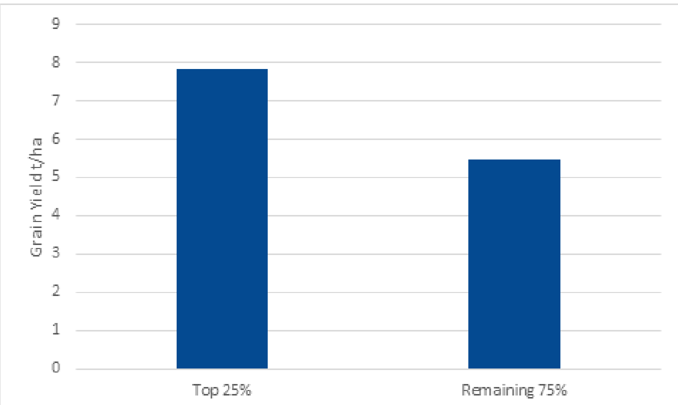


Figure 2. Barley yield comparison between the top 25% of benchmarked awards paddocks and the remaining 75% for 2022.

Wheat

The 2022 wheat yields for the HYC group outperformed the previous two seasons, with a district average of 6.14 t/ha. The seasonal conditions were ideal for producing high yielding wheat, as water was never a limiting factor to crop production. Additionally, the critical grain fill period (2 weeks prior to flowering) which occurred between the last week of September and the third week of October for most of the award paddocks, was cool with above average solar radiation, which is ideal for grain set.

In 2022, the top 25% of paddocks yielded 7.49t/ha, while the remaining 75% yielded 5.69t/ha (Figure 2). Interestingly, of the observed paddocks, the winter wheats outyielded the spring wheats (Figure 3), despite only making up 30% of the wheat pool. This differential in yield between the wheat types is due to the soft finish coupled with the ample September and October rainfall. These conditions allowed the long season winter wheats to accumulate biomass late into the season, without risk of heat or drought stress in the late spring.

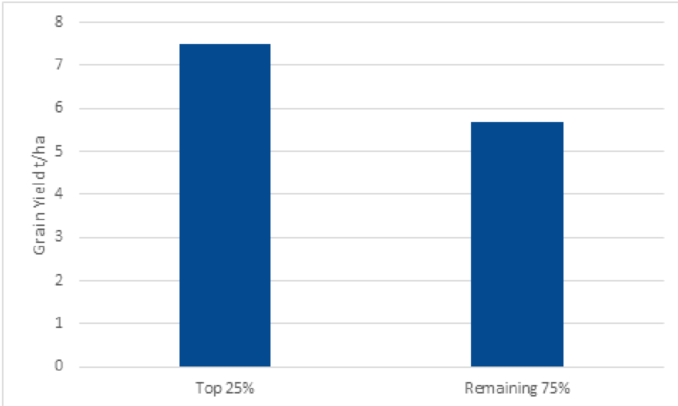


Figure 3. Wheat yield comparison between the top 25% of benchmarked awards paddocks and the remaining 75% for 2022.

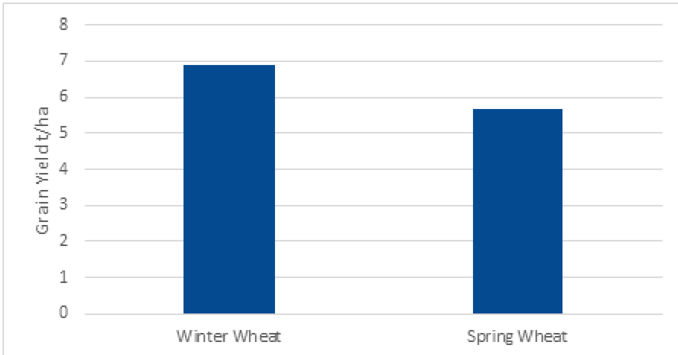


Figure 4. Yield comparison of winter versus spring wheat varieties for 2022 awards paddocks.

Conclusion

The HYC awards and benchmarking program will continue in 2023. While the yields are not guaranteed to show the continued year-on-year improvement that we have seen to date, the ability to benchmark crop production and management is critical to improving productivity in grain production in the high rainfall zone of WA.

Acknowledgments

This project has been run in conjunction with FAR Australia.

FAR AUSTRALIA

Western Dairy Claying Trial

Host: Jenkins Family (Denmark).

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- Soil incorporation (tillage) had a significant effect on plant dry matter production at the time of first pasture cut.
- Surface applied clay produced less dry matter at the first cut; this was likely due to the initial water repulsion effect of the clay.
- By the 4th grazing, a production benefit was observed in the clay x incorporation plots over and above the tillage only affect.

Background

Stirlings to Coast Farmers (SCF) are working in collaboration with Western Dairy on a project exploring the use of claying as an amelioration technique to improve pasture production and to manage nutrient run-off and improve fertility. As part of this investment, two trials have been established to examine the viability of claying to ameliorate sandy, low fertile soils that are typical to the Great Southern and South-West regions of WA. Clay spreading is a common practice for soil amelioration on light sandy soils in broadacre agriculture, however the practice is considered novel within the dairy industry. This is largely due to the high up-front cost, the need for specialised equipment to ameliorate at scale and the lack of available data on the economic and productivity returns for pastures. Given the novel nature of claying in the dairy industry and the difference in scale compared to broadacre claying, this project utilised farmer held equipment to apply the treatments. This report examines the results from the site established at Denmark.

Methodology/Treatments

The trials examine three differing clay rates, as well as a nil control, to determine the most efficient level of clay to improve pasture production. Additionally, there is an incorporation treatment, where two replications of the plots have been incorporated with a speed tiller, while the clay has been left on the soil surface of the other two replications.

The trial is replicated and blocked in a fashion to ensure trial rigour; however, randomisation could not be achieved with the farm scale equipment.

Clay Spreading

The clay for the project was sourced on farm, and prior to spreading it was sampled and tested for both clay % content and nutrients. Soil samples were also taken from the paddock to ascertain the baseline clay % and soil nutrient status. The clay was spread using a Marshall Muck spreader, and rates were determined using measurements of applied clay per m2, per pass, the approximate incorporation depth, and the targeted clay percentage.

Pasture composition assessments

The site was seeded with a pasture mix at 35kg/ha and comprised a multiple of varieties of ryegrass, clover, brassicas and perennial herbs along with 80kg/ha of oats.

Plant health status

Plant health measurements were recorded in season via a handheld Trimble GreenSeeker (NDVI), and drone (green/red index).

Dry Matter Cuts

Dry matter cuts were taken in-season to determine the treatment effect of claying and/or incorporation on pasture production. Two in-season cuts were taken at the Denmark site prior to grazing.

Results and Discussion

The applied clay had an average clay fraction percentage of 38%. Soil samples from the site were tested for clay fraction prior to clay being added, the average clay percentage of the 10cm topsoil horizon was 2.94%.

Dry Matter

The first pasture cut, taken prior to grazing, showed no significant effect of the claying on pasture production. Comparisons between the applied rates showed that there was no dry matter yield increase from applying higher rates of clay (Table 1). However, there was a significant biomass response in the incorporated plots versus the unincorporated plots ($p = 0.0016$). This result shows that tillage is driving the pasture production. Given these are heavily trafficked paddocks, with high stocking rates, it is unsurprising that tillage was the first treatment to significantly increase pasture production. Sandy soils that are responsive to claying are also prone to soil compaction, which reduces the soil porosity and aggregation, impacting root growth and ultimately plant development.

Table 1. Denmark trial site dry matter production from Cut 1 (t/ha) against varying clay percentages.

	0%	1%	3%	6%
Incorporated	4.21	3.71	3.49	4.03
Unincorporated	2.68	2.99	3.85	2.07

The second pasture cut was taken prior to the 4th graze on the 20th of October. The incorporated plots produced a greater level of dry matter across all claying treatments compared to the un-clayed treatments (Table 2). However, the tillage effect on dry matter production was reduced, with the incorporated nil treatment only marginally outperforming the unincorporated nil treatment.

Table 2. Denmark trial site dry matter production from Cut 2 (t/ha) against varying clay percentages.

	0%	1%	3%	6%
Incorporated	2.67	3.31	2.99	2.87
Unincorporated	2.36	2.00	2.10	2.61

Pasture composition

Where the ground had been cultivated (clay incorporated), the Brassica species were dominant particularly early in the growing season. The increased level of brassica in the pasture mix is likely a result of the tillage/clay reducing non-wetting in the incorporated areas, whereas the surface applied clay formed a physical barrier to establishment and created localised surface waterlogging. However, after multiple grazing periods the pasture make up equalised.

Conclusion

The first year of the claying project showed some promising results at the Denmark site. However, most of the gains in pasture production this season resulted from incorporation and tillage in combination with the clay, rather than a specific rate response. Positive plant health effects, greater plant diversity, and increased dry matter yield differentials were observed as the season progressed. These results highlight the potential benefits of claying high production pastures, however further examination is required to distinguish the results as a product of the clay rates, rather than the tillage. It is notable that this season has had favourable growing conditions, which may have limited the potential positive benefits of claying (e.g. alleviating non-wetting soils at the break, and improved water holding towards the end of the season). If claying is shown to be successful within dairy-focused pasture systems, it could prove to be an effective management tool to increase productivity on a wider range of pasture-based farming systems.

Acknowledgments

Grateful acknowledgement to Western Dairy and Dairy Australia for their collaboration and investment in the project.

MLA PDS Alternate summer forage crops for Southern WA

Hosts: Webster Family (Tenterden) and Metcalfe Family (Porongurup).

By: Samantha Cullen, Project Officer, SCF

KEY MESSAGES:

SITE 1: TENTERDEN

- **Millet oat mix had a higher nutritional value (NV) than the ryegrass clover control, with a higher crude protein, digestibility and metabolisable energy.**
- **Millet oat mix and ryegrass clover pasture had similar biomass of 1.2t/ha and 1.5t/ha respectively.**
- **Lambs on the millet had an average daily gain (ADG) of 83.3g/head, compared to no growth achieved by the lambs on the ryegrass clover mix.**

SITE 2: PORONGURUP

- **Winter wheat (DS Bennett) produced more than double the biomass at 3.88t/h across 85ha compared to the clover rye pasture that averaged 1.86t/ha across 25.5ha.**
- **Total livestock weight gain was 17.2kg/ha higher on the DS Bennett compared to the clover rye pasture.**
- **DS Bennett benefits extended beyond grazing, with 65ha being taken through to harvest (3.6 t/ha) and 17ha being cut for silage yielding 12t/ha.**

Background

In 2020 Stirlings to Coast Farmers (SCF) began a three-year Producer Demonstration Site (PDS) with Meat & Livestock Australia (MLA) looking at alternative forage crops for southern WA. Growing alternate forage crops means producers can potentially grow cost effective feed which will be available to their livestock during the feed gaps during summer/autumn and winter periods. This offers producers an opportunity to increase profits, by carrying more livestock because they are confident of feeding animals outside the growing season and by having livestock ready for market outside of peak supply times, producers will achieve higher prices. Producers typically calculate whole farm stocking rates based on their ability to carry stock over the autumn period. This project aimed to improve producers carrying capacity over this time and therefore increase stock carrying capacity and ultimately profits from increased livestock production.

Six producers hosted demonstrations sites over the three-year project from 2020 until 2023. The final two demonstrations were completed in 2022 in Tenderden (hosted by the Webster Family) and Porongorup (hosted by the Metcalfe Family).

During the 2022 spring, areas of the Great Southern region of WA recorded over 100mm for November. This intensity of rainfall is not uncommon to this region and there is an opportunity for producers to take advantage of these events with alternate forage crops.

For the final year of the project the two demonstration sites were:

- Webster - Tenterden, lambs grazing Millet (treatment) versus clover ryegrass mixed pasture (control)
- Metcalfe - Porongurup, yearling cattle grazing DS Bennett (treatment) vs Clover ryegrass mixed pasture (control).

Table 1. Nutritive value analysis of each forage, supplementation and biomass available before grazing.

NV Analysis	Ryegrass Clover Pasture	Millet Oat Mix	Supplementation (Home n' Dry mix)	Supplementation Oaten Hay
Dry Matter (DM)	86.7 %	28.6 %	88%	89.9 % of DM
Moisture	13.3 %	71.4 %	12%	10.1 % of DM
Crude Protein	5.9 % of DM	7.2 % of DM	-	5.0 % of DM
Protein (N x 6.25)	-	-	21.6 % of DM	-
Acid Detergent Fiber	35.8 % of DM	26.8 % of DM	-	30.5 % of DM
Neutral Detergent Fiber	70.0 % of DM	54.9 % of DM	-	57.0 % of DM
Digestibility (DMD)	52.0 % of DM	68.7 % of DM	87.9 % of DM	58.9 % of DM
Digestibility (DOMD)	50.8 % of DM	65.0 % of DM	-	56.7 % of DM
Est. Metabolisable Energy	7.3 MJ/kg DM	10.2 MJ/kg DM	13.5 MJ/kg DM	8.5 MJ/kg DM
Fat	2.7 % of DM	4.6 % of DM	-	2.5 % of DM
Ash	7.2 % of DM	7.4 % of DM	2.1 % of DM	2.1 % of DM
Dry Matter cuts (DM)				
g of 0.1m^2 quad	15.1	11.9		
t/Ha	1.5	1.2		

Methodology/Treatments

Site 1: Tenterden

The Millet was seeded on 26th October 2022 at 8kg/ha into a previously cut hay crop. Only millet was seeded, however, the 26 ha paddock composition was approximately 80% millet and 20% volunteer oats. Within the first 2 weeks of seeding a cold front came through. Although there was a good germination, this caused the millet to have stunted growth and shows the importance of having the soil temperature at 14°C and rising. The Millet was compared to a 20ha paddock of senesced clover ryegrass pasture.

Site 2: Porongurup

The DS Bennett (winter wheat) was seeded into a 85ha paddock was seeded with DS Bennet winter wheat on 15th April, 2022, sown at 115kg/ha. The crop received 150kg/ha of super potash 3:1 top dressed and 80L of Flexi-N per ha. A herd of 210 yearling heifers rotationally grazing 85ha of winter wheat (treatment paddock) and a herd of 35 yearling steers grazing a 25.5ha clover rye pasture (control paddock). Ideally, the cattle grazing the two treatments should have been of the same class, however, this was not possible at the time.

Measurements for both demonstrations

Measurements at both demonstrations for both the treatment and control paddocks included:

- Biomass cuts for dry matter assessment
- soil samples
- plant samples for nutritive value (NV) analysis; and
- lamb/cattle weights (pre & post-grazing)

Results and Discussion

Site 1: Tenterden

The millet/oat mix had a much higher feed quality compared to the senesced clover/rye pasture (Table 1), with a 40% higher metabolisable energy and 22% higher crude protein. The millet/oat mix also had a higher digestibility of 68.7% compared to 52% in the clover ryegrass pasture.

Figure 1. Millet oat mix (top) and clover rye pasture (bottom)

Table 2. Merino lamb liveweight gains grazing on a senesced clover ryegrass pasture with supplementation compared to Shirohie millet oat mix at Tenterden January 2023.

Description	Ryegrass clover pasture	Millet oat mix
Grazing duration days	12	12
Paddock size (ha)	20	26
Stock numbers (head)	100	1000
Stocking rate (lambs/ha)	5	38.5
Weight in (kg lwt) or kg of liveweight	30	30
Weight out (kg lwt)	30	31
Weight gain (kg lwt) per lamb	0	1
Average weight gain (grams/head/day)	0	83.3
Total weight gain (kg lwt)	0	1000
Total weight gain (kg lwt/ha)	0	38.5
Supplementation		
oaten hay bale x3 * @$50/bale	0	$150
400g/hd/day Home n' Dry mix * @$350/t	$168	
150g/hd/day Home n' Dry mix * @$350/t		$630
Total cost of supplementation	$168	$780

Even though the Millet had slightly less dry matter, 1.2t/h compared to 1.5t t/ha for the clover ryegrass pasture, the higher feed quality led to increased weight gain of lambs on the millet, averaging 1kg/head over the 12 days. Keep in mind this was a very short crash grazing event due to the millet having stunted growth and showing signs of heat and moisture stress Clare wanted to use the feed before it was lost.

Both mobs received a bit of supplementation via lick feeders in their respective paddocks. The control lambs on the clover rye pasture also received an extra 250g/head/day of Home n' Dry mix while the millet lambs received an extra 3 bales of oaten hay over the 12 days (Table 2). Economic analysis showed both the traditional feed and the Millet oat mix produced a loss of -$8.4 and -$43 respectively. In regard to the millet, the cooler temperatures after seeding definitely impacted on the feed availability and subsequent profitability of this forage crop.

Site 2: Porongurup

The control paddock of clover and ryegrass pasture equated to 1.86t dry matter/ha across 25.5ha, and the DS Bennett wheat averaged 3.88t/h across 85ha (Figure 2). Both feed sources were relatively comparable in quality, with the DS Bennett being slightly higher quality (Table 3). Both had comparable crude protein at ~20%, with DS Bennett having ~5% less acid detergent fiber (ADF). ADF is the least digestible component of the plant, so the DS Bennett showed a slightly better digestibility than the clover and ryegrass pasture. The DS Bennett also had a higher metabolisable energy (ME) of 12.9MJ/kg DM compared to 10.6 MJ/kg DM in the clover ryegrass mix.

Figure 2. Biomass cuts of DS Bennet averaged 3.88t/ha (left) and clover rye pasture averaged 1.68t/ha (right)

Table 3. Nutritive value of each forage and biomass available before grazing.

NV Analysis	Clover Rye pasture	DS Bennett
Dry Matter (DM)	18.5 %	14.9 %
Moisture	81.5 %	85.1 %
Crude Protein	20.0 % of DM	21.7 % of DM
Acid Detergent Fiber	22.1 % of DM	17.3 % of DM
Neutral Detergent Fiber	42.5 % of DM	37.9 % of DM
Digestibility (DMD)	71.1 % of DM	84.3 % of DM
Digestibility (DOMD)	67.1 % of DM	78.2 % of DM
Est. Metabolisable Energy	10.6 MJ/kg DM	12.9 MJ/kg DM
Fat	5.6 % of DM	6 % of DM
Ash	9.8 % of DM	9.6 % of DM
Dry Matter cuts (DM)		
g of 0.1m^2 quad	18.63	38.83
t/Ha	1.86	3.88

Table 4. Metcalfe yearling cattle liveweight gains grazing on a clover ryegrass pasture compared to DS Bennett winter wheat at Porongurup 2022.

Description	Clover Rye Pasture	Winter wheat (DS Bennet)
Grazing duration days	40	40
Paddock size (ha)	25.5	85
Stock numbers (head)	35	210
Stocking rate (yearling cattle/ha)	1.4	2.5
Weight in (kg lwt) or kg of liveweight	389	385
Weight out (kg lwt)	463	433
Weight gain (kg lwt) per head	74	48
Average weight gain (kg/head/day)	1.85	1.2
Total weight gain (kg lwt)	2590	10080
Total weight gain (kg lwt/ha)	101.6	118.6

This extra biomass and quality allowed the DS Bennett to support a higher stocking rate of 2.5 heifers/ha, compared to the 1.4 steers/ha on the clover rye mix (Table 4).

Winter wheat varieties are well-suited to the high rainfall zone and are a great alternate feed source. Advantages of DS Bennett include higher biomass production which in turn supports higher stocking rates of 2.5 heifers/ha, compared to the 1.4 steers/ha on the clover rye mix (Table 2). Sowing winter wheat early for early grazing opportunities can also allow farmers to defer grazing. This deferment allows these pastures to establish and increases subsequent pasture availability. Over the 40 days of grazing, the heifers on the winter wheat and the steers on the clover rye produced very similar net income at $493 and $498 per ha respectively. Even though the heifers produced an extra 17kg/ha (Table 4) this profit margin was consumed by the cost of sowing the winter wheat. However, there are other benefits DS Bennett can provide in regard to the versatile options available post grazing. These include to either graze again, lock up for silage or take through to grain production. Tim took full advantage of these options and locked some up for silage and took the better parts through to grain contributing an extra $1,292/ha to their operation.

Acknowledgments

Grateful acknowledgement to Meat and Livestock Australia (and the levy paying growers) for continued investment in the project as well as Lucy Anderton for the economic analysis.

MEAT & LIVESTOCK AUSTRALIA

Producer Demonstration Site

Optimised Pasture Management

Tools & technologies to help maximise groundcover and sustainably improve total farm productivity.

Hosts: Walker Family (Green Range) and Pyle Family (Palmdale).

By: Philip Honey, Smart Farms Co-ordinator, SCF

KEY MESSAGES:

- **Current ground cover measurement methodologies are based on assessing pasture availability irregularly & generally undertaken in selected locations in a paddock that may not be representative of a paddock's production potential.**
- **The adoption of digital technologies provides landholders with the ability to monitor a more significant proportion of their land more effectively, allowing the opportunity to monitor changes and trends over time through spatial analysis.**

Project aim:

To increase the skills & knowledge of landholders, researchers & local NRM officers in the use of effective and practical digital tools that can help monitor and improve our land resources through active management of groundcover.

Project background:

Climate change presents a real threat to farming operations, particularly as seasonal conditions continue to change year on year. Rainfall variability, frosts & changes in temperature all play a significant part in the development and maintenance of groundcover. Effective ground cover management protects our soils against erosion, rain impact, and compaction and is an essential contributor to soil biology and soil chemistry, herbicide effectiveness, and overall soil condition.

With a varying climate, landholders need help to adapt their livestock and cropping management to limit their effect on the land whilst trying to optimise their production systems to remain sustainable into the future. Successful adaptation to climate change will need strategic preparation and tactical responses from landholders to ensure that farming remains sustainable and pasture production remains synergistic with animal production.

Current ground cover measurements assess pasture availability by eye based on the farmer's experience. Many landholders find it difficult to accurately determine feed availability and extrapolate measurements to define a whole paddock's livestock carrying capacity. The adoption of digital technologies will provide landholders with the ability to monitor their land more effectively and the opportunity to monitor changes and trends over time through spatial analysis. Low-cost technologies are easily adaptable to farming enterprises where landholders can utilise monitoring, analysis & learning within their decision-making process to understand the impacts on groundcover production better.

A better understanding of ground cover variation across paddocks means that landholders can implement better animal grazing to ensure that biodiversity continues to thrive. Better ground cover management will improve the sustainably of animal production both on & off-farm.

Tools & Technologies Available

There is a wide range of tools and technologies available to help increase farmers' awareness of pasture levels across a paddock, across a wide range of measurement methods. The methods analysed include:

- Ground based sensor measurements – which take measurements via direct contact (such as pasture measurement discs),

- Remotely sensed measurements – measure pasture density, quality and/or health from a distance (non-contact), such as vehicle-based sensor, drone, plane or satellite. These can come in either an:

    - active-sensed form (utilise their own light source to provide a reference point, day or night), or,

    - passive-sensed form (utilise existing light sources such as sun to measure, however, lose accuracy in some conditions, such as cloud cover)

- Simulation-based measurements – these utilise algorithms and calculations to predict and simulate a result based on a range of user-inputted information (including soil type, rainfall, and climate information)

The Optimised Pasture project demonstrates a range of the following tools across 3 selected locations throughout the SCF membership zone:

- ***Pastures from Space***
  Pastures from Space allows farmers to track Pasture Growth Rates (PGR) and Food On Offer (FOO) weekly over their property using satellite technology. Users can see FOOD & PGR rates in 6.25ha pixels, whilst the graph component allows farmers to turn on/off individual years, to get a better understanding of seasonal changes.
  https://pasturesfromspace.dpird.wa.gov.au/

- ***Australian Feedbase Monitor (in conjunction with CiboLabs)***
  The Australian Feedbase Monitor tool is a relatively new grazing management tool that gives farmers insights into their feed capabilities. It uses higher-resolution satellite imagery and calibrated measurement points to generate percentage groundcover and total standing dry matter. This platform is free of charge for MLA members.
  https://www.cibolabs.com.au/

- ***GreenSeeker NDVI***
  Either hand-held or vehicle mounted, GreenSeeker systems measure plant NDVI levels to indicate overall plant health. Being an active sensor, these systems can be utilised day or night, but require complex calculations & measurement to return a food-on-offer value. This data can be mapped and modified, to be utilised in Variable Rate nitrogen applications to increase feed production prior to grazing.https://ww2.agriculture.trimble.com/product/greenseeker-handheld-crop-sensor/

- ***Drone Imagery***
  Either through RGB and/or NDVI based imagery collected via drone and simple software such as Drone Deploy, Pix4D or Metashape, farmers have the ability to directly map and monitor their individual paddocks and measure plant health across the landscape. These systems typically allow timebased comparisons (comparing two different timeframes) to enable identification of areas impacted or of substantial growth.

- ***FarmingForecaster – GrazPlan***
  Utilising a web-based (Farming Forecaster) or computer software-based version (GrazPlan) users can simulate & predict future pasture growth rates based off historic rainfall information, enterprise types and soil information, stocking rates and effects of supplementary feeding systems.
  https://grazplan.csiro.au/

Discussion & Conclusion

Ultimately, there are three ways to optimise the production of pasture on farming land, and these are typically confined to:

- Soil fertility and plant nutrition – managing your soils through ameliorants and fertiliser to increase biomass production,

- Improving farm grazing management – managing the effective stocking rates and duration to ensure pasture composition is managed, minimising the risk of overgrazing, and working to increase rooting depth of pasture to create environmental resilience to seasonal conditions, and,

- Selecting the right species – selecting the right species of pasture which maximises the production, quality and value of your pasture.

The use of technology such as those demonstrated through this project will help enable the ability for landholders to better manage and understand their pasture production at a much greater resolution than current practices. By improving their pasture production and management, farmers are more likely to benefit from increased pasture production, but also improved animal welfare, improved ground cover, reduction in weeds, increase in biodiversity and reduced erosion potential/land degradation potential.

Resources Available:

For more information regarding the tools and technologies available, please visit the Stirlings to Coast Farmers projects webpage via www.scfarmers.org.au/pasture-optimization

Project Acknowledgements:

This program is jointly funded through Australian Government's National Landcare Program (Smart Farms Small Grants Round 4) and Stirlings to Coast Farmers.

Australian Government | National Landcare Program

Assessing the Economic Benefits of Confinement Feeding

Hosts: Walker Family (Green Range), Griffiths Family (Boxwood Hill) and Webster Family (Tenterden).

By: Sheridan Kowald, Project Officer, SCF

KEY MESSAGES:

- **Confinement feeding allows for deferment of pasture paddocks resulting in increased pasture leaf area and growth rates.**
- **Confinement feeding reduces stock energy requirements by 8-15% (less walking for feed and water) & reduced supplement feed wastage by 5-10%.**
- **Manual stock feeding is quicker and easier.**
- **Stock health and weight can be easily monitored, and sale stock separated.**
- **Maintains paddock ground cover, reduces erosion, and maximises rain infiltration.**

Background

Earlier this year, SCF began our MLA-funded Producer Demonstration Site (PDS) project titled 'Assessing the Economic Benefits of Confinement Feeding. The project aims to examine the production benefits to farm businesses of different confinement feeding setups. Confinement feeding is an intensive feeding system where livestock are confined to a relatively small area and are hand-fed grain and hay. Feeding stock in a confined area allows producers to provide full or partial rations and for pastures to be rested. It is a valuable management strategy, providing numerous benefits; however, confinement feeding does have costs associated with it, mainly infrastructure and feed costs. As a result, confinement feeding may only be profitable some of the time and likely depends on other management aspects of the farm. For example, with a low stocking rate pasture will be less limiting and therefore increasing pasture production due to deferment or reducing animal energy requirements will not be as valuable.

Methodology/Treatments

Data collected from the three demonstration sites to date include ewe condition scores (10%) on two mobs each, feed tests on all grain feeds and roughage, pasture cuts for dry matter (DM) / feed on offer (FOO) calculations on two paddocks, as well as data on the volume of feed fed and the number of stock contained.

Each of the three host producers had different methods and rations to feed their sheep in confinement, including:

1. Full mixed ration, feeding three times a week in a communal feed trough pen.
2. Feeding a grain mix into fence-mounted troughs in each pen
3. Trail feeding a lupin-barley-oats mix that had been treated with Home n' Dry alkasystems product.

All were supplying ad-lib hay or straw on the ground in the pens and supplying water through water troughs. Test results show the variability in feed quality between farms and compared to industry-accepted average values.

Results and Discussion

Performance Metrics:

Producer 1: 4179 ewes were confined from the end of March until mid-May. In confinement, feeding time was reduced by 35% (63 hours total) and mortality was 1% lower because of improved monitoring. Extra FOO at

Table 1 - Overall producer confinement details.

	Period confined	Total ewes confined	Extra Pasture Growth (FOO increase %)	Days between cuts
Producer 1:	21/3/22 to 26/4/22 (36 Days)	4179	Pdk 1: 276.66% Pdk 2: 129.62%	7
Producer 2:	4/4/22 to 29/4/22 (25 Days)	2000	Pdk 1: 90.62% Pdk 2: 24.22%	17
Producer 3:	18/4/22 to 7/6/22 (50 days)	4377	Pdk 1: 68.08% Pdk 2: 175.80%	28

Table 2- Confinement feeding producer rations and dry matter gains.

	Feeding System	Ration Overall	Condition scores	Deferred pasture production
Producer 1:	Communal feed trough pen	35T Hay 6.7T Loose lick minerals 145T of grain mix – 40% lupins and 40% barley, 20% barley/oats/wheat seed - seconds	+ 0.2	+ 1383.33kg DM/ha - volunteer barley + 1166.67kg DM/ha - Clover/ ryegrass pasture
Producer 2:	Halved poly culvert pipes mounted outside pens	26T oat seconds, 13T lupins, 26T barley (mixed) 200 rolls - Ad-lib hay and straw bales on the ground	+ 0.4	+ 387.5kg DM/ha - chicory, lucerne and serradella mix + 966.67 kg DM/ha - medic pasture on canola stubble.
Producer 3:	Trail feeding	186T home & dry barley/ lupin mix 250 bales - Ad-lib hay/ straw	+ 0.4	Increase of 800kg DM/ha on pasture with tall dry grass Increase of 908.22kg DM/ha on wheat regrowth with seeded barley/clover

the end of confinement resulting from deferment was estimated to be 64kg/WGHa.

Producer 2: 4,377 head were confined from the start of April until mid-June. In confinement, feeding time was reduced by 54% (120 hours total). Extra FOO at the end of confinement resulting from deferment was estimated to be 241 kg/WGHa.

Producer 3: 2000 head were confined from the start of April until mid-May. In confinement, feeding time was reduced by 75% (101 hours total). Extra FOO at the end of confinement resulting from deferment was estimated to be 67 kg/WGHa.

Conclusion

In many cases, confinement feeding is used at the beginning of the year to defer pastures and increase future productivity. The value of deferring pastures depends on the value of feed throughout the year, which is affected by livestock and feed management throughout the year.

The value of confinement feeding is primarily due to:

- Reduced labour and cost of supplementary feeding

Table 3 - Confinement feeding performance metrics gains and cost benefit analysis.

	Producer 1:	**Producer 2:**	**Producer 3:**
Labour efficiency gains	10.75hrs/week	16.4hrs/week	24hrs/week
Reduced feeding time	35% (63hrs)	75% (101hrs)	54% (120hrs)
Reduced supplement wastage (5%)	2.33kg/hd	4.12kg/ha	3.55kg/hd
Pasture deferment gains (winter grazing ha)	64kg/WGHa	67kg/WGHa	241kg/WGHa
Pasture production gains (dry matter/ha)	64kg DM/ha	67kg DM/ha	241kg DM/ha
Energy Efficiency gains(megajoules)	0.80mj/d/hd	0.76mj/d/hd	0.73mj/d/hd
Reduced mortality rate	1%	0.50%	nil
Extra supplements	$0	$13,750	$30,591
Pasture deferment	$19,034	$19,449	$32,376
Labour reduction (@$40/hr in super & wc)	$2,520	$4,040	$4,800
Mortality reduction	$739	$369	$0
Gross margin	$22,293 $3.6/DSE $23.20/WGHa	$10,108 $3.4/DSE $5.62/WGHa	$6,585 $1.0/DSE $11.9/WGHa

- Reduced supplement wastage
- Increased energy efficiency of stock
- Increased pasture production due to deferring

The key findings were similar across all three producers' operations, with confinement feeding leading to an increase in profitability in all cases; however, it is important to note, that there was significant variability in the operational benefits across the three sites ranging from $6,500 to $22,200.

The pasture deferment makes up approximately 80-90% of the economic value of confinement feeding, and labour saved from confinement feeding offsets was 17-31% of the cost of the additional supplement.

Confinement feeding before the break of the season is less profitable because pasture is not being deferred.

In 2023 SCF will continue to monitor an extra 3 confinement feeding producer host sites before the completion of the project.

Acknowledgments

Grateful acknowledgement to Meat and Livestock Australia (and the levy paying growers) for continued investment in the project and also to Michael Young for his economic analysis of the project.

FUTURE TRIALS

Optiweigh - in paddock weighing system

By: Samantha Cullen, Project Officer, SCF

Background

The aim of this MLA-funded Producer Demonstration Site is to utilise an Optiweigh unit on properties in Southern WA to demonstrate the value of in-paddock cattle weighing systems for improved labour efficiency, monitoring animal weights and optimising compliance with target market weight specifications.

The Project

The project will be undertaken on a minimum of six properties and six herds of cattle over three years. Each producer will use the unit for at least one period on one herd of cattle across the project duration. Herd choice will be at the discretion of the producer.

Cattle are enticed onto the Optiweigh with an attractant, such as molasses, a lick block or salt. Stepping on, they have their EID recorded and front feet weighed. This information is sent to the cloud and an algorithm is applied to calculate total body weight.

See weight gain information on your phone or laptop.

Liveweight information is updated multiple times daily and sent to any device type including phone, laptop, or tablet. Users receive a daily email each morning summarising the information gathered by the Optiweigh in the last 24 hours. More detailed information is available to be viewed and downloaded via the Optiweigh website.

Outcomes

Producers will be able to use the data from the Optiweigh in paddock cattle weighing system to monitor overall herd weight and health which will aid in decision making and herd management.

The Optiweigh system will help reduce the time and expense of yarding cattle to be weighed.

The producer can monitor weights with the in-paddock system in real time and respond to growth rate changes by providing additional supplementation or other suitable interventions in a more timelier manner.

Acknowledgments
Grateful acknowledgement to Meat and Livestock Australia (and the levy paying producers) for investment in the project.

mla MEAT & LIVESTOCK AUSTRALIA

Producer Demonstration Site

Feed365

Hosts: Slade Family (Mount Barker) and Lester Family (Manypeaks).

By: Samantha Cullen, Project Officer, SCF

Background

The Stirlings to Coast Farmers FEED365 is a three-year project (2023–2025) being undertaken in collaboration with the Department of Primary Industries and Regional Development (DPIRD) SheepLinks program. This larger program aims to engage sheep producers and allied industries to re-design livestock forage systems for grazing all-year-round in Mediterranean environments, and to underpin the future prosperity of the sheep industry in Western Australia. The SheepLinks program is a partnership between DPIRD and Meat & Livestock Australia (MLA).

Specifically, the FEED365 project as part of this larger program, aims to create resilient sheep production systems to enable farmers to increase livestock returns by grazing quality (preferably green) forage all year round with minimal supplementary feeding.

DPRID Project Outcome: To reduce supplementary feeding costs of a typical mixed farming business by 30% and lift on-farm profitability by 10%.

Methodology

The SCF FEED365 project will investigate various pastures and forage plants through demonstrations implemented on host producer properties. Sheep weight gain will be monitored on the alternative pastures and forages and compared to weight gain on traditional pastures. Different crop and pasture types and different management methodologies will be implemented to gauge what will best suit producers in the Albany Port Zone.

In 2022

In Mount Barker, a paddock was sown to winter canola (variety Hyola 970CL) in September 2022, and will be divided into two with half the paddock over-sown with Maximus barley at 30 kg/ha. The sheep weight gains will be compared between the straight winter canola (control) and the winter canola/barley mix (treatment). The site is yet to be grazed.

In Manypeaks an annual mix of plantain and ryegrass (control) will be compared to a nearby paddock divided in two and sown to:

- Lotus @ 80kg/ha, ryegrass @ 10-15 kg/ha and chicory @ 1-1.5 kg/ha.
- Red clover @ 8kg/ha, ryegrass @ 10-15 kg/ha and chicory @ 1-1.5 kg/ha.

Producer Surveys

Grower surveys are also currently being undertaken to gain information on current attitudes of SCF members towards including alternate pastures in their farming systems and to gauge what sorts of 'non-standard' pastures have already being successfully implemented by local producers.

Results to date

Data collected from producers during the survey process so far is yielding some interesting results, with a mix of attitudes towards including alternative pastures and forages in farming systems. Some farmers can be hesitant to experiment with different species while others have embraced the notion of substituting traditional methods with other practices which may be more complementary to their individual farming enterprises.

Conclusion

The FEED365 project will provide important data for sheep producers, providing data on new species and pasture systems, validated in the local area. This will assist producers in making decisions as to what will work on their farms. It is hoped that the inclusion of alternative pasture crops and forage shrubs in farming systems will help fill the feeds gaps throughout the year and potentially alleviate the need for supplementary feeding, providing better economic outcomes for farmers.

Acknowledgments

Grateful acknowledgement to DPIRD and MLA (and the levy paying producers) for continued investment in the project.

Department of Primary Industries and Regional Development, Government of Western Australia

MLA Meat & Livestock Australia

Early Sown Winter Wheat Paddock Scale Demonstration in the APZ

Host: Slade Family (Kendenup).

By: Sheridan Kowald, Project Officer, SCF

KEY MESSAGES:

- **This new project commencing in 2023, will provide growers and advisors with crop productivity and disease resistance information for numerous winter wheat varieties to give greater confidence in selecting a suitable variety for the region.**
- **The project will give growers and advisors the opportunity to discuss winter wheat agronomy in general with growers who have been successfully incorporating winter wheats in their programs for several years.**

Background

Winter wheats have slowly been growing in popularity with local growers in the Great Southern Region. In the last couple of years, local growers have had outstanding results from both DS Bennett and RGT Accroc and are keen to understand what other varieties of a similar calibre are available or are soon to be available.

This project will give wheat growers in the Albany Port Zone a winter wheat varietal decision-making tool that provides them with independent and credible yield, disease, and grain quality information to make the most profitable variety decisions for their farming system going forwards.

Methodology

A paddock-scale trial was seeded in Mount Barker on the 5 April 2023 to explore the value of sowing winter wheat to take advantage of good subsoil moisture and early seeding opportunities. Four long winter wheat varieties were sown (RGT Cesario, DS Bennett, Longreach Mowhawk and RGT Accroc) to determine if there is a fit for these varieties in local seeding programs. An Illabo treatment was seeded as a control in the trial, and a neighbouring paddock will to a spring wheat, as a second control. A small area of each variety trial strip will not receive any post-seeding fungicide to determine the effects of disease on each variety.

Conclusion

The trial will run for the duration of the 2023 season and the key learnings extended to local growers and advisers through field walks, newsletter articles and social media.

Acknowledgments

Grateful acknowledgement is directed to GRDC for investment in this project, and Living Farm, who are collaborating with SCF to deliver the project.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

living farm

Mouse Surveillance

By: Sheridan Kowald, Project Officer, SCF

KEY MESSAGES:

- High numbers of mice cause crop damage, loss of livestock feed & fodder, contamination of stored grain, and can spread disease.
- The breeding season is usually October to May, but the start and duration is determined by the availability and quality of food.
- Monitoring reveals changes in populations and can help indicate when control is needed, and the most important times to undertake monitoring are prior to sowing (March–April) and in early spring (September–October).
- SCF will be monitoring 10 paddocks throughout 2023 for mouse activity using chew cards and undertaking active burrow counts.

Background

The overall project, led by Farmanco Management Consultants, will complement the additional $7.5 million GRDC has invested into mouse outbreak research (RD&E) with CSIRO, centred around better understanding mice in cropping systems. It includes activities such as studying the impact of residual food in stubbles, increasing surveillance, and improving strategic management options on managing mice numbers on farm.

As part of the larger project, Stirlings to Coast Farmers (SCF) has been asked to assist with the surveillance activities for the Albany Port Zone (APZ). The surveillance conducted will provide local growers and advisors with information about the presence of mice throughout the 2023 season. SCF will also assist in extending information on effective management tactics.

Methodology/Treatments

The SCF team will assist with mouse monitoring through the use of chew cards and active burrow counts for 10 sites (i.e. 10 paddocks). These sites are geographically spread across the membership zone, with at least 10-15km between each. The sites will be monitored four times throughout the season - pre-sowing, post sowing/early crop emergence, mid-season, and late-season.

At each site the following were installed and monitored:

- 2 x 100m transects
- 10x chew cards soaked in linseed/canola oil evenly spread on one of the 100m transects
- Cornflour to mark burrows in each transect, to see whether they have been active overnight.

Results and Discussion

Pre-seeding bait cards & active burrows

Pre seeding mouse surveillance was completed at all 10 sites on 13 April & 14 April 2023. Overall, seventy-eight burrows were recorded, with 12 being active. Only 5 chew cards out of the 100 placed showed feeding activity of between 1-15% card damage. The lack of card damage may have been due to significant available feed in most of the paddocks, with all participating growers informed of the results.

The next round of monitoring is due to be completed at the end of May/June, post-seeding.

Conclusion

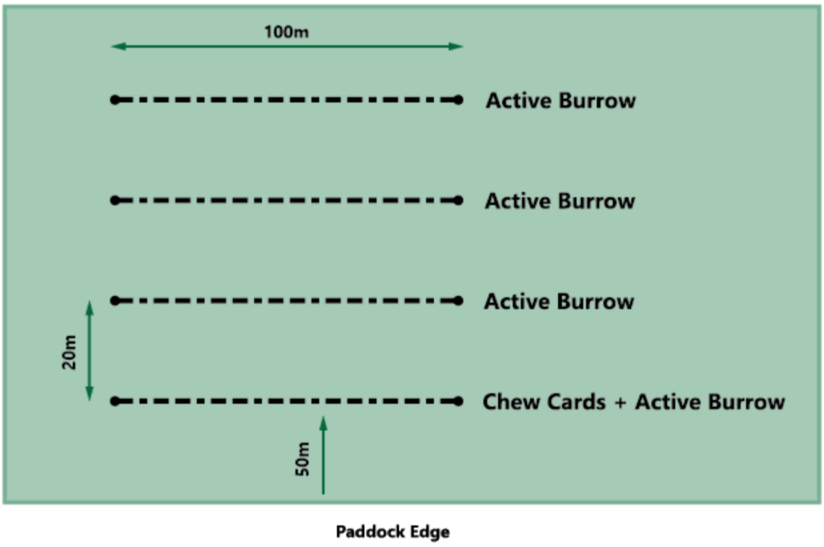
This project will continue throughout 2023. Some key mice strategies to consider before and after sowing include:

- Controlling weeds and volunteer crops along fence lines, crop margins and channel banks before seed set to minimise sources of food and shelter.
- Monitoring mice through the stubble to enable timely control efforts at sowing.
- When mouse populations are high at sowing, baiting at sowing. Best practice - bait as the crop is sown to give mice the best chance of discovering the bait.
- Coordinate management strategies with neighbours to minimise the risk of mouse re-invasion.

Acknowledgments

Grateful acknowledgement to Farmanco and GRDC for investment in this project.

Monitoring Method for Mouse Surveillance



Step 1	At the selected site walk approximately 50 m from the edge of the paddock (see figure 1) and mark the beginning of the first transect (chew cards + active burrows) by placing a marker e.g. flag tape (do this for all transects). Set the transects in the direction of the furrows to make it easy to locate chew cards the following day.
Step 2	Along the first transect set 10 pre-soaked chew cards in a line spaced at 10 m intervals (approximately 10 steps). Peg each card to the ground using a roofing nail or similar. Chew cards are only placed on the first transect. While setting the chew cards mark any burrows observed within 0.5m each side of the centre transect line by covering it with cornflour
Step 3	Mark the end of the first transect and walk a further 20 m into the paddock to the start of the second transect. Along the active burrow transects mark any burrows within 0.5m each side of the centre transect line. Don’t be tempted to add any burrows outside of the 1 m width as this can increase the active burrow count by 100 burrows per hectare.
Step 4	Repeat this for the third and fourth active burrow transects spacing them 20 m apart
Step 5	Record the number of burrows marked in each quarter of the transect (25 m) on the data sheet provided.
Step 6	On the next morning locate the beginning of the chew card transect and pick up each card and each peg (take your small bucket with you). Record the amount of card chewed on the data sheet (it doesn’t have to be exact) e.g. 1%, 2% 5% 10% 25%, 50%, 75% 100% (see figure 2).
Step 7	Any disturbance to the cornflour e.g. trails or dirt mounds (see figure 6) indicates an active burrow. Count the number of marked burrows that displayed signs of activity from each transect and record this next to the number of marked burrows on the data sheet

Fallow Replacement

Host: Adams Family (Woogenellup).

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **The first legume trial of the project was sown on the 2 February 202 with the purpose of fixing nitrogen over the summer period.**
- **Six legume species were seeded and included vetch, soybean, lablab, cowpea, chickpea and faba bean.**
- **A winter cereal crop will be sown over the trial in 2023 without nitrogen fertiliser to quantify the benefits of the summer legume species.**

Background

There is a potential in the southwest of WA to include a legume-based cover crop as a summer chemical fallow replacement, as rainfall in this region over harvest, summer and early autumn is relatively common. When properly inoculated, forage legumes such as cowpea, lab lab, sorghum and vetch nodulate well and can fix anywhere from 20 to 140 kg of residual nitrogen/ha (NSW DPI). This is the equivalent of 50-300 kg/ha of urea fertiliser/ha, which at current urea prices is valued between $50 - $300/ ha. Decomposition and nitrogen release rates are faster if the cover crop is incorporated as opposed to being left on the soil surface as mulch.

Cover crops also provide additional benefits of ground cover and protection against erosion, weed suppression, improved soil biological activity, improved soil water dynamics, and potentially can increased fallow efficiency.

This project will investigate the viability of legume crops sown post-harvest after a significant rainfall event or where ample soil water is available, solely to produce nitrogen for the following winter crop. This is in replacement of the traditional chemical fallow. It differs from previous summer cropping investments which have explored summer grain production and/ or grazing opportunities.

Methodology/Treatments

In the summers of 2022/23 and 2023/24, one small plot trial site will be established with up to 6 summer active legume species by three replications. The first-year trial was established on the 2 February 2023 and included the following treatments:

- (VC) common vetch at 50 kg/ha
- (S) soybean at 50 kg/ha
- (LL) lablab at 20 kg/ha
- (CP) cowpea at 20 kg/ha
- (C) chickpea at 115 kg/ha
- (FB) faba bean at 150 kg/ha

This is in addition to two control treatments- a chemical fallow (FC) and a cultivated control (FT). Due to the lack of rainfall, the trial was irrigated with the equivalent of 25mm of rainfall, and despite the subsequent hot conditions each treatment had good germination and established well.

The cover crops will be terminated as they begin to set pods, or at autumn knockdown (whichever comes first), before the paddock is then seeded to a spring wheat. At this time cover crop plant biomass will be assessed to determine the total nitrogen contribution to the system. The plots will then be incorporated into the soil

Figure 1: 2023 Legume cover crop small plot trial design.

to encourage a rapid breakdown of the plant residue. The winter crop and soil nitrogen will be monitored to effectively establish the impact each legume species has had on nitrogen availability and winter crop production.

Deep soil cores have been taken to 80cm to establish the level of nitrogen currently in the soil, and to act as a baseline figure. Throughout the trial, additional deep soil core samples will be taken and analysed to form an account of the nitrogen as it moves through the system.

Conclusion

Broadly, the project will pilot the effectiveness of a legume cover crop in the HRZ of the Albany port zone, in place of a summer chemical fallow, to supply the following winter grain crops with residual soil nitrogen. It is hoped that the legume nitrogen produced will justify cutting nitrogen fertiliser rates without compromising productivity outcomes.

Acknowledgements

Grateful acknowledgement is directed to GRDC for investment in this project, and Living Farm, who are collaborating with SCF to deliver the project.

Closing the economic yield gap of grain legumes in WA – testing the performance of a new acid-tolerant rhizobia inoculant in the field

By: Dan Fay, Research and Development Co-ordinator, SCF

KEY MESSAGES:

- **Faba beans are the preferred legume crop in the high rainfall region because they have the greatest waterlogging tolerance.**
- **A major limitation to growing legumes can be the detrimental impact of soil acidity on legume nodulation for soil nitrogen production.**
- **A new rhizobium strain has been developed in South Australia that has increased tolerance to soil acidity. A demonstration trial has been set up in Frankland to compare the nodulation and productivity of faba beans grown in acidic soil using the new acid tolerant inoculant with faba beans grown using the standard Group E/F inoculant.**

Background

Grain legumes have been widely grown in Western Australia, with lupins the most dominant species due to their suitability to acidic sandy soils. Although high value legumes may not be suited to all soil types and regions, there are areas of WA (soil type x environment) where they are highly suited. Despite this, the adoption of grain legumes in these areas has been limited and the proportion of legumes grown in farming systems is declining.

Faba beans are the preferred legume crop in the high rainfall region because they have the greatest waterlogging tolerance. Many growers are replacing lupin hectares with faba beans because they are more profitable (where soil pH is above 5.2). A current limitation to growing faba beans is the detrimental impact of soil acidity on nodulation. Research shows that when commercial inoculants for faba beans are used, nodulation decreases rapidly below pH 6 to almost negligible at pH 4. A rhizobium strain has been developed by SARDI that has increased tolerance to soil acidity. This strain is likely to be commercially available in 2024.

The Grower Group Alliance (GGA) is leading the project with investment from GRDC to support local development and extension in the Western Region of the profitable production of grain legumes. SCF is one of several grower groups in the state participating in the project, which includes the expansion of local agronomic knowledge of faba beans (see report elsewhere in this booklet), and to validate the efficacy of the new acid-tolerant inoculant.

This trial aims to compare the nodulation and productivity of faba beans grown in acidic soil (pH 4.8) using the new acid tolerant inoculant (developed by SARDI) for faba beans compared with the standard group E/F inoculant.

Methodology

Farm-Scale Demonstration

SCF has designed a simple but optimal layout for this farm-scale demonstration (Figure 1). Essentially the demonstration will include 'seeder width' replicates of each of the following treatments:

- Faba beans sown at 120 kg/ha with acid tolerant inoculant (equiv. 1.25kg per 500kg seed)
- Faba beans sown at 120 kg/ha with Group E/F inoculant (equiv. 1.25kg per 500kg seed)

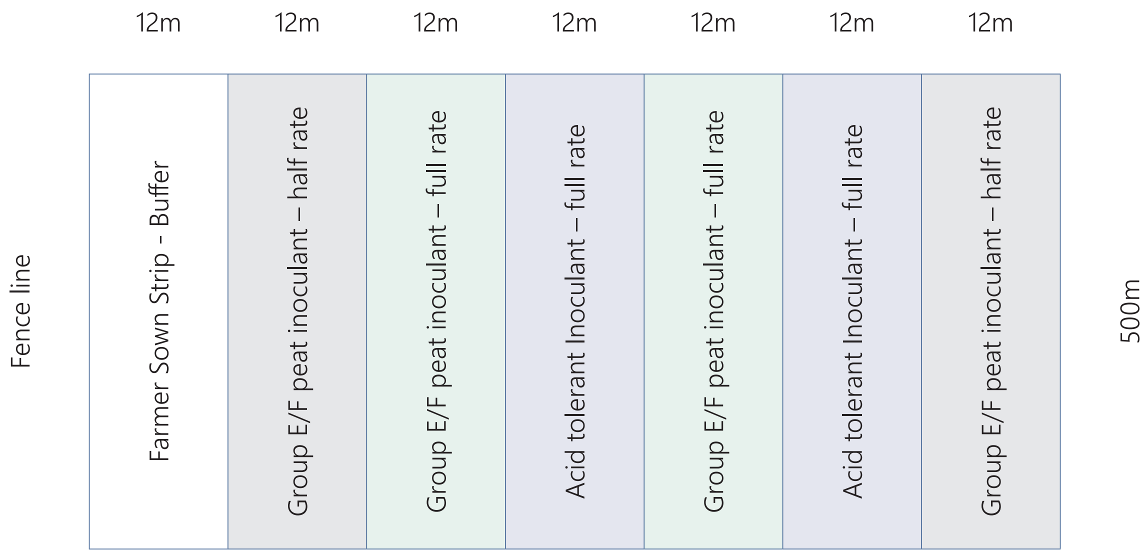


Figure 1. Demonstration design – all treatments sown to faba beans at 120 kg/ha.

- Faba beans sown at 120 kg/ha with Group E/F inoculant (equiv. 0.625kg per 500kg seed)

The host farmer will be responsible for seeding, spraying, and harvesting the crop. SCF staff will take all the required field assessments and ensure the harvest yield data is collected correctly by the harvest yield monitor(s).

The trial is located at Frankland River and was sown on 25th May 2023. Prior to sowing, baseline soil samples were collected, and samples taken for Predicta rNod analysis (SARDI). In-season plant establishment counts, biomass and nodulation assessments will be collected/measured from each plot.

Harvest will be conducted using the farmer's machinery, with the yields of each plot being determined by analysing the harvest yield files.

Acknowledgements

Grateful acknowledgement to project lead GGA as well as GRDC (and the levy paying growers) for continued investment in the project.

GRDC National Risk Management Initiative – Nitrogen Use Efficiency in the High rainfall zone

Host: Beech Family (Kendenup).

By: Dan Fay, Research and Development Co-ordinator, SCF

Background

The high rain fall zone (HRZ) of Western Australia is a unique environment, where most of the cropping is conducted on sandy soil types with low nutrient and water holding capacities. As a result, there is a significant yield gap between the WA HRZ and those in the eastern states in similar rainfall zones. It has been estimated that potential grain yield for wheat in the high rainfall zone (HRZ) of WA is in the range of 6-12 t/ha and 3-5t/ha for canola. However, average crop yields are below these potentials (except in 2022). On top of this the nitrogen use efficiency in the WA HRZ poses a significant risk and challenge to farmers. The low conversion rate of applied nitrogen to grain yield and grain protein, which is likely the result of losses through high rates of leaching and denitrification, coupled with the inability to bank nutrients in typical WA soils, has led most farmers to be somewhat conservative i.e., not fertilising to meet the yield potential.

In 2023, Stirlings to Coast Farmers will establish a comprehensive long-term small plot trial to examine the impact of crop rotation and grower appetite for nitrogen risk on nitrogen use efficiency, carbon emission efficiency, and profitability. In addition, APSIM models will be utilised to expand upon the field research by utilising the field trial data to model different cropping scenarios and management strategies to broaden the scope of the project.

Methodology/Treatments

Trial Design

The small plot trial will be located in Kendenup and the basic design will be a factorial crop rotation by nitrogen management strategy with full phasing of crop rotations (every crop planted in every year). The trial will contain three crop rotations (with and without legumes) and three nitrogen management, strategies (decile 8, decile 5 and nil nitrogen) within the paddock.

In consultation with local agronomists, a baseline nutrient management plan has been established for the decile 8, decile 5 and Nil nitrogen treatments. In the seasons following 2023, the nutrient management will be adjusted in relation to the carry over soil nitrogen. The number of applications will remain constant, rates will be adjusted only. This will accurately account for the season-on-season variability.

Measurement

The measurements taken throughout the trial will allow for a full nitrogen account to be kept, as nitrogen cycles through the cropping system over the four years of the project. To keep this account, the following metrics will be recorded; soil nitrogen to 100cm pre-seeding and at harvest, plant tissue and harvest residue nitrogen, harvest biomass, harvest index grain removal and grain nitrogen %.

These measurements will allow us to accurately measure the nitrogen use efficiency of each crop rotation system under each nitrogen management strategy, as well as accurately model (with the use of APSIM) these rotations under a range of different climate and management scenarios to establish how to manage nitrogen most profitably and sustainably in the WA HRZ.

Conclusion

This trial is an ambitious undertaking that will allow us to deliver locally relevant and comprehensive information on nitrogen use efficiency for our rainfall zone and our soils. This research will be undertaken in close consultation with local farmers and consultants. We will also be encouraging members to get in touch with us, who are interested in this project and in benchmarking their own nitrogen use efficiency.

Acknowledgments

Grateful acknowledgement is directed to GRDC for investment in this project, and to GGA and Living Farm, who are collaborating with SCF to deliver the project.

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PARTNER TRIALS

CSBP Urea Sustain boosts Yields and Nitrogen Use Efficiency at Three Springs

James Easton, CSBP Senior Agronomist

Volatilisation losses of ammonia from urea applications can be significant.

Studies in WA have been limited, but one experiment by CSIRO near Merredin in 1995 indicated that losses under adverse conditions could be as high as 35%. In this study, urea was topdressed on the 23rd of May onto a moist surface, and there was no significant follow up rain for 12 days.

CSBP has released a product, Urea Sustain, which can significantly reduce such volatisation losses.

In 2022, the effectiveness of CSBP Urea Sustain was compared to urea in a wheat trial at Three Springs.

The results showed that CSBP Sustain can significantly increase efficiencies and returns from nitrogen (N) fertiliser.

Calibre wheat was sown on the 11th of May, and the urea treatments were topdressed on the 20th of June, a few days after good rains were received. There was no significant follow up rain until nearly three weeks later, so conditions for volatisation were ideal.

The site was very N responsive. There were good responses to urea, but there were much better responses to CSBP Urea Sustain (Figure 1).

While volatisation losses were not directly measured, stronger responses to Urea Sustain indicated that they were significant.

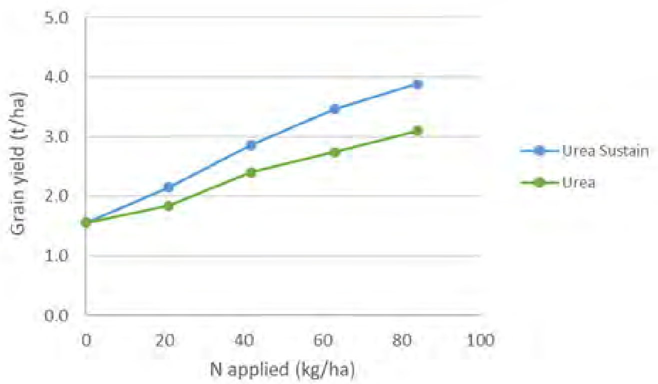


Figure 1. Wheat grain yield responses to CSBP Urea Sustain and Urea at Three Springs in 2022.

Nitrogen use efficiency (NUE) from Urea Sustain was double that from Urea (Figure 2).

Another trial CSBP conducted in 2022 near Kojaneerup, looked at whether volatilisation and nitrification inhibitors can improve the nitrogen use efficiency (NUE) of urea top-dressed five weeks after sowing.

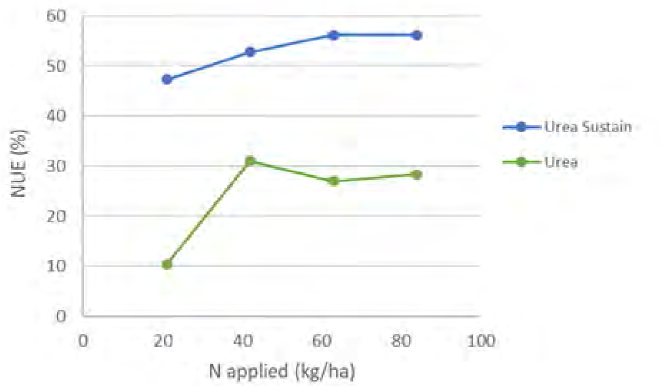
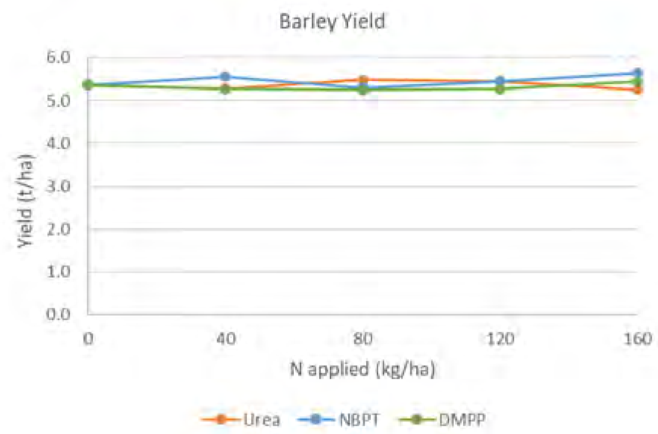


Figure 2. Nitrogen use efficiency (NUE) from CSBP Urea Sustain and Urea at Three Springs in 2022.

The trial was sown on the 26th May to Commodus Barley . Nitrogen (N) treatments were applied on the 29th June. There was no significant rainfall event until the 18th July - about 3 weeks after application.

Unlike the Three Springs trial, this site was unresponsive to N fertiliser.



Big cropping programs challenge the logistics of applying urea within a day or two of expected rain to minimise losses. And then there is the risk that there may not be enough rain to stop these losses.

Contact your local CSBP Account Manager for more information on CSBP Urea Sustain

Phosphorus and Manganese responses in gravel soil, Summit Fertilizers

Trial Background:

As modern farming systems evolve and adapt there is constantly a need to update and reinforce the importance of crop nutrition on production and profitability. Phosphorus (P) is an essential macro nutrient required for overall plant health and vigour. It also plays a vital role in energy transfer. However, it's importance is sometimes downplayed because of generalisations about historic use and availability in soil and pressures to decrease application rates due to product cost.

Manganese (Mn) is an essential plant micro-nutrient with complex soil chemistry. Research in Western Australia has shown a poor relationship between soil test Mn values and crop response to applied Mn. This is because the divalent or 'reduced' Mn (Mn2+) is available to plants where oxidised Mn forms are not. The release of Mn2+ is governed by complex reduction and oxidation processes, and greatly affected by soil pH.

As soil pH increases oxidation of Mn increases, in-turn decreasing plant-available Mn. Western Australian soils are typically acidic and below the cropping optimal of pH 5.5 to 6.5. This has led to liming becoming a key focus for most growers to address soil acidification. There are thoughts that broad increases in soil pH across the region may contribute to increasing instances of Mn deficiency.

It is important that local growers understand the nutrition requirements of crops in their local area to optimise fertiliser usage to not only maximise yield but, more importantly, profitability. The trial tests six phosphorus rates, both with and without Mn for a total of 12 treatments. MAP was used as the P source, and Summit's MAP & Mn compound along with MnSO4. granules as Mn sources, with both fertilisers banded below the seed.

Aims:

- Investigate local P requirements in wheat and reinforce the importance of P for producing a profitable crop.
- Determine if increasing P rates influences crop Mn status.
- Assess yield and quality benefits from various P rates (+/-) Mn.

Table 2. TRIAL TREATMENTS: Majority of manganese was applied using Summit's full compound MAP & Mn. Manganese sulphate was applied on nil to low P treatments.

Treatment	Nutrient (kg/ha)	Establishment Fertiliser product banded (kg/ha)	In-Season product (kg/ha or L/ha)	Total (kg/ha) N	P	K	S	Mn
1	P0 Mn0	56 MAXam, 50 Urea	110 NK21, 110 Urea, 70 UAN	145	0	32	14	0
2	P10 Mn0	44 MAP, 52 MAXam, 41 Urea	110 NK21, 110 Urea, 70 UAN	145	10	32	14	0
3	P20 Mn0	88 MAP, 49 MAXam, 31 Urea	110 NK21, 110 Urea, 70 UAN	145	20	32	14	0
4	P30 Mn0	132 MAP, 45 MAXam, 22 Urea	110 NK21, 110 Urea, 70 UAN	146	30	32	14	0
5	P40 Mn0	176 MAP, 42 MAXam, 12 Urea	110 NK21, 110 Urea, 70 UAN	146	40	32	14	0
6	P50 Mn0	220 MAP, 38 MAXam, 2 Urea	110 NK21, 110 Urea, 70 UAN	146	50	32	14	0
7	P0 Mn4	14 $MnSO_4$, 45 MAXam, 53 Urea	110 NK21, 110 Urea, 70 UAN	145	0	32	14	4
8	P10 Mn4	53 MAP&Mn, 7 $MnSO_4$, 26 MAXam, 48 Urea	110 NK21, 110 Urea, 70 UAN	145	10	32	14	4
9	P20 Mn4	106 MAP&Mn, 7 MAXam, 43 Urea	110 NK21, 110 Urea, 70 UAN	146	20	32	14	4
10	P30 Mn4	44 MAP, 106 MAP&Mn, 4 MAXam, 33 Urea	110 NK21, 110 Urea, 70 UAN	146	30	32	14	4
11	P40 Mn4	88 MAP, 106 MAP&Mn, 24 Urea	110 NK21, 110 Urea, 70 UAN	146	40	32	14	4
12	P50 Mn4	132 MAP, 106 MAP&Mn, 13 Urea	110 NK21, 110 Urea, 70 UAN	146	50	32	14	4

Table 1. SOIL TEST RESULTS: Texture by MIR scanning of sieved soil <2mm. Gravel is a visual estimate of total sample volume.

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	Sand %	Silt %	Clay %	Gravel %
0-10	5.0	39	240	11	130	27	3.0	0.08	17	2	0.6	0.7	3.0	82	11	7	25
10-20	5.0	14	112	4	59	10	1.2	0.04	4	1	0.3	0.3	1.3	93	2	5	75
20-30	5.1	10	77	4	60	8	1.4	0.03	3	1	0.3	0.3	0.9	94	2	4	75

Soil test results are illustrated in Table 1 and treatments detailed in Table 2. Aside from the P and Mn treatments, the site was managed as per paddock practice. The area had a decile 9 growing season rainfall of 516mm 91 mm above long-term average. The site was gravelly loamy sand sown to Scepter Wheat on 25/05/2022 at 85kg/ha.

Results:

Plant samples were collected from all plots during tillering on the 3rd August 2022, dried and analysed for shoot nutrient concentration (Figure 1). Shoot Mn content was significantly increased by Mn application ($p<0.001$), with nil Mn averaging 50mg/kg compared to 4 Mn/ha averaging 77mg/kg. There was a strong correlation between rate of P applied and increasing plant weight ($p<0.001$), but growth was not affected by application of Mn ($p=1$). Plant tissue P concentration increased with increasing P rates, again

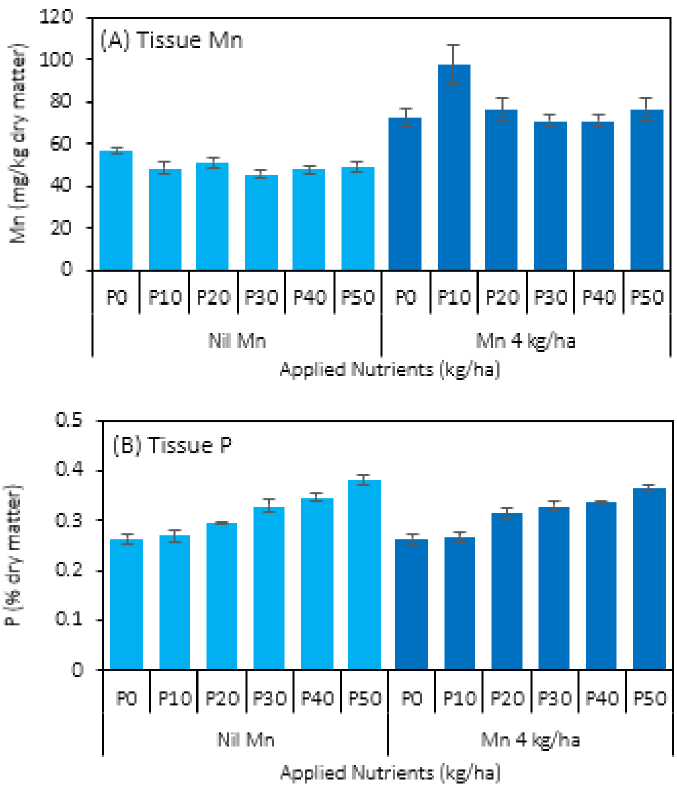


Figure 1. Above-ground wheat shoot tissue concentrations of (A) Manganese and (B) Phosphorus with different Mn and P application rates.

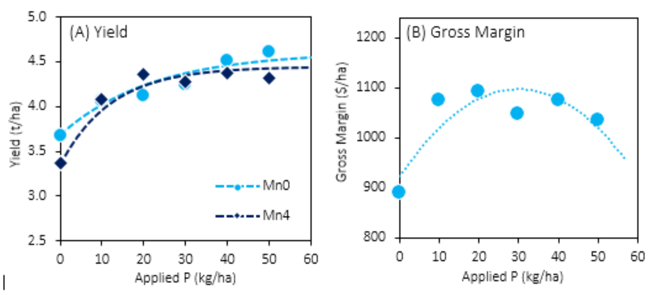


Figure 2. (a) Wheat yield response to different P and Mn rates and (B) indicative returns from altering P application rates. Returns are a simple gross margin of grain value minus the cost of all fertiliser applied, averaged for +/- Mn treatments..

unaffected by Mn application ($p=0.84$).

Yield was highest (4.6t/ha) with 50kg/ha of phosphorus and no manganese applied (Figure 2). There were significant differences in yield, up to 1 t/ha, between different applied rates of P ($p<0.001$). Manganese had no effect on grain yield ($p=0.47$). Optimising P application indicatively increased profit at the site by up to $200/ha.

Discussion:

With the expansion of cropping and a push to improve overall farm productivity in the Southwest, growers are looking to more accurately predict P responses in gravel soils. Historically, the industry has relied on the Colwell P extraction test in conjunction with a phosphorus buffering index (PBI) value and a gravel content factor to determine the P rate to achieve optimum yield potential. This process has proven to be of limited value in evaluating overall P status for iron stone gravel soil types, in particular when bulk density is not known and because estimating gravel content is difficult. It has been proposed that for soil types of this nature the Diffusive Gradients in Thin Films Phosphorus Test (DGT-P) may be more accurate in determining phosphorus response.

Thanks to the co-operation of Jason Watterson of Watterson Estate supporting Summit trials at Tenterden that will gain long term data and help to refine the DGT-P thresholds for productivity and profit-maximising P fertiliser requirements.

Key messages

- Not all forest gravels are responsive to manganese, particularly when moderate acidity is present.
- Plant tissue tests are an important tool in evaluating manganese status.
- The highest gross margin was achieved at 20kg/ha of P, minus Mn, and optimising P had up to $200/ha benefit.
- Growers that require a greater level of accuracy in predicting phosphorus (P) responses in forest gravel soils should consider the DGT-P test.

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NOTES

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