LOCAL RESEARCH AND DEVELOPMENT RESULTS

RESULTS FROM THE 2022 SEASON

LiEBE GROUP

Working together in Agriculture

2022/23

Dear Liebe Group Members and Supporters,

The Liebe Group team are proud to present the annual Local Research and Development Results Book for 2023. This publication contains the results from research trials and demonstrations conducted in the Liebe Group region from the 2022 season, as well as current projects across the district.

The past 12 months have highlighted the resilience and strength of farming communities, with harvest records broken throughout the state. The season did not come without its challenges though including mice, a longer than average harvest season and rising input costs among other factors. However thanks to some decent rainfall events, high grain prices and innovative farming practices, it was an overall positive outcome for the Liebe Group region.

We would like to sincerely thank the Liebe Group committee members and staff for their hard work and effort. It is with the contributions made by the team of dedicated staff and respected volunteers that kept this grower group pushing through its 25th year of research, development and extension activities.

Many thanks are also extended to Sam, Terry and Andrea Reynolds for hosting the 2022 Main Trial Site at their property in north Miling, along with all other members who have hosted or contributed towards research, trial and demonstration efforts throughout the region.

All partners and supporters play a vital role in ensuring the continued success of the Liebe Group. The Liebe Group acknowledges the invaluable support received from the Grains Research and Development Corporation (GRDC), the Department of Primary Industries and Regional Development (DPIRD), the Farm Weekly, the Shire of Dalwallinu and the Grower Group Alliance. We would also like to thank our long term Diamond Partners Rabobank, RSM, CSBP and CBH Group, along with our valued Gold and Silver Partners.

The Liebe Group team are anticipating a fantastic year ahead, with the Main Trial Site being hosted by Boyd Carter at his property at Jibberding.

Liebe Group's main events this year are scheduled for:

- Women's Field Day on Tuesday 13th June
- Post-Seeding Field Walk on Wednesday 26th July
- Spring Field Day on Thursday 7th September

Please note that the majority of results presented in the book are from one season, and therefore should be interpreted with caution. Guidelines to understanding the results and statistics are included on page 15. Please contact the Liebe Group office if you have any further queries and we encourage you to get in touch with our research partners if you would like any further information on a particular trial.

We wish you all the best for a successful 2023 season and look forward to working with you throughout the year.

Kind regards,

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The Liebe Group would like to recognise the support and contribution of the Liebe Group Committees throughout the 2022 season.

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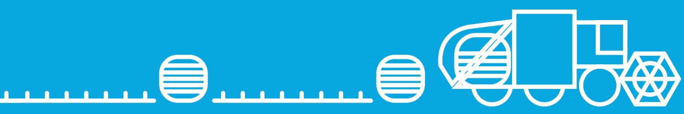

The story of RSM's founding father dates back to the roaring 1920s – Edgar J Woolcott returned from the great war where he served as a quartermaster in the army.

Australia's attitude was one of rebuilding and there was tremendous opportunity on offer for those who were prepared to "have a go". Edgar Woolcott was certainly in this category.

Forming a strong culture from the start

A culture of familiarity and family appeared to permeate the firm. It was extending this culture of family to clients that is seen as the firm's greatest competitive edge. Rather than asking clients to bring their books to an office, the accountants would visit clients in their homes.

They became part of the family, working from the kitchen table and acting as trusted advisers, which is something RSM's accountants and business advisers still do today.

As we enter our 100th year, we are reminded that it's all about understanding our clients and understanding them better than anyone else.

RSM is delighted to be able to provide their expertise and services to the Wheatbelt region. Still the same familiar faces and now even wider services and access to experts across the country:

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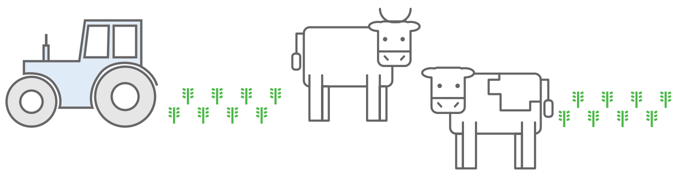

Celebrating 100 Years in Australia Est.1922

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Youth Focus and CBH working together to support young people in Western Australia's grain growing regions.

