Final Technical Results Report

2023

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

Project code:	9177001 / SCF1902-002SAX
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REPORT SENSITIVITY

Does the report have any of the following sensitivities?

Intended for journal publication	YES ☐ NO ☒
Results are incomplete	YES ☐ NO ☒
Commercial/IP concerns	YES ☐ NO ☒
Embargo date	YES ☐ NO ☒ If Yes, Date: N/A

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ABSTRACT

It has been estimated that potential grain yield, in the high rainfall zone (HRZ) of WA, for wheat is 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). The collective HRZ project aimed to increase the value of the cropping phase in the HRZ farming system by 10% by addressing both crop yield potential and the gap between potential and realised yield, by 2023.

To assist in achieving this target, six demonstration sites between 2020 and 2022 were implemented in the HRZ of the Albany port zone. These sites collectively investigated deep ripping, long season wheats, time of sowing and nitrogen strategies as levers to push productivity of wheat and canola.

Results of note showed that deep ripping increased yields on sand over clay soils, long season wheats (when sown in their optimal sowing time) yielded comparatively with Planet barley and that increased nitrogen fertiliser did not result in any definitive yield or protein increase in 2022.

However, overall, the project objective was met, with many growers in the high rainfall zone of the Albany Port Zone in 2022 achieving record yields that were well over 6 t/ha for wheat and over 3 t/ha in canola.

EXECUTIVE SUMMARY

Background

The HRZ is characterized by a longer growing season than the Wheatbelt, which means yield potentials are much higher. It has been estimated that potential grain yield for wheat is 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). Yields had plateaued over the previous decade, which is surprising with significant technological advances in this time.

This investment aimed to contribute to the broader GRDC HRZ investment outcome that seeked to affect change such that by 2023, growers had increased the value of the cropping phase in the HRZ farming system by 10% by addressing both crop yield potential and the gap between potential and realised yield (as per Robertson et al., 2016).

Methodology & Results

In order to ascertain the impact of this GRDC investment, pre-project and post-project grower surveys were undertaken. These surveys captured the farming enterprise performance and farming system practices in the HRZ regions of both the Esperance and Albany Port Zones in 2019 and again in late 2022.

In addition to the surveys, six demonstration sites were successfully sown (and extended to growers through field walks) between 2020 and 2022. These purposefully investigated the issues of significance brought to light by the 2019 grower survey data.

In 2020, the two demonstration trials (Cranbrook and South Stirling) investigated deep ripping, time of sowing and wheat variety choice against a control of Planet barley. Plant counts, NDVI, grain yield and grain protein were recorded for all treatments. The deep ripping showed to be effective in increasing the wheat yield on sand over clay soil but not on forest gravels. Results also showed that Ilabo (long season wheat), when sown in its optimal sowing window, yielded comparatively to Planet barley.

The 2021 trials (nitrogen nutrition) were abandoned due to severe waterlogging.

In 2022, four nitrogen nutrition demonstration trials were sown to either wheat or canola (Mount Barker, Frankland River, South Stirling and Gairdner) to determine if nitrogen was the limiting factor. NDVI, plant tissue N%, harvest yield and grain protein % were recorded for all treatments (except grain protein for canola). The results showed no conclusive, significant advantage (yield or protein) to increased N applications. 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 equally 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 survey results, however, show it is clear that growers are upping 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 units in wheat (Hyper yielding awards paddock data). This is a change from four years ago.

Project Conclusions

Overall, the project was a success. Many growers in the HRZ of the APZ in 2022, achieved record-breaking yields, and although these yields may not be achieved again immediately, the project data and the 2022 yields have given growers the confidence and tools to achieve potential grain yields when conditions are favourable.

Given the 2022 yield results, Stirlings to Coast Growers can confidently say that growers easily increased the value of their cropping phase by 10%, although the field trials highlight the complexity of prescribing parameters for maximising and achieving this crop production.

BACKGROUND

The high rainfall zone (HRZ) of Southern Western Australia represents approximately 1.2million ha in WA (Robertson et al., 2016) with an annual rainfall of between 450-800mm. As annual rainfall has decreased over the last four decades, the amount of area in the HRZ sown to crops has increased (Kingwell 2006). Increased cropping in the HRZ is due to less frequent and less severe waterlogging events, which can reduce yields by 37% in wheat (Zhang 2004).

The HRZ is characterized by a longer growing season than the Wheatbelt, which means yield potentials are much higher. It has been estimated that potential grain yield for wheat is in the range of 6-12 t/ha and 3-5t/ha for canola. However, at the commencement of this project, 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). Yields had plateaued over the previous decade, which is surprising with significant technological advances in this time. The yield plateau indicates that there were other considerable crop limiting factors. For example, the benefits of auto-steering, precision seed placement, new herbicide modes of action, liquid fertilisers etc., have not outpaced soil nitrogen depletion, increased disease pressure and herbicide resistance.

Historically most common local crop sequence is canola, followed by barley and repeated for as long as possible. With mixed growers eventually entering a pasture phase to build up organic matter, soil nitrogen and give the paddock a disease, pest, and weed break from cropping. This agronomic approach is one that has been perpetuated by the idea that wheat yields cannot match those of barley within the WA HRZ.

Local growers have also started managing and mitigating soil constraints through liming, deep tillage and spreading clay on sandy soils. Anecdotally, this is improving paddock yield potential, but it is a slow and expensive process. There are currently very few long-term solutions to mitigate waterlogging in the Albany Port Zone's southern part (APZ). Most growers manage the risk by thoughtful paddock selection, but this can be very hit and miss based on seasonal conditions. In dry seasons, the 'wetter' paddocks will be the highest yielding; in seasons with average or above average rainfall, these paddocks will suffer severe yield losses.

Research from the mid to late 2000s indicates that higher yields are possible in the HRZ in modelled scenarios. High yields in small plot research are also regularly achieved using optimal inputs and application timing. There are major constraints to crop production, which are stopping growers from reaching their optimum yield potentials. Overcoming these limitations to production will increase the productivity and profitability of growers in the HRZ. A key driver of the yield gap identified in a review by Robertson et al. (2016) is the timeliness of applying inputs and operational logistics (e.g., sowing, weed and disease control, crop flowering and nitrogen application). The top 25% of growers have learnt and adopted timely practices in the HRZ (Planfarm Bankwest 2016- 17), and there is strong evidence that assisting those not in the top 25% to adopt these practices will close the yield gap (Robertson et al. 2016).

PROJECT OBJECTIVES

Current research suggests that growers in the high rainfall zone are missing out on an extra 1 to 3 t/ha of wheat and 0.5 to 1.5 t/ha of canola, depending on the decile year.

The GRDC investment "Optimising the profitability of high rainfall (HRZ) farming systems – survey, grower scale demonstration trials and field days" aims to reduce the gap between current and potential yield in the high rainfall zone, focusing on wheat and canola production. This investment will contribute to the broader GRDC HRZ investment outcome that seeks to affect change such that by 2023, growers have increased the value of the cropping phase in the HRZ farming system by 10% by addressing both crop yield potential and the gap between potential and realised yield (as per Robertson et al., 2016).

Closing this yield gap will be achieved Collaboratory through growers, researchers, and advisers better understanding and overcoming the major constraints to production in the HRZ, including varietal selection, timeliness of applications of inputs, operational logistics, soil amelioration priorities, and crop sequencing options. Grower scale trials will demonstrate these improvements and field walks will extend the information. Pre and post-project surveys will capture grower practice change in the HRZ as a result of this project.

METHODOLOGY

Survey

In order to ascertain the impact of this GRDC investment, pre-project and post-project grower surveys were undertaken. These surveys captured the farming enterprise performance and farming system practices in the HRZ regions of both the Esperance and Albany Port Zones in 2019 and again in late 2022. SEPWA and Stirlings to Coast Growers came together to prepare the surveys with input from DPRID, CSIRO and FAR Australia researchers involved with GRDC investment 'Optimising HRZ Cropping for Profit in the Western and Southern Regions'. The survey was also developed with input from Linda Hygate, a survey, and monitoring and evaluation specialist from Queensland. SEPWA and SCF each undertook 20 interviews with growers in their respective port zones in 2019 and then interviewed the same growers again (for the most part) in 2022.

A wide cross-section of enterprises was included in the survey conducted by SCF. Both sole cropping and mixed enterprises were included, as were small to large-scale operations. Diversity was also sought in terms of grower age and consulting agronomist.

Given the style and interview methodology employed for this survey, the results have been summarized as graphs or tables. SCF felt it was important that grower responses were not overly simplified or condensed, given its purpose to provide as much information as possible to GRDC, DPIRD, CSIRO and FAR Australia as to changes in grower practice during the course of the project. The full survey report was submitted and approved as a previous milestone to GRDC, however, key learnings are summarised in this report.

Field trials

It was planned that in 2020, 2021 and 2022, two demonstration sites per year would be implemented in the HRZ of the Albany port zone (APZ), targeting major constraints to production.

In 2021, the two sites implemented in Mount Barker and South Stirlings (Photo 1 & 2) were severely waterlogged and abandoned (not reported on in this report). A variation was approved by GRDC to re-implement these two sites in 2022, therefore there were four demonstration sites in 2022.

Photo 1: 2021 Failed Canola crop (Mount Barker) due to excessive waterlogging. Trial site abandoned. Photo taken the 2 August 2021 by Nathan Dovey SCF.

Photo 2: 2021 Failed Canola crop (South Stirling) due to excessive waterlogging. Trial site abandoned. Photo taken the 21 July 2021 by Nathan Dovey SCF.

Trials - 2020

In 2020, the two demonstration sites were located in Cranbrook and South Stirling. The site in Cranbrook was located on a heavy forest gravel over clay while the South Stirling site was located on a light sand over gravel clay. Both demonstrations aimed to demonstrate the benefits of ripping by the benefits of time of sowing and crop type (Table 1). Trial designs for each are shown in Figure 1 and 2.

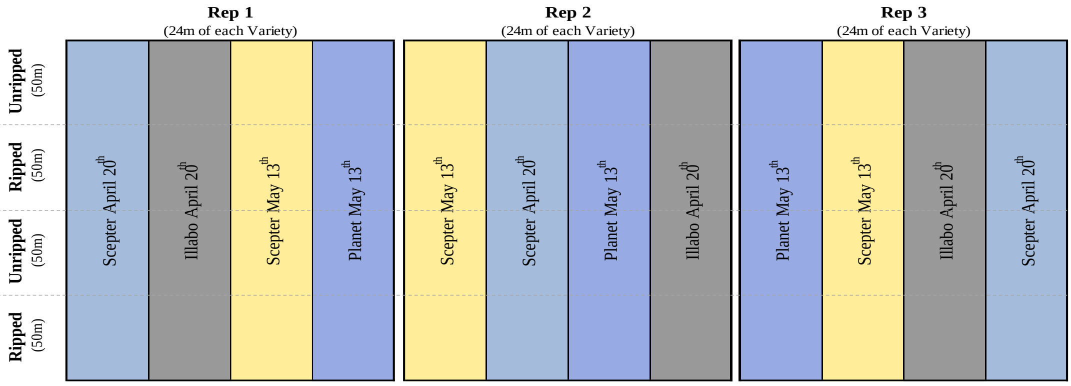


Figure 1: Trial design for the Cranbrook site. The different colours represent the treatments tested at the trial site. For example, Scepter sown on 13th May is represented by the yellow strips.

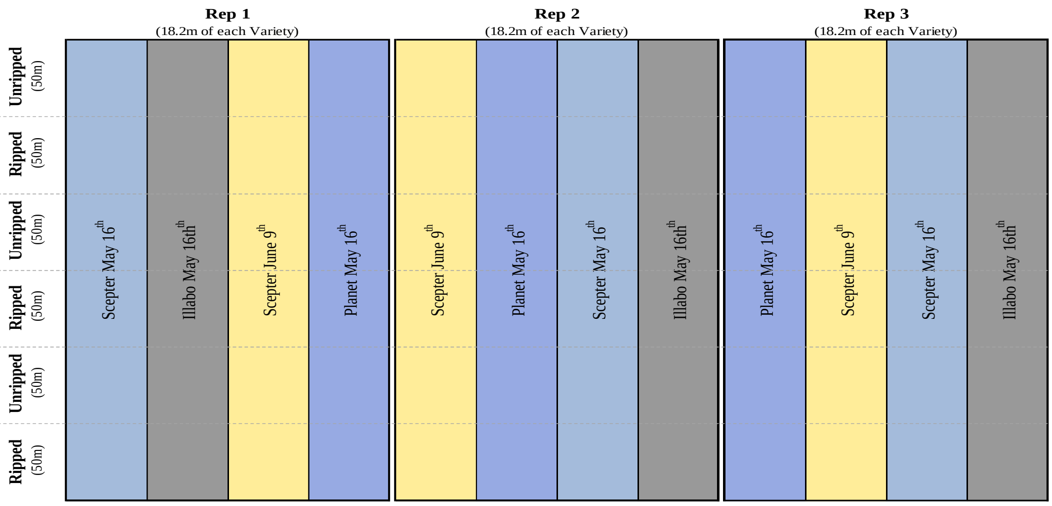


Figure 2: Trial design for the South Stirling Site. The different colours represent the treatments tested at the trial site. For example, Scepter sown on 9th June is represented by the yellow strips.

Table 1: Treatment list for each site

Cranbrook Site Treatments:	South Stirling Site Treatments:
• Ripped (across trial site) Tilco 500mm • Unripped (across trial site) • Scepter wheat sown 20 Apr 2020 • Illabo wheat sown 20 Apr 2020 • Scepter wheat sown 13 May 2020 • Planet Barley sown 13 May 2020 (control)	• Ripped (across trial site) Ausplow 450mm • Unripped (across trial site) • Scepter wheat sown 16 May 2020 • Illabo wheat sown 16 May 2020 • Scepter wheat sown 9 June 2020 • Planet Barley sown 9 June 2020 (control)

*Seeding delayed at the South Stirling site due to delayed season break

Measurements at each site included:

- Post-seeding plant counts (plant/m2)
- NDVI measurements (3m satellite) – at least three in-season timings.

- Harvest yield
- Grain quality

Trials - 2022

In 2022, the paddock scale trials were designed to examine nitrogen (N) utilisation and how to efficiently meet the plant peak N demand. These trials were driven by record high input costs, coupled with the idea that there is potentially a large degree of wastage in the current HRZ farming system, particularly where fertiliser is applied in a rigid and set manner, rather than attempting to maximise the nitrogen use efficiency (NUE) through peak N demand where plant uptake will be maximised. Trial designs for each demonstration are shown in Figures 3, 4, 5 and 6.

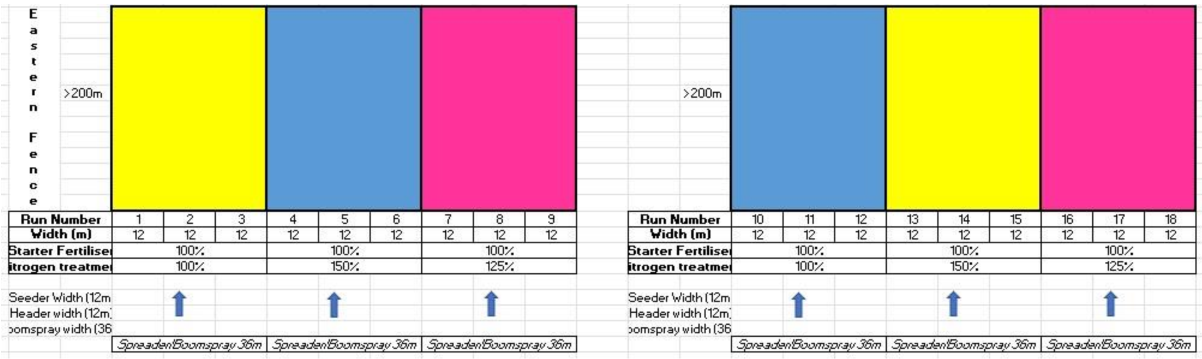


Figure 3: Trial design for the 2022 Frankland River Site.

The Frankland River site was replicated twice with the following treatments (keeping in mind all treatments had 100% of the standard starter fertiliser):

- 100% of standard in-season nitrogen application (grower practice)
- 125% of standard in-season nitrogen application
- 150% of standard in-season nitrogen application

In the Frankland River trial, the in-season nitrogen fertiliser applications were split into two application timings (50/50).

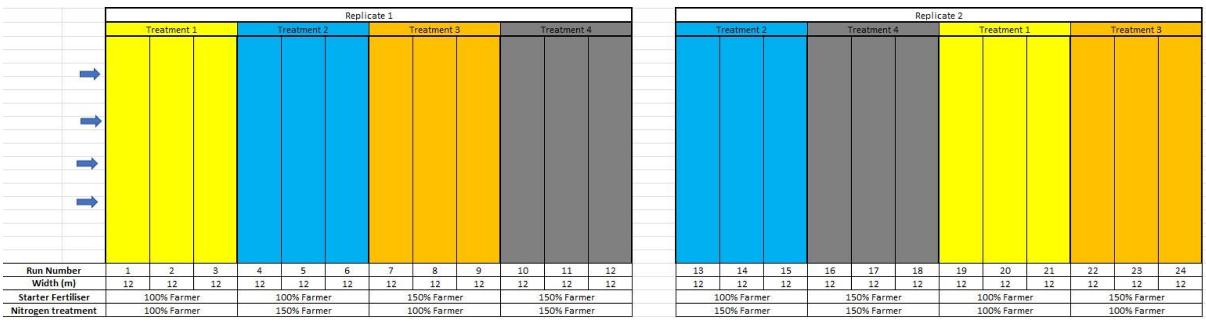
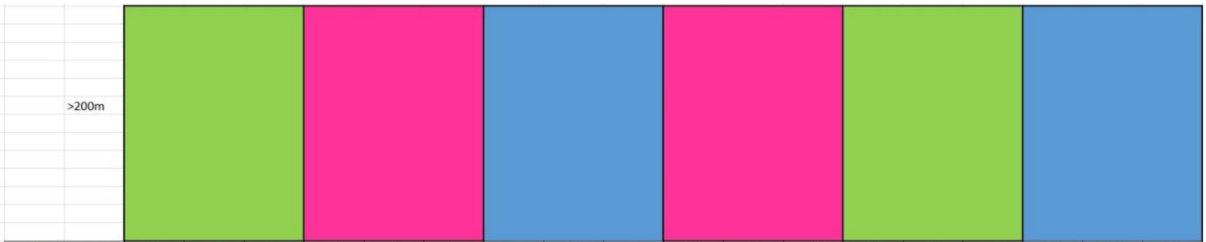


Figure 4: Trial design for the 2022 South Stirling Site.

The South Stirling site was replicated twice with the following treatments:

- 100% starter fertiliser, 100% in-season nitrogen fertiliser (grower practice)
- 100% starter fertiliser, 150% in-season nitrogen fertiliser
- 150% starter fertiliser, 100% in-season nitrogen fertiliser
- 150% starter fertiliser, 150% in-season nitrogen fertiliser

At the South Stirling site, all of the additional in-season N applied was applied in the second (final) ures fertiliser application at booting.



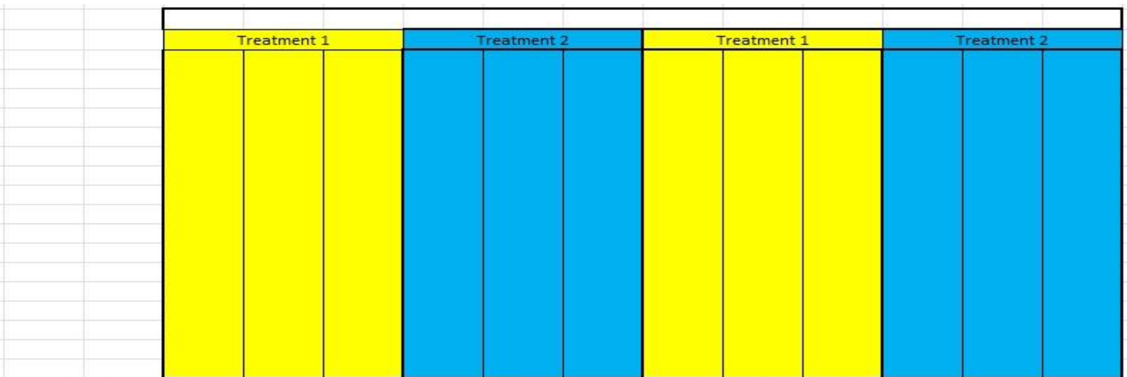
Run Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Width (m)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Starter Fertiliser	100%			100%			100%			100%			100%			100%		
Nitrogen treatment	100%			125% pre tillering			0% total, 125% pre & post-tilleri			125% pre tillering			100%			0% total, 125% pre & post-tilleri		

Figure 5: Trial design for the 2022 Gairdner Site.

The three treatments at the 2022 Gairdner site were replicated twice and included (keeping in mind starter fertiliser remained the same for all treatments):

- 100% in-season nitrogen fertiliser (grower practice)
- 125% in-season nitrogen fertiliser
- 150% total nitrogen fertiliser

In the Gairdner trial. The in-season nitrogen fertiliser applications were split into two application timings (50/50).



Run Number	1	2	3	4	5	6	7	8	9	10	11	12
Width (m)	12	12	12	12	12	12	12	12	12	12	12	12
Starter Fertiliser	100% Farmer			100% Farmer			100% Farmer			100% Farmer		
Nitrogen treatment	100% Farmer			150% Farmer			100% Farmer			150% Farmer		

Figure 6: Trial design for the 2022 Mount Barker Site.

The treatments at the Mount Barker site were replicated twice and were as follows:

- 100% starter fertiliser and 100% in-season nitrogen fertiliser (grower practice)
- 100% starter fertiliser and 150% in-season nitrogen fertiliser

In the Mount Barker trial, the in-season nitrogen fertiliser applications were split into two application timings (50/50).

Measurements at each of the four 2022 demonstration sites included:

- Tissue testing (plant tissue samples collected and sent to laboratory for analysis)
- NDVI measurements (post in-season N application with the exception of the South Stirlings site)
- Harvest yield – yield maps
- Grain quality - CBH

LOCATION

Where field trials have been conducted, provide the following location details in the table below: latitude and longitude, or nearest town. (Add additional rows as required.)

Site #	Latitude (decimal degrees)	Longitude (decimal degrees)	Nearest town
Trial Site (2020)	-34.317701	117.377601	Cranbrook
Trial Site (2020)	-34.545864	118.235100	South Stirling
Trial Site (2022)	-34.477836	117.497676	Mount Barker
Trial Site (2022)	-34.355825	117.192593	Frankland River
Trial Site (2022)	-34.208621	118.908753	Gairdner
Trial Site (2022)	-34.595844,	118.281359	South Stirling

If the research results are applicable to a specific GRDC region/s (e.g. North/South/West) or [GRDC agro-ecological zone/s], indicate which in the table below:

Research	Benefiting GRDC region (select up to three)	Benefitting GRDC agro-ecological zone	
Optimising profitability of high rainfall zone farming systems- survey, grower-scale demonstration trials and field days	Western Region Choose an item. Choose an item.	☐ Qld Central ☐ NSW NE/Qld SE ☐ NSW Vic Slopes ☐ Tas Grain ☐ SA Midnorth-Lower Yorke Eyre ☐ WA Northern ☐ WA Eastern ☐ WA Mallee	☐ NSW Central ☐ NSW NW/Qld SW ☐ Vic High Rainfall ☐ SA Vic Mallee ☐ SA Vic Bordertown-Wimmera ☒ WA Central ☒ WA Sandplain

RESULTS

Survey Results

The survey taken originally in 2019 and followed up in 2022 with the same growers, contained 57 questions. These questions explored a wide range of topics to comprehensively track practice change across the surveyed period within the APZ. The final survey report has previously been submitted to GRDC and report findings are drawn upon to some degree in the discussion section of this report.

Trial Results 2020

Plant Counts

At the Cranbrook site, plant density counts were slightly higher in the unripped sites at the compared to the ripped treatments, and the May-sown Scepter had a higher plant count than the other crop type/sowing timing treatments (Figure 7), possibly due to the 34mm of rainfall received just before this second time of sowing. Although sown at the same time, Planet barley was only sown at 100kg/ha compared to the Scepter at 120kg/ha. The trial site was rolled after ripping, yet there was patchy germination due to the seeder setup not being suited to the soft topsoil resulting from the ripping.

At the South Stirling site, there was no discernible difference between the ripped and unripped treatments, however, the early sown Ilabo and the later sown Scepter had noticeably higher plant counts than the other two treatments (Figure 8). For the Scepter this was most likely due to good soil moisture at the time of seeding, and rainfall thereafter. The later Overall, the ripping process bought rocks to the surface, which left ungerminated areas.

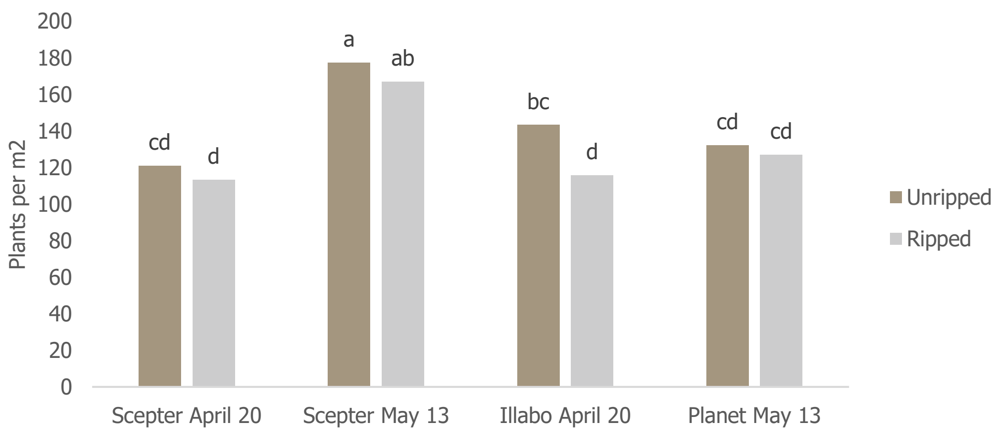


Figure 7: Plant density counts (plants/m^2) for April 20 and May 13 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the Cranbrook site in the 2020 season.

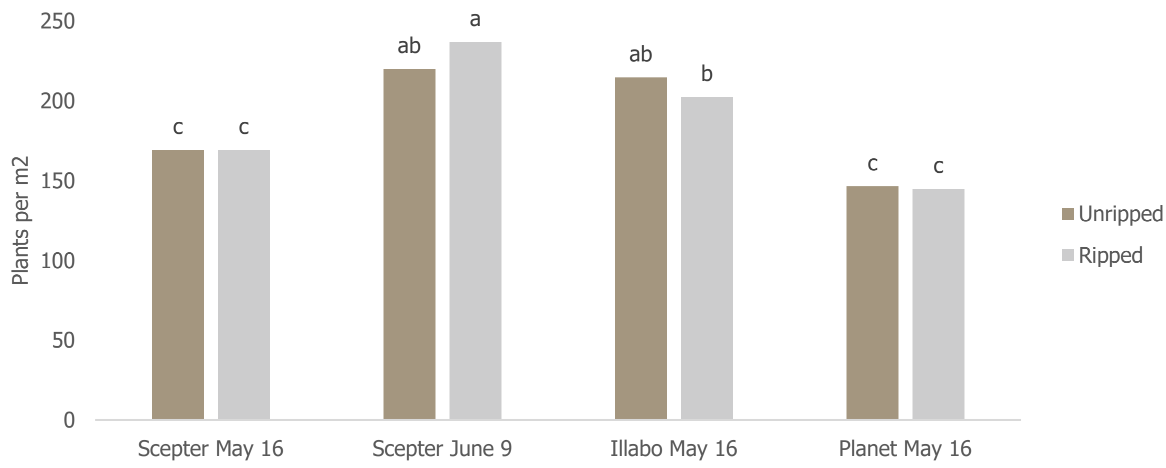


Figure 8: Plant density counts (plants/m^2) for May 16 and June 9 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the South Stirling site in the 2020 season.

NDVI

NDVI readings were taken at three timings for the Cranbrook site and four timings for the South Stirling site in 2020 (Figures 9 and 10). For the Cranbrook site there was a marginally higher measurement recorded for the Planet barley compared to the other treatments and the ripped treatment for Ilabo and Planet showed a slightly higher value than the unripped treatments for the same crop types.

The South Stirling site NDVI readings shows predominately higher values in the ripped treatments, particularly evident in the August 2020 NDVI readings (Figure 10). The May-sown Scepter and the Planet barley also show slightly higher NDVI measurements compared to the other time of sowing/variety treatments.

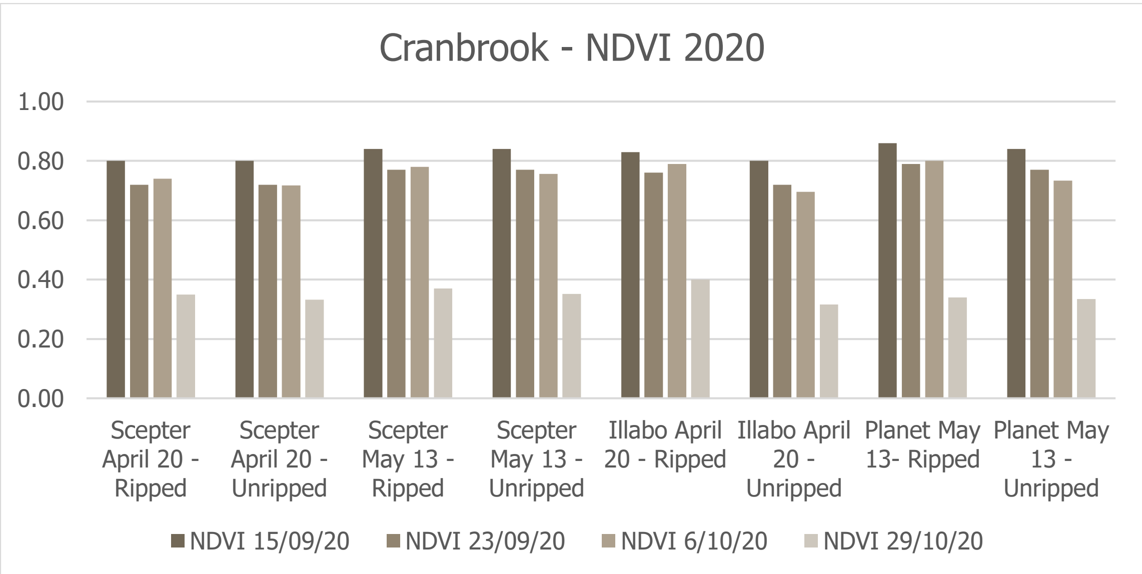


Figure 9: Cranbrook site NDVI readings (3m satellite) for each treatment across four different timings in the 2020 season.

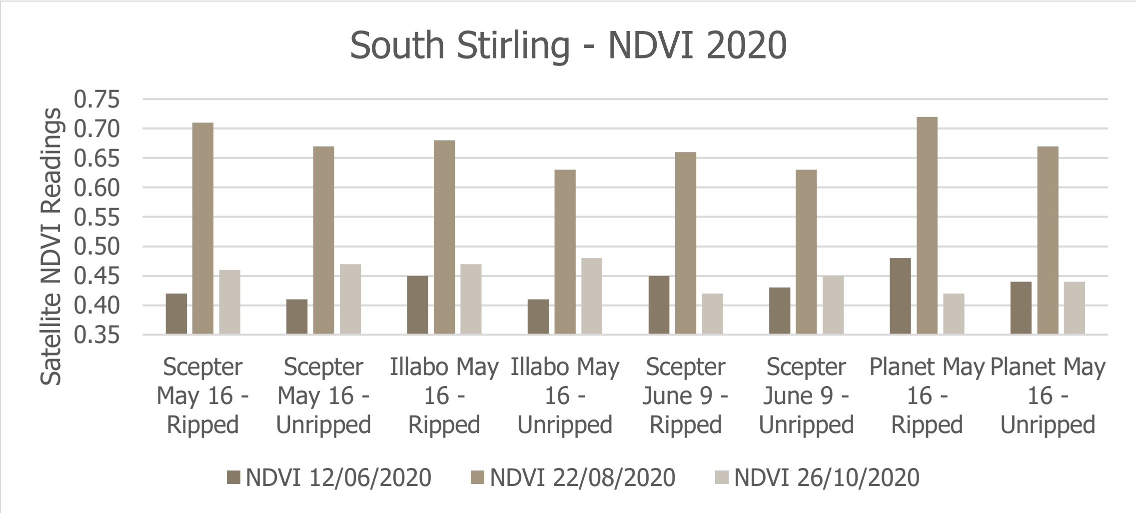


Figure 10: South Stirling site NDVI readings (3m satellite) for each treatment across four different timings in the 2020 season.

Grain Yield

Grain yields from the Cranbrook site show that there was very little difference between the ripped and unripped treatments but does show that Planet barley yielded slightly higher than the wheat cultivars (Figure 11). The later sown Scepter wheat and early sown Illabo wheat yielded significantly higher, average of 880kg/ha, than 20th April planted Scepter.

Again, at the South Stirling site, Planet barley yielded significantly higher than the wheat cultivars in the demonstration (Figure 12). There was no significant difference in yield between wheat cultivars and sowing timing (first time of sowing sown dry), however there was a noticeable difference between the ripped and unripped treatments, with the ripped treatments achieving a higher yield across all other treatments.

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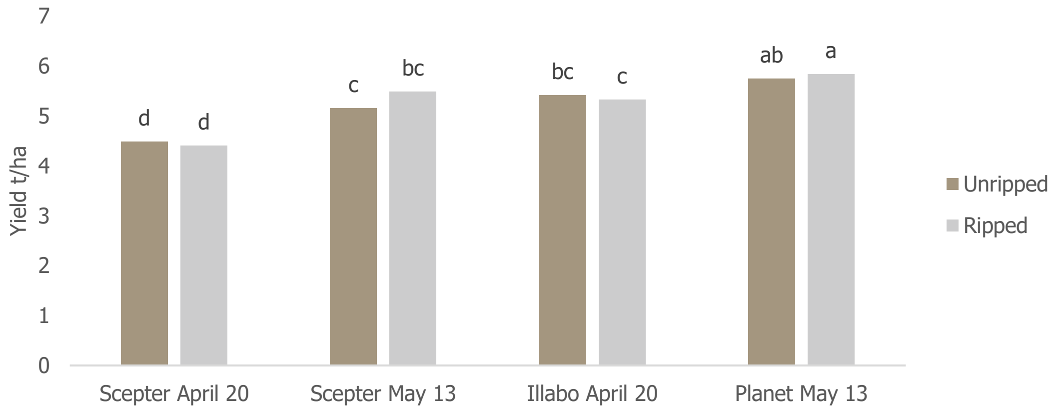

Figure 11: Grain yields (t/ha) for April 20 and May 13 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the Cranbrook site in the 2020 season.

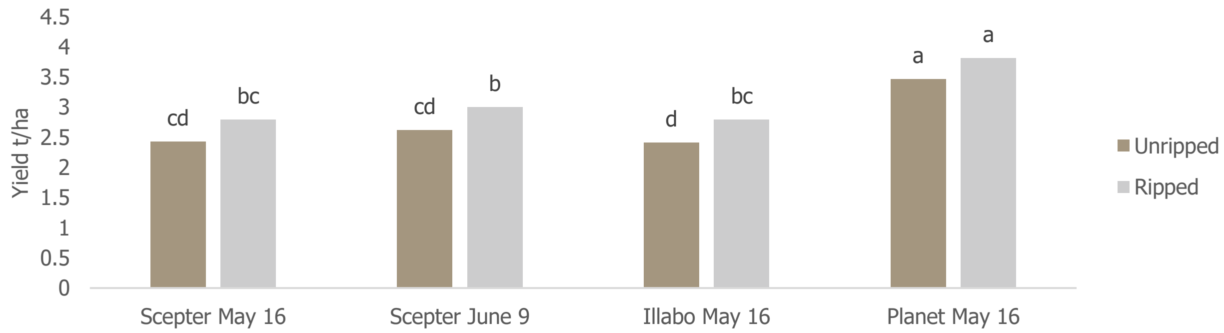

Figure 12: Grain yields (t/ha) for May 16 and June 9 sown, Scepter, Illabo and Planet varieties over ripped and unripped treatments for the South Stirling site in the 2020 season.

Grain Protein

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

For the South Stirlings site, there were significant differences in the protein levels when comparing late and early Scepter wheat and Illabo wheat. The early Scepter had the highest protein, followed by early Illabo and then late Scepter. Again, difference in protein levels seems to somewhat correspond to yield, in that the higher yielding wheat treatments had lower protein i.e., protein dilution.

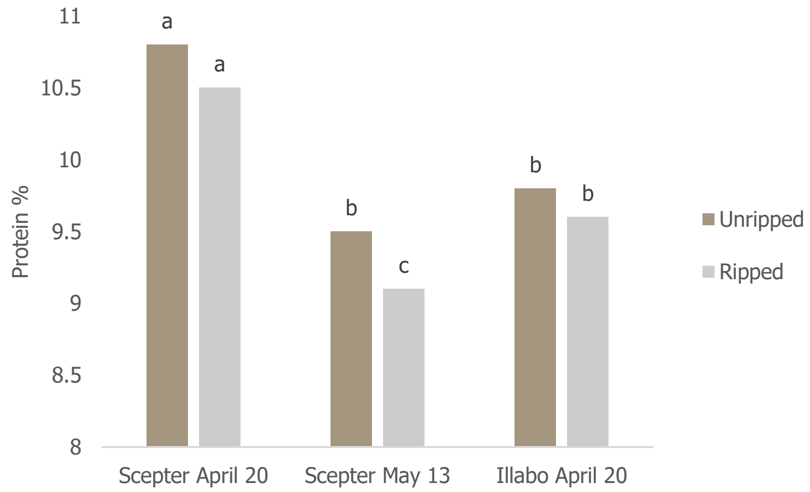

Figure 13: Grain protein (%) for April 20 and May 13 sown, Scepter and Illabo varieties over ripped and unripped treatments for the Cranbrook site in the 2020 season.

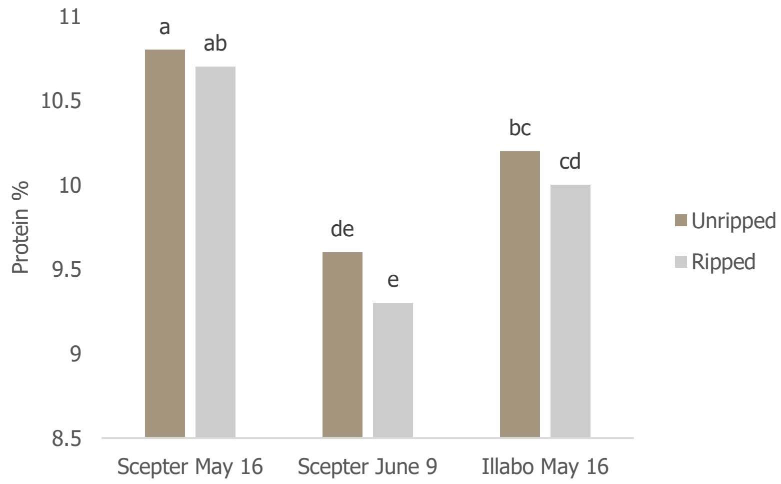

Figure 14: Grain protein levels (%) for May 16 and June 9 sown, Scepter wheat, Illabo wheat and Planet barley over ripped and unripped treatments for the South Stirling site in the 2020 season.

Trial Results 2022

<u>Gairdner</u>

The NDVI readings and the plant tissue samples were taken after the second (final) in-season nitrogen application. The NDVI readings, taken with a Trimble GreenSeeker show plant health to be improved in the control (standard) treatment and in the treatment that had an extra 50% of N fertiliser applied on top of the control amount (Figure 15). Surprisingly, the treatment with an extra 25% of N fertiliser had a lower NDVI reading than the control. This was in reverse for the plant tissue

N percentages, whereby the extra 25% nitrogen treatment had a higher reading (Figure 16). This may be due to dilution of the N in the treatments with a likely higher biomass.

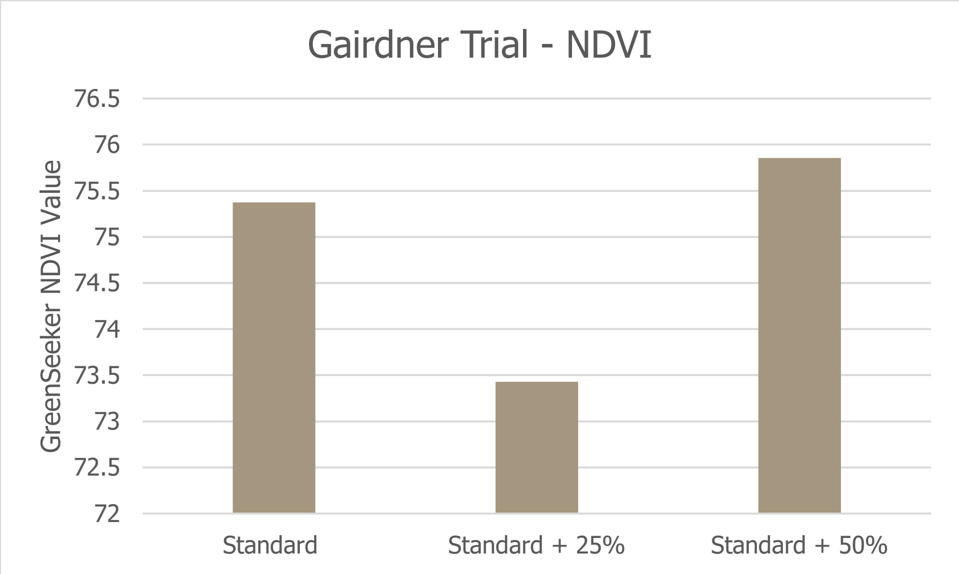

Figure 15: Average Gairdner trial site Trimble GreenSeeker readings for each treatment, taken on the 26 August 2022.

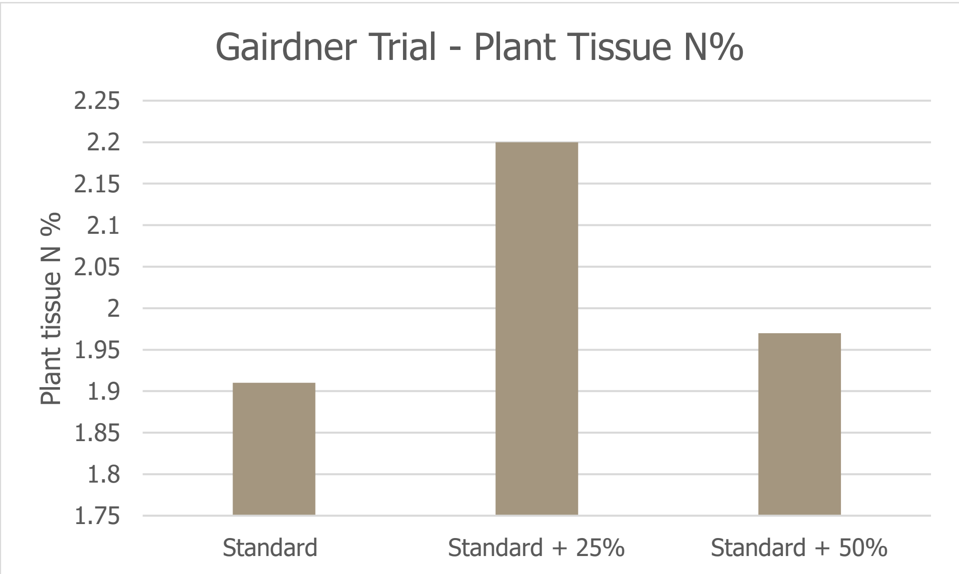

Figure 16: Average Gairdner trial site plant tissue nitrogen % from analysed plant tissue samples for each treatment, sampled on 9 September 2022.

The wheat grain yield results for the Gairdner trial site show that the standard grower practice (control) yielded slightly higher (0.17-2.1 t/ha), indicating in this instance there was no yield gain for increasing the in-season N applied.

There was a grain protein gain of approximately 1% in the two treatments where additional in-season N applied (Figure 18). There was not, however, a significant grain protein advantage in applying more than 25% additional in-season N in this instance.

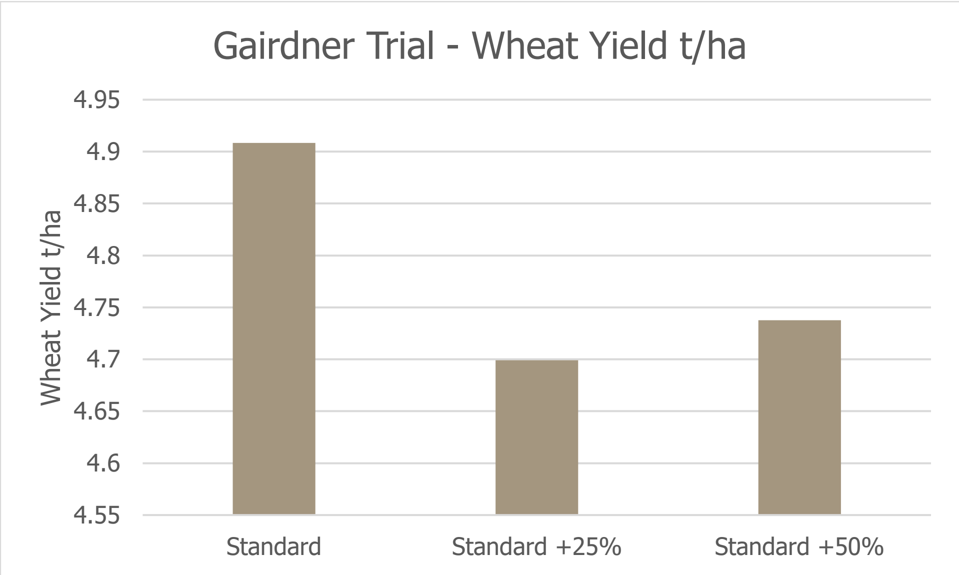

Figure 17: Average Gairdner trial site wheat grain yields for each treatment, 2022.

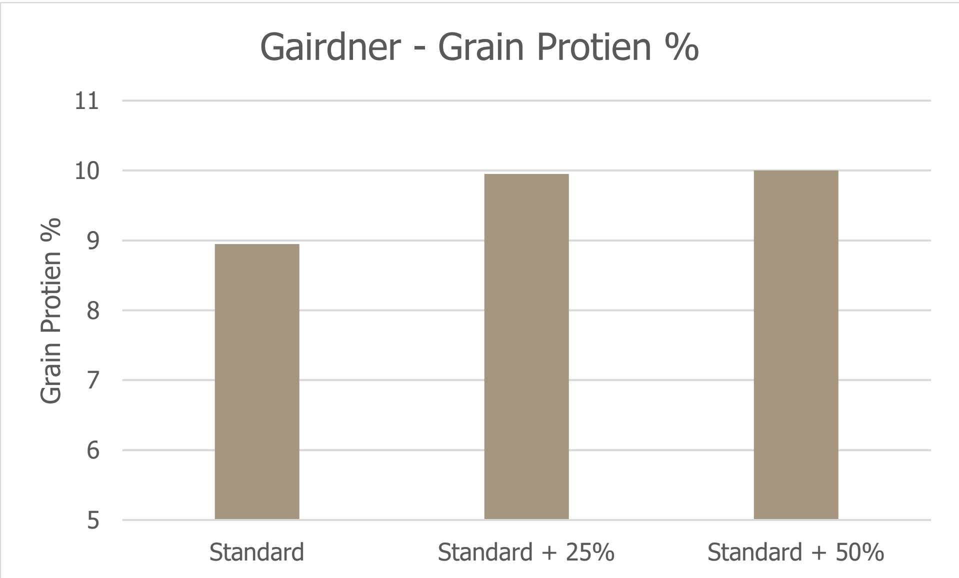

Figure 18: Average grain protein per treatment for the Gairdner trial site, 2022.

Frankland River

The NDVI readings and the plant tissue samples for the Frankland River site were taken after the second (final) in-season N application. Compared with the Gairdner results, the results for this site are more straightforward, in that the treatments that received a higher rate of N, showed (for the most part) higher NDVI and plant tissue N% recordings (Figure 19 and 20).

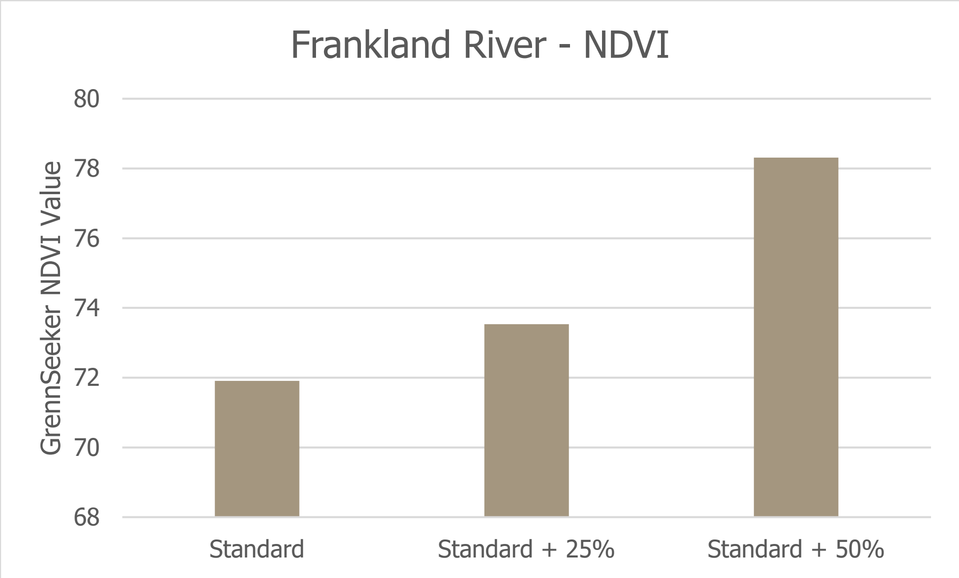

Figure 19: Average Frankland River trial site Trimble GreenSeeker readings for each treatment, taken on the 18 July 2022.

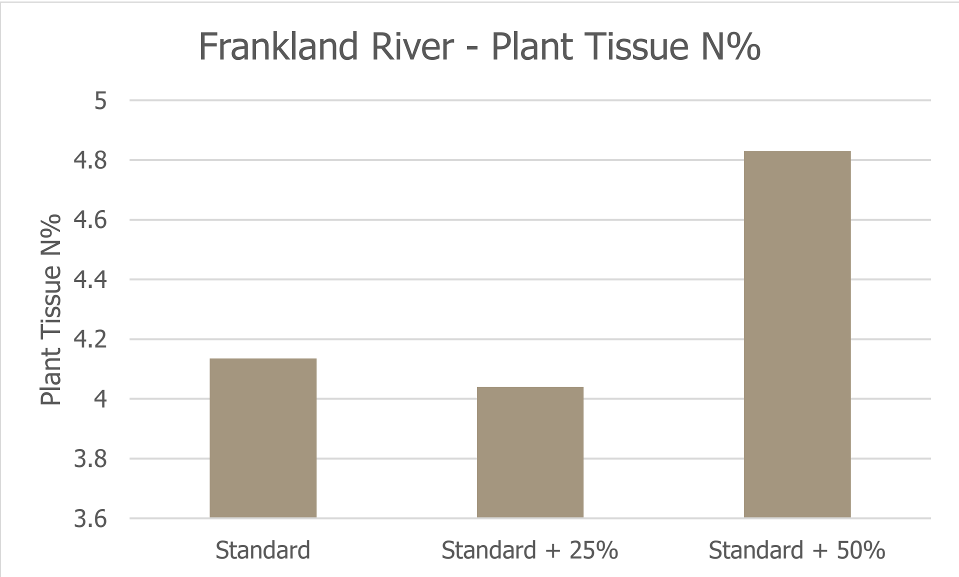

Figure 20: Average Frankland trial site plant tissue nitrogen % from analysed plant tissue samples for each treatment, sampled on 18 July 2022.

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 21). Grain protein was only very marginally higher in the additional N treatments (Figure 22).

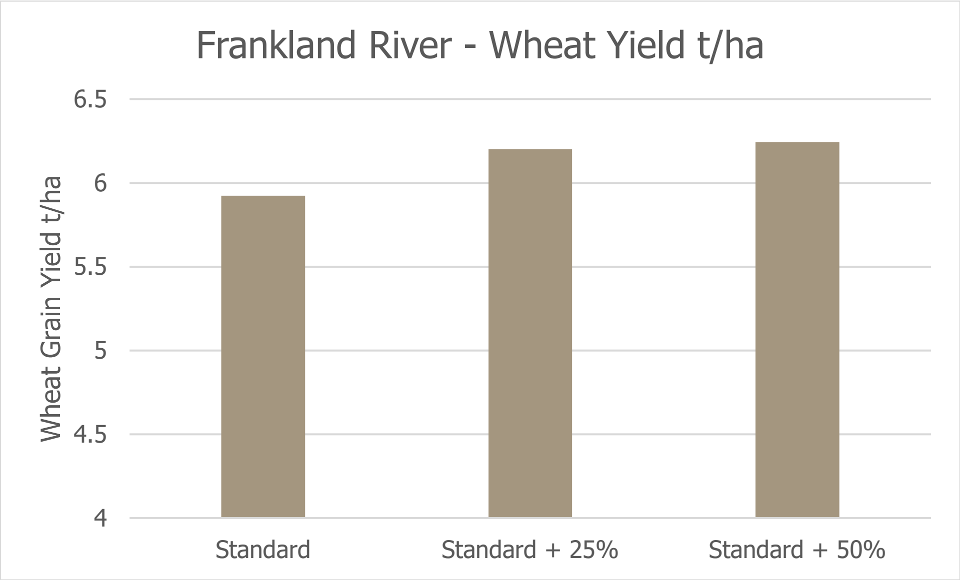

Figure 21: Average Frankland River trial site wheat grain yields for each treatment, 2022.

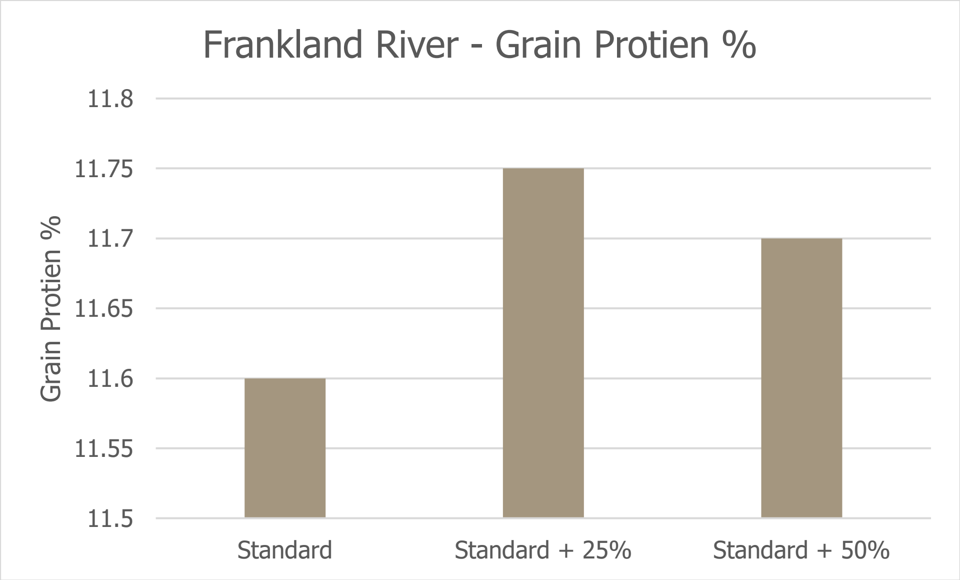

Figure 22: Average grain protein per treatment for the Frankland River trial site, 2022.

<u>Mount Barker</u>

The NDVI readings and the plant tissue samples for the Mount Barker site were taken after the second (final) in-season N application. The NDVI readings and the analysed plant tissue N show marginally higher results in the treatment with the additional 50% of in-season N applied (Figure 23 and 24).

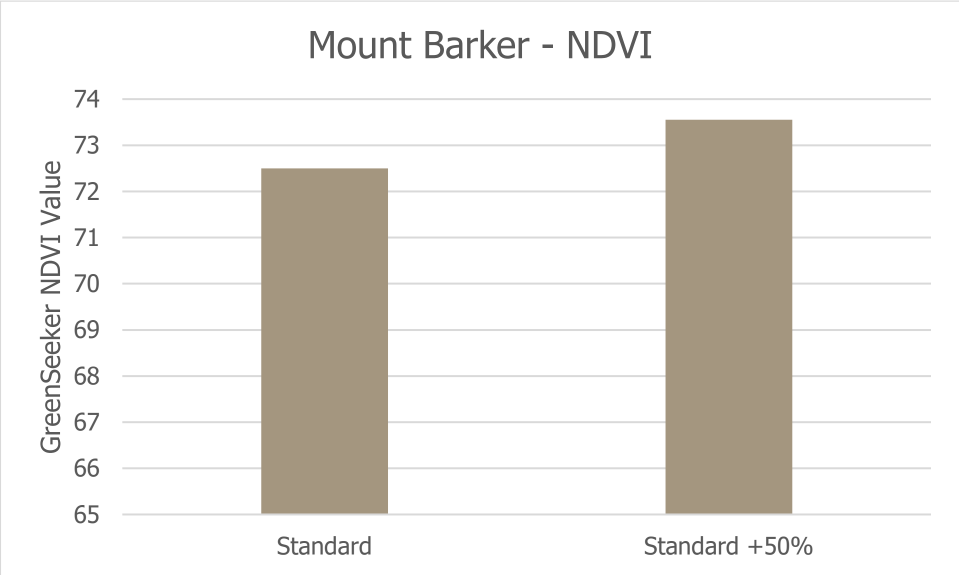

Figure 23: Average Mount Barker trial site Trimble GreenSeeker readings for each treatment, taken on the 18 August 2022.

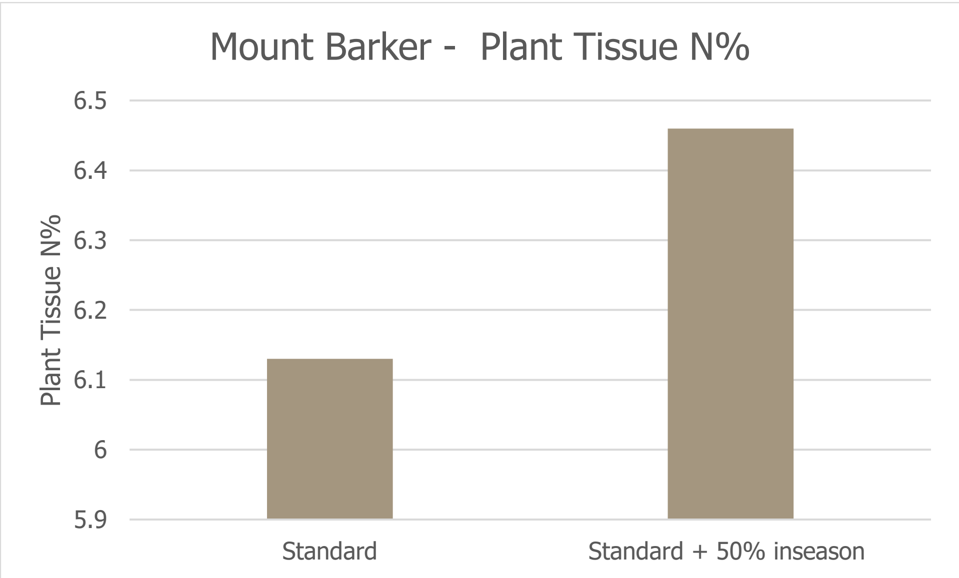

Figure 24: Average Mount Barker trial site plant tissue nitrogen % from analysed plant tissue samples for each treatment, sampled on 6 July 2022 at rosette stage.

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 in this instance.

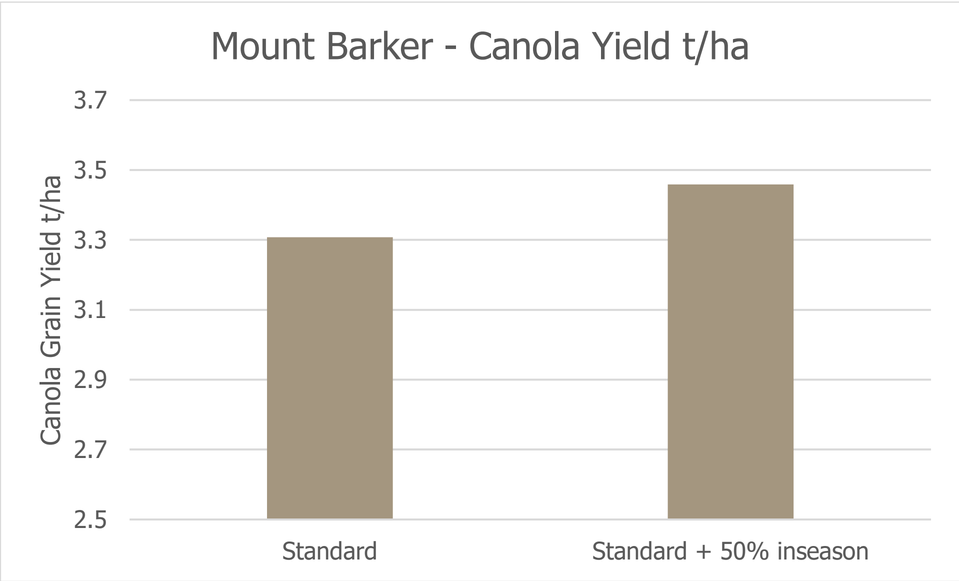

Figure 25: Average Mount Barker trial site canola grain yields for each treatment, 2022.

<u>South Stirling</u>

NDVI readings were taken twice for the South Stirlings trial site as the starter fertiliser was also varied as a treatment (50% increase). The plant tissue samples for tissue N% were collected prior to the application of the additional in-season N application so show the change as a result of starter fertiliser treatments only.

The results for NDVI across both measurement timings do not show any advantage to addition of starter fertiliser or in-season N fertiliser (Figure 26). Figure 27 shows that there was only a very marginal increase in plant tissue N% as a result of increasing the starter fertiliser by 50% (Figure 27).

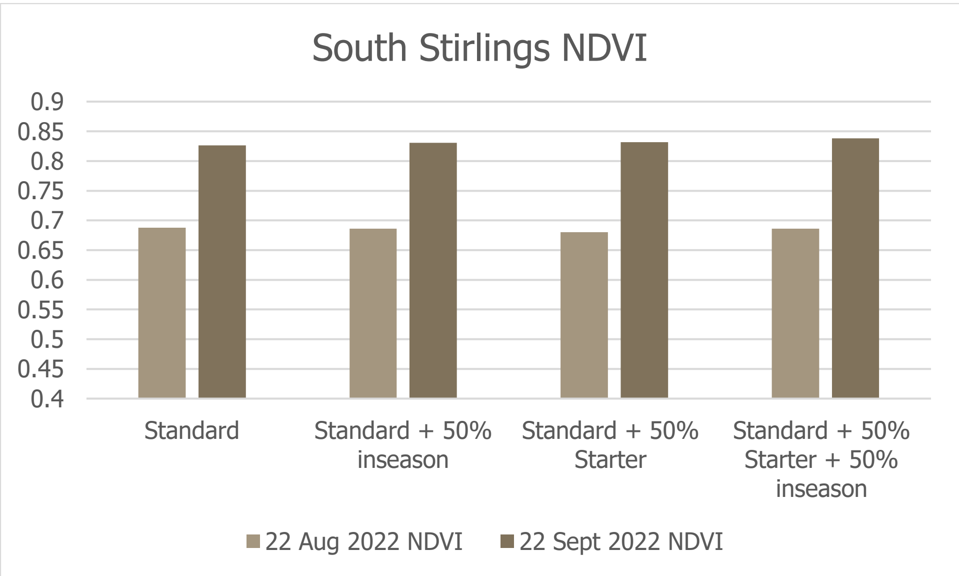

Figure 26: Average South Stirlings trial site Trimble GreenSeeker readings for each treatment, taken on the 22 August and 22 September, 2022.

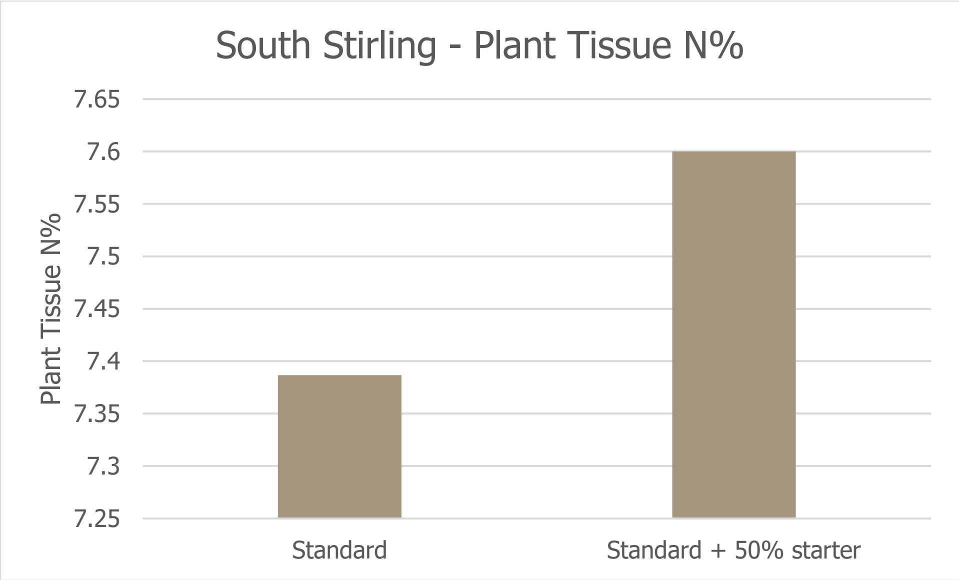

Figure 27: Average South Stirling trial site canola plant tissue N% for each treatment, 2022

The canola yield results for the South Stirling trial site, overall, indicate that additional fertiliser, either starter, in-season, or both, did not result in a significant yield advantage in this instance.

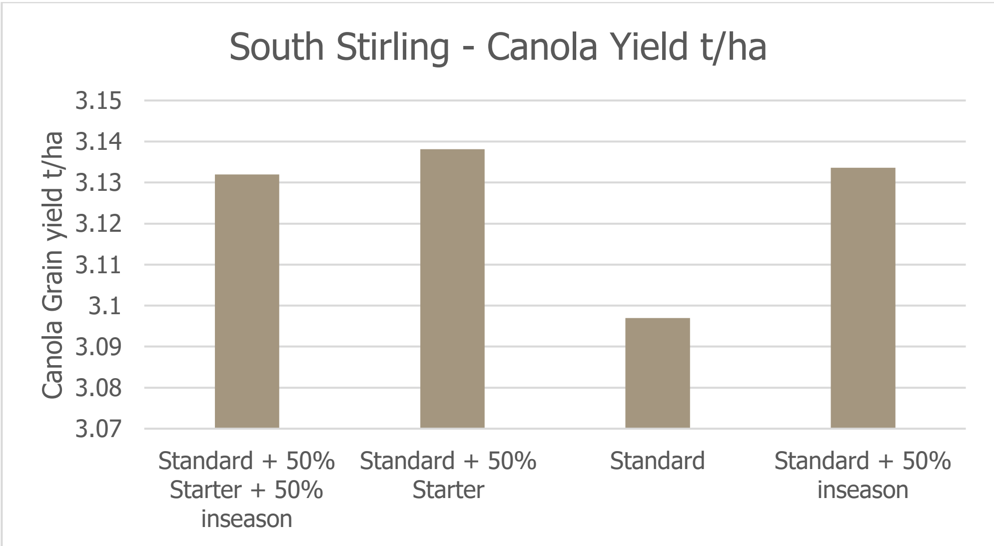

Figure 28: Average South Stirling trial site canola grain yields for each treatment, 2022.

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DISCUSSION OF RESULTS

Soil amelioration and time of sowing as a yield drivers – the 2020 trials

The project survey results showed a change in the growers perceived drivers of yield between 2022. Soil amelioration and overcoming soil constraints was identified as the key impediment to increasing yields in 2019 (Figure 29 and 30), and drove the 2020 demonstration site treatments. Given much soil amelioration has been undertaken in the three years between the two survey periods, it is unsurprising that the 2022 survey showed a slight dip in respondents identifying that soil amelioration was the only method of realising higher yields. Many growers who have conducted extensive amelioration programs are yet to achieve their yield potential, therefore other constraints are at play.

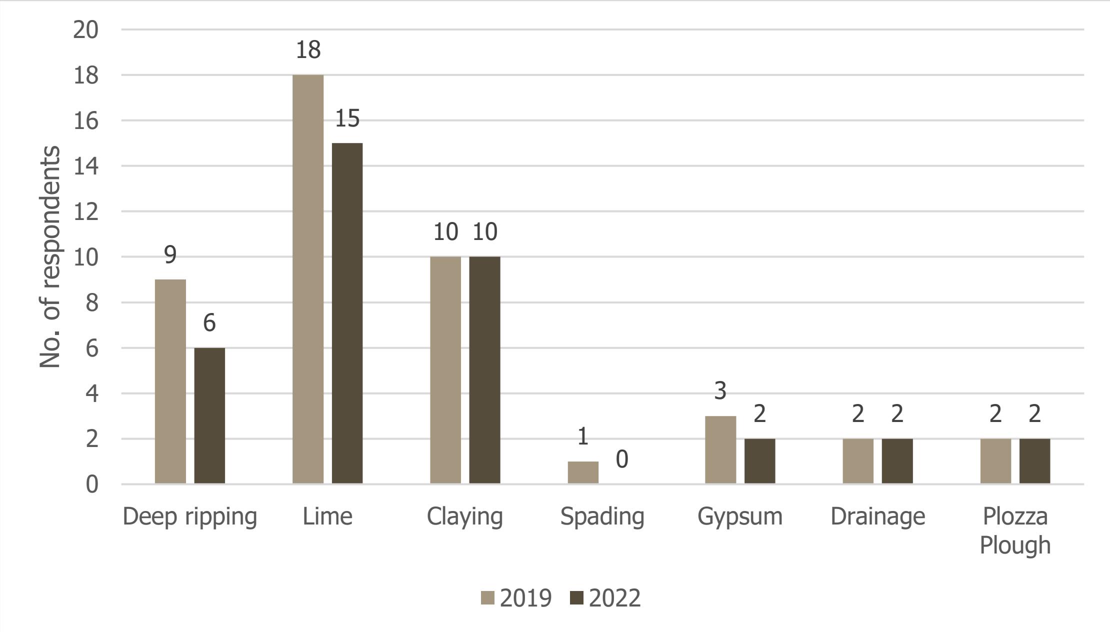

Figure 29: Survey data - type of soil amelioration required as determined by growers (2019 & 2022)

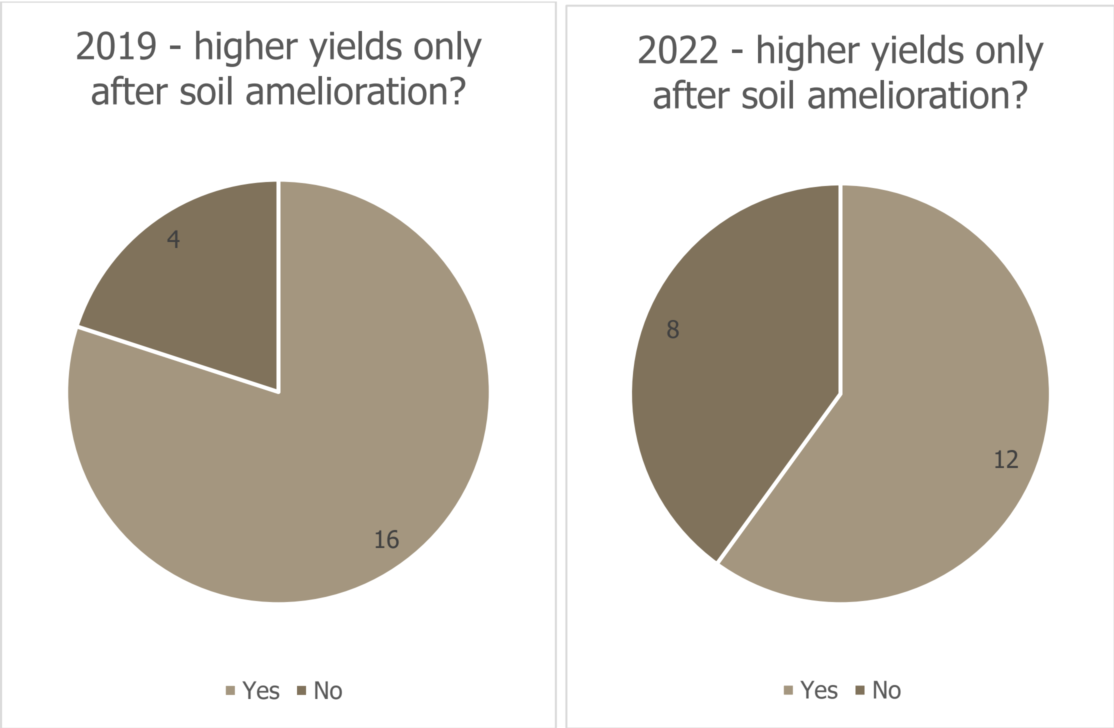

Figure 30: Survey data - Grower answers as to the impact of soil amelioration on higher yields (2019 & 2022)

The field trials in 2020, which investigated the benefits of ripping by crop type and time of sowing, only showed a significant increase in yield in the deep ripped treatments (regardless of other treatments) at the South Stirlings site. The soil type at this site was sand over clay and ripping is known to overcome compaction and some non-wetting issues in this soil type, so these results are unsurprising. The Cranbrook site was forest gravel over clay and the ripping did not provide the same yield benefit at this site, showing compaction to unlikely be the primary soil constraint on this soil type (non-wetting more so). This highlights the complexity of deep ripping in the APZ with varying soil types that respond very differently to ripping.

The Ilabo wheat sown mid-April at the Cranbrook site yielded comparably to the Planet barley sown mid-May, showing the longer season wheats can compete with barley yields in this HRZ region. Ilabo was sown too late (mid-May) at the South Stirlings site to show its full potential (this was unfortunately due to a dry start). The dry start at this site may have also masked the full benefits of the ripping given the delayed seeding meant the ripped soil was exposed to the environment for over a month, which likely led to increased evaporation and a lower level of plant available water (PAW) at the time of sowing. This possibly offset some yield advantage resulting from the decrease in soil compaction.

Single year trials examining sowing date by variety/crop type are always going to be constrained by the environmental conditions impacting crop growth in that season. However, in addition to the key learning mentioned above, it is also worth noting that the field trial at South Stirlings indicated that a late sowing of Sceptre wheat (into June) resulted in no significant yield penalty compared to the (considered) optimal mid-May sowing timing. This is interesting given only one of the surveyed growers identified early June as an optimal time for seeding wheat. Whilst the trial at Cranbrook showed that if adequate moisture is available crops perform best when seeded in their optimised seeding windows, mid-April for Illabo wheat and mid-May for Sceptre wheat.

Additional nitrogen fertiliser to drive yield – 2022 trials

The project survey results show that the maximum amount of N applied by the growers surveyed to a canola or wheat crop, had increased during the period of the project, particularly for wheat (Figure 31). This is interesting given the learnings from the four 2022 trials. These all aimed to determine if nitrogen was the limiting factor and did not show any conclusive, significant advantage (yield or protein) to increased N applications. 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 equally 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 Albany 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 had no yield response to the additional fertiliser, although there was a slight grain protein response. However, the grain protein levels were still low, across all three treatments, suggesting the paddock was under still fertilised. This phenomenon could be potentially driven by N losses (leaching) in season occurring before the applied fertiliser can be fully utilised, or alternatively nitrogen availability may not be the key constraint limiting crop production in the biomass accumulation phase. As a result, the N demands may be below the N supply. It is clear that increasing nitrogen, whilst being critical to crop production within the high rainfall zone, is not the sole driver of increasing canola and wheat yields.

However, the survey results show it is clear that growers are upping their nitrogen rates regardless of the trial results, 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, 2022). This is a change from four years ago.

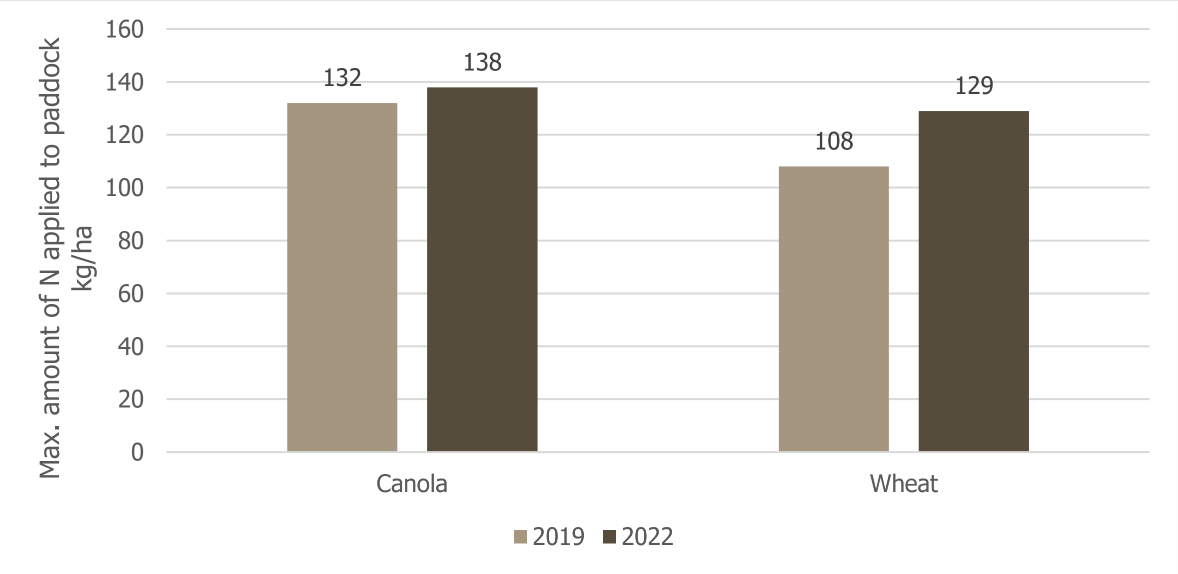

Figure 31: Survey data - the maximum amount of N applied to a paddock of canola and wheat by growers (2019 & 2022).

CONCLUSION

The flexibility within this project to survey growers and then use field demonstrations to explore the factors that they believed were impacting on production of wheat and canola in the region, ensured the project remained relevant and credible. At the commencement of the project, soil constraints, varieties and time of sowing were explored. The soil constraint story was simple, a yield advantage was achieved by ripping sand over clay soils but not in ripping forest gravels (as could be expected). The 2020 trials also brought to light the usefulness and fit of a longer season wheat, such as Ilabo. When sown in its ideal sowing window, Ilabo yielded comparably with Planet barley. Since 2020, growers in the region have steadily increased uptake of long season/winter wheats (replacing barley with these), and in the hyper yielding awards project, winter wheats in 2022 significantly outyielded the spring wheats by 1.5 t/ha and barley also by 1.5 t/ha. This has been a very positive outcome, somewhat kick-started by this project.

By 2022, nitrogen applications had become very front-of-mind for many growers. They were now optimising time of sowing and using long season wheats but were keen to understand the role of nitrogen in pushing production in the region. Although the results from the four trials showed inconclusive, insignificant results, growers have pushed ahead with increasing nitrogen fertiliser rates anyhow (as shown in post-project survey results).

This has all contributed to the increase average yields by 0.11 t/ha in wheat and 0.25 t/ha in canola between the period 2019 and 2022 (project survey data). It should also be noted that most of the surveys were conducted before the record-breaking harvest in the HRZ of Albany Port zone (APZ), and actual yield results reported as part of the hyper yielding awards paddock project show that wheat achieved between 4.5 and 8.9 t/ha. Average canola yields, anecdotally, were reported to have been between 3 and 5 t/ha and in this project were well above 3 t/ha (regardless of the treatments).

At the commencement of this project, it was estimated that potential grain yield for wheat was in the range of 6-12 t/ha and 3-5t/ha for canola, and actual crop yields were only about 50% of these potentials at 2.7t/ha for cereals and 1.4t/ha canola (Robertson et al. 2016). Although 2022 was a record-breaking year for many growers in the HRZ of the APZ, and may not be achieved again immediately, the project and the 2022 yields have given growers the confidence and tools to achieve potential grain yields when conditions are favourable.

Given the 2022 yield results, Stirlings to Coast Growers can confidently say that growers easily increased the value of their cropping phase by 10%, although the field trials highlight the complexity of prescribing parameters for maximising and achieving this crop production.

IMPLICATIONS

The wheat and canola grain yield achievements of the growers in the HRZ of the APZ since 2019 have been remarkable. Some notable implications of this achievement are:

- CBH has had some difficulties in moving adequate quantities of grain out of the Albany port, due the record grain harvests. This has resulted in some growers having to invest in on-farm grain storage options.
- There has been a move to long season/winter wheats, which has been profitable for the livestock component of many of the mixed enterprise farms, as these varieties have also offered a grazing opportunity with limited impact on grain yield.
- The requirement for higher N inputs as yields have increased (and N prices have increased) have renewed grower focus on opportunities for fixed nitrogen.

RECOMMENDATIONS

An optimal nitrogen strategy is still an unknown for the higher rainfall zone of WA. Growers still grapple with this nitrogen fertiliser decisions year-to-year. Further research into the dynamics of nitrogen in the HRZ farming system for this region would be beneficial. This will be investigated further in the Stirlings to Coast Farmers component of the GRDC National Risk Initiative.