As part of the CBH Regional Mental Health Program, Youth Focus counsellors are delivering specialist mental health care to young people in a way that enables us to connect to and see young people where they live, alongside the people who care about them. The service can be accessed by our partner schools, using online counselling sessions with Youth Focus counsellors.

The service is at no cost to young people. Please contact Youth Focus on (08) 6266 4333 or via email at **reception@youthfocus.com.au** to find out more or request support.

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LIEBE GROUP CALENDAR OF EVENTS - 2023

EVENT	DATE	LOCATION
Women's Field Day	Tuesday 13th June	Dalwallinu Recreation Centre
Succession Planning Workshop #2	Tuesday 20th June	Liebe Group Office
Succession Planning Workshop #3	Tuesday 18th July	Liebe Group Office
Post Seeding Field Walk	Wednesday 26th July	Main Trial Site, Jibberding
Spring Field Day	Thursday 7th September	Main Trial Site, Jibberding

UNDERSTANDING TRIAL RESULTS & STATISTICS

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

Mean

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 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.

Standard Error (SE)

The standard error is a statistical term that measures the accuracy with which a sample distribution represents a population by using standard deviation. In statistics, a sample mean deviates from the actual mean of a population; this deviation is the standard error of the mean or the SE. The standard error tells us how confident we can be in the observed sample mean. A larger sample size usually results in a smaller standard error, and a more accurate sample mean.

The Least Significant Difference (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 its is 95% (P=0.05) certain that the difference in yield is a result of variety 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), so in this example, there is no significant different 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.

Table 1: **Yield of five wheat varieties.**

Treatment	Yield (t/ha)
Variety 1	2.1[a]
Variety 2	2.2[a]
Variety 3	2.0[a]
Variety 4	2.9[b]
Variety 5	1.3[c]
P value	<0.001
LSD (P=0.05)	0.6
CV (%)	9.4

The Coefficient of Variation (CV%)

The CV measures the amount of variation in the data. A low CV means less background noise or variations. Having less variation means there is more confidence in the trial results. Having high variation could mean that factors other than the one being tested are influencing the results (e.g. soil type), and if the same trial was recreated at your place, results may be different. Generally a CV of 5-10% (up to ~15%) is considered acceptable for wheat yields in field trials; some measurements would expect a higher CV, and some lower.

Non-replicated Demonstrations

This book presents the results from a range of non-replicated demonstrations. In this case we cannot say for certain if the difference in yield or quality is the result of treatment or some other factor (e.g. soil type or old wheel tracks). Whilst the results from demonstrations are important, they need to be interpreted carefully as they are not statistical.

Nearest Neighbour Control

Some demonstrations will indicate a nearest neighbour control. In unreplicated research, often a control treatment will be included throughout the trial so a better decision can be made regarding treatment performance. This is helpful in situations where there may be a fertility gradient in the trial paddock, hence it would be better to compare treatments against the nearest neighbour control rather than against other varieties. This would give a more accurate indication of treatment performance.

Glossary of terms

DAA	Days After Application
ToS	Time of Sowing
NSD	No significant difference
GSR	Growing Season Rainfall
IBS	Incorporated by Sowing
PSPE	Post Seeding Pre Emergent
EPE	Early Post Emergent
ANA	Analysis not Applicable

Disease Ratings

Disease ratings in Australia are developed by plant pathologists in a nationally co-ordinated program of both field and controlled environment testing. The work is funded by the GRDC through its NVT program with the work undertaken by specialist plant pathologists across Australia.

VS = Very susceptible, SVS = Susceptible to very susceptible, S = Susceptible, MSS = Moderately susceptible to susceptible, MS = Moderately susceptible, MRMS = Moderately resistant to moderately susceptible, MR = Moderately resistant, RMR = Resistant to moderately resistant, R = Resistant. No score '-' = no rating is currently available. p = Provisional assessment. * = some races in eastern Australia can attack these varieties, including races with Yr17 virulence for stripe rust and races with Lr24 virulence for leaf rust. Combined P. neglectus ratings from DPIRD, SARDI, AgVic and USQ data. Not all varieties have been tested in WA. P. quasitereoides ratings are from DPIRD glasshouse and field trials. Provisional ratings provided for varieties with fewer than three observations or where there has been no field trial verification of the glasshouse rating. CCN ratings from GRDC NVT data. R = resistant – nematode numbers will decrease when this variety is grown. MR = Moderately resistant – nematode numbers will slightly decrease when this variety is grown. MS = Moderately susceptible – nematode numbers will slightly increase when this variety is grown. S = Susceptible – nematode numbers will increase greatly when this variety is grown. Crown rot ratings from SARDI, USQ and DPI NSW data.

2022 Season Overview

Dylan Hirsch, R&D Committee Chair

2022 ended up being a cracker of a year for the Liebe region, with many records broken for grain production from paddock right through to regional level. It wasn't without it's challenges though, with mice plagues, a depleted nutrient bank and crop residues from 2021, extremely high nitrogen prices, and a range of late weeds and plant diseases threatening to undo some otherwise very impressive crops - we almost forget that in mid-July, many of us were talking about a drought! But there were also plenty of opportunities with good (but patchy) summer rainfall and early sowing opportunities leading to an increase in canola plantings and research focus. Late rains also allowed longer season and later sown crops to finish well in most cases.

Continuing the theme of opportunities, Liebe Group were able to take advantage of a rapid project approval from GRDC. This saw the group implement the first early sown canola variety trial on the back of March rains. Thanks to a big effort by Bec and Kat to put together a project design the next day. The excellent results and feedback from the trial will keep us on the lookout for further rapid trial opportunities in 2023.

The stubble height project also commenced in conjunction with other grower groups and has already produced some interesting observations. Within the R&D committee we welcomed our new R&D coordinator Juniper Kiss, and although we only had Juniper for a short time, she left an impression with her enthusiasm and attention to detail. Evidence of this can be found in her extraordinary ability to decipher and record the ideas and ramblings of members during the Yuna Bus Tour.

Sam and the Reynolds family hosted an excellent trial site, on their sandy North Miling block with the typical issues and potential of the sandplain West of Dalwallinu. A total of 15 trials were implemented, with nutrition, weed control and variety selection gaining particular attention during the post seeding field walk and spring field day. The mixed results from the many herbicide trials compared to the Reynolds paddocks reminded us how important local conditions and knowledge is when managing weeds. Both the Post Seeding Field Walk and Spring Field Day were well attended, with the impressive wheat and canola crops built on years of soil management by the Reynolds family making up for the lack of Telstra signal!

In 2023 the Main Trial Site will head back to Jibberding, coincidentally 20 years after KL Carter & Co hosted their first main trial site where Yitpi topped the wheat variety trial and Summit's new potassium compound fertiliser trial gained significant interest. This year Boyd has helped the R&D team select a great site with a mix of soil types including lake loams, gravel and yellow sand. The Carter's progress with faba beans is sure to gather plenty of attention, so I hope for everyone's sake we get a third good year in a row!

Finally I'd like to thank my fellow R&D committee members and Liebe staff who help bring many of these trials to life. I look forward to working with you and other Liebe Group members as we investigate new issues and opportunities this year.

CEREAL RESEARCH RESULTS

A Demonstration of the CoAXium Barley Production System

Alana Hartley, Variety Support, WA (North), Australian Grain Technologies

Key Messages

- The first CoAXium® barley variety.
- Tolerant to Sipcam Aggressor® (Group 1) herbicide.
- Control of brome grass, barley grass, wild oats, and ryegrass.
- Flexible application window.
- No soil residue carry over.
- High yielding variety suited to medium to low rainfall areas of WA.

Aim

Demonstrate the CoAXium® system, a world first barley crop tolerant to the Group 1 herbicide Aggressor®.

Background

CoAXium® barley carries a tolerance to Sipcam Aggressor® herbicide (Group 1, Quizalofop-P-Ethyl), which allows growers to control susceptible populations of brome grass, barley grass, wild oats and annual ryegrass in the barley phase of the rotation; offering an alternative to Clearfield® technology which growers have relied on for some time now.

The purpose of the demonstration is to show the tolerance and weed control of three crop treatments: (1) CoAXium® barley, (2) CoAXium® barley plus weed mimic (awnless wheat) and, (3) conventional barley. Each treatment has a sprayed and un-sprayed control, where sprayed plots were treated with 190 ml/ha Aggressor® herbicide. Assessments of herbicide tolerance and weed control were made at 14 and 21 days after application.

Treatments

	Treatment
1	CoAXium® barley, Nil Aggressor®
2	CoAXium® barley, Aggressor® spray
3	Conventional barley, Nil Aggressor®
4	Conventional barley, Aggressor® spray
5	CoAXium® barley + weed mimic*, Nil Aggressor®
6	CoAXium® barley + weed mimic*, Aggressor® Spray

Comments

Sown on the 18th May, the CoAXium® demonstration was sown into a slightly drying profile. All treatments emerged well, with some slower emergence in the growers control traffic wheel tracks.

The demonstration was sprayed with 190 ml/ha Aggressor® herbicide on the 14th June when the crop was at three to five leaf. Herbicide observations were taken at mid tillering, approximately 14 and 21 days after the application of Aggressor®.

The conventional barley showed severe herbicide damage by day 21, while the CoAXium® barley did not have any symptoms. The awnless wheat in the CoAXium® weed mimic treatment showed herbicide damage from the Aggressor® however, this was a visual demonstration only and no harvest results were recorded.

Acknowledgements

Thank you to Living Farm for sowing and managing the demonstration on behalf of AGT, and to Liebe Group Main Trial Site host, Sam Reynolds, for allowing AGT to establish this demonstration on his property.

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Calibre Depth of Sowing and Pre-emergent Herbicide Interaction - Mingenew

Alana Hartley, Variety Support, WA (North), Australian Grain Technologies

Key Messages

- Calibre is a new elite high yielding Scepter replacement with longer coleoptile.
- Deep sowing significantly reduced emergence in both varieties.
- Significant phytotoxicity was observed early in some treatments however, ideal growing conditions allowed the crop to grow out of this quickly.
- Sowing depth negatively impacted yield and screenings.

Aim

To investigate the potential benefits of using longer coleoptile wheat variety Calibre to sow deep and reduce the effects of herbicide injury from pre-emergent herbicides.

Background

The maximum coleoptile length of a wheat variety is one of a number of limiting factors in how deep you can plant that variety. In most cases, sowing depth is shallow enough to allow all commonly grown varieties to establish well. However, there are some instances where deeper sowing may be warranted: when there is a chance of furrow fill by wind or rain, chasing receding moisture profiles, anticipating uneven sowing depths across a seeding bar on renovated soils or, when trying to achieve adequate pre-emergent herbicide separation. Shorter coleoptile varieties may not be as well suited compared to longer coleoptile varieties in these situations.

AGT have developed the variety Calibre as an elite yielding Scepter replacement, which is agronomically very similar to Scepter, but importantly, has a longer coleoptile, like Magenta. This trial was designed to assess the value of Calibre's longer coleoptile under deep sowing and the benefit of this to reduce incidence of herbicide injury.

Trial Details

Trial location	Daybreak Cropping, Erregulla Plains, Mingenew
Plot size & replication	12m x 2.31m x 3 replicates
Soil type	Deep yellow sandplain
Paddock rotation	2022 Wheat, 2021 Lupins, 2020 Wheat
Sowing date	25/05/2022
Sowing rate	90 kg/ha, Scepter and Calibre
Fertiliser	25/05/2022; 100 kg/ha Kstart (10.8 N, 14 P, 9.9 K, 0.06 Cu, 0.12 Zn), 100 kg/ha Urea top dressed (46 N) 03/08/2022; 50 L/ha Flexi N (21.1 N)
Herbicides, Insecticides & Fungicides	28/06/2022; 1 L/ha Velocity, 400 ml/ha MCPA LVE, 3 g/ha Ally, 40 g/ha Lontrel, 20 ml/ha Trojan, Liberate spray oil 1% 3/08/2022; 150 ml/ha Prosaro
Harvest date	21/11/2022

Treatments

Treatment	Description
1	Scepter; SHALLOW 20mm; GROWER STANDARD *
2	Scepter; SHALLOW 20mm; OVERWATCH
3	Scepter; SHALLOW 20mm; LUXIMAX
4	Calibre; SHALLOW 20mm; GROWER STANDARD
5	Calibre; SHALLOW 20mm; OVERWATCH
6	Calibre; SHALLOW 20mm; LUXIMAX
7	Scepter; DEEP 110mm; GROWER STANDARD
8	Scepter; DEEP 110mm; OVERWATCH
9	Scepter; DEEP 110mm; LUXIMAX
10	Calibre; DEEP 110mm; GROWER STANDARD
11	Calibre; DEEP 110mm; OVERWATCH
12	Calibre; DEEP 110mm; LUXIMAX

**Grower standard practice = Treflan 1.5 L/ha + Sakura 210 ml/ha*

Results

Good seasonal conditions and adequate soil moisture saw little difference in early ratings of phytotoxicity and emergence. Deeper sown plots appeared to have phytotoxic symptoms (table 3, results appendix); however, the yellowing or pale colouring of leaves can also be attributed to exhaustion of nutrients and energy after using seed nutrient resources to emerge from depth.

Sowing depth directly affected yield (table 3), where shallow sown plots yielded an average of 330 kg/ha more than deep sown plots. Calibre, a new elite high-yielding Scepter replacement, yielded significantly higher than Scepter. Although not statistically significant, Calibre's yield trended higher across interactions between sowing depths (table 1) and herbicide treatments (table 5). A reduction in Calibre's yield was still observed in deep sown treatments, despite its longer coleoptile.

Sowing depth had the most significant impact on grain quality. Deep sowing resulted in slightly higher screenings (table 3). Although not high enough to result in a bulk handler grade penalty in 2022, a season where terminal stress is experienced will see the effect of sowing depth on screenings become more pronounced. There was also a variety effect (table 2), where Scepter had more screenings than Calibre. The interaction between sowing depth and variety saw an inverse protein response between Scepter and Calibre (table 1). Calibre achieved a higher protein in shallow sown plots, while Scepter performed significantly better than Calibre at depth. Further research is required to clarify this interaction. Hectolitre was unaffected by all treatments and their interactions. The combined interaction of all treatments had no statistical affect in 2022 and has not been presented in the results appendix.

In summary, Calibre is a higher yielding, longer coleoptile alternative to Scepter. While Calibre yielded more than Scepter under both sowing depth treatments, deeper sowing negatively impacted both varieties yield and grain quality (screenings). Therefore, Calibre sown shallow remains the lowest risk practice to adopt.

Acknowledgements

Thank you to Crop Circle Consulting for sowing and managing the demonstration on behalf of AGT, Paul Flanders (Daybreak Cropping) and, MIG for hosting this trial.

Peer Review

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Appendix - Calibre Depth of Sowing and Herbicide Interaction, Mingenew

Table 1: Impact of variety and sowing depth on yield and grain quality

Table of A (Variety) B (Depth) means	Emergence (plants/m²)	Phytotoxicity (score 0-5)	Yield (t/ha)	Protein (%)	Hectolitre weight (kg/hl)	Screenings % (2.0mm screen)
Scepter: DEEP 110mm	80.80	1.67	4.23	8.84[a]	80.63	2.78
Calibre: DEEP 110mm	105.12	0.44	4.69	8.71[ab]	79.34	2.30
Scepter: Shallow 20mm	118.24	0.44	4.57	8.54[b]	80.07	2.34
Calibre: Shallow 20mm	128.90	0.00	5.02	8.82[a]	79.98	2.08
LSD P<.05	0.3879	0.3003	0.9925	0.0238	0.0937	0.3355
Standard Error	10.9695	0.5185	0.1645	0.1197	0.4843	0.1516

Table 2: Impact of variety on emergence, phytotoxicity, yield and grain quality

Table of A (Variety) means	Emergence (plants/m²)	Phytotoxicity (score 0-5)	Yield (t/ha)	Protein (%)	Hectolitre weight (kg/hl)	Screenings % (2.0mm screen)
Scepter	105.91[b]	1.06[a]	4.34[b]	8.69	80.35	2.56[a]
Calibre	117.01[a]	0.22[b]	4.85[a]	8.77	79.66	2.19[b]
LSD P<.05	0.0344	0.0331	0.0008	0.4029	0.0567	0.0022
Standard Error	7.7566	0.3666	0.1164	0.0847	0.3424	0.1072

Table 3: Impact of variety on emergence, phytotoxicity, yield and grain quality

Table of B (Depth) means	Emergence (plants/m²)	Phytotoxicity (score 0-5)	Yield (t/ha)	Protein (%)	Hectolitre weight (kg/hl)	Screenings % (2.0mm screen)
Deep 110mm	98.96[b]	1.06[a]	4.46[b]	8.78	80.02	2.54[a]
Shallow 20mm	123.57[a]	0.22[b]	4.79[a]	8.68	79.99	2.24[b]
LSD P<.05	0.0007	0.0331	0.0090	0.2767	0.9233	0.0058
Standard Error	7.7566	0.3666	0.1164	0.0847	0.3424	0.1072

Table 4: Impact of herbicide on yield and grain quality

Table of (Herbicide) means	Emergence (plants/m²)	Phytotoxicity (score 0-5)	Yield (t/ha)	Protein (%)	Hectolitre weight (kg/hl)	Screenings % (2.0mm screen)
Treflan, Sakura	106.52	0.67	4.62	8.78	80.16	2.36
Overwatch	115.46	0.92	4.58	8.78	80.06	2.37
Lumax	113.19	0.33	4.67	8.64	79.80	2.40
LSD P<.05	0.6658	0.4411	0.8261	0.3498	0.6825	0.9453
Standard Error	9.4999	0.4490	0.1425	0.1037	0.4194	0.1313

Table 5: Impact of variety and herbicide on yield and grain quality

Table of A (Variety) C (Herbicide) means	Emergence (plants/m²)	Phytotoxicity (score 0-5)	Yield (t/ha)	Protein (%)	Hectolitre weight (kg/hl)	Screenings % (2.0mm screen)
Scepter; Treflan, Sakura	99.73	1.00	4.45	8.70	80.25	2.47
Calibre: Treflan, Sakura	113.30	0.33	4.79	8.85	80.07	2.25
Scepter: Overwatch	95.82	1.50	4.26	8.67	80.10	2.58
Calibre: Overwatch	114.37	0.33	4.91	8.62	79.50	2.15
Scepter: Luximax	103.02	0.67	4.49	8.72	80.70	2.63
Calibre: Luximax	123.37	0.00	4.86	8.83	79.42	2.17
LSD P<.05	0.9341	0.8148	0.5146	0.5937	0.4302	0.5933
Standard Error	13.4349	0.6350	0.2015	0.1467	0.5931	0.1857

Table 6: Impact of sowing depth and herbicide on yield and grain quality

Table of B (Depth) C (Herbicide) means	Emergence (plants/m²)	Phytotoxicity (score 0-5)	Yield (t/ha)	Protein (%)	Hectolitre weight (kg/hl)	Screenings % (2.0mm screen)
Deep 110mm; Treflan, Sakura	95.13	1.00	4.57	8.90	79.78	2.52
Shallow 20mm; Treflan, Sakura	117.90	0.33	4.67	8.65	80.53	2.20
Deep 110mm; Overwatch	87.50	1.50	4.35	8.71	79.68	2.52
Shallow 20mm; Overwatch	122.68	0.33	4.25	8.57	79.92	2.23
Deep 110mm; Luximax	96.25	0.67	4.46	8.72	80.50	2.58
Shallow 20mm; Luximax	130.13	0.00	4.88	8.83	79.62	2.23
LSD P<.05	0.7749	0.8148	0.3806	0.5937	0.1618	0.9657
Standard Error	13.4349	0.6350	0.2015	0.1467	0.5931	0.1857

Calibre Depth of Sowing and Pre-emergent Herbicide Interaction - Merredin

Alana Hartley, Variety Support, WA (North), Australian Grain Technologies

Key Messages

- Calibre is a new elite high yielding Scepter replacement with longer coleoptile.
- Overwatch herbicide caused significant phytotoxicity and reduction in emergence when both varieties were sown shallow.
- Ideal conditions resulted in no significant effect on emergence or vigour between the interaction of variety, sowing depth and pre-emergent herbicide.
- In 2022, yield and grain quality was not impacted by variety, sowing depth, pre-emergent herbicide, or the interaction of the three.

Aim

To investigate the potential benefits of using longer coleoptile wheat variety Calibre to sow deep and reduce the effects of herbicide injury from pre-emergent herbicides.

Background

The maximum coleoptile length of a wheat variety is one of a number of limiting factors in how deep you can plant that variety. In most cases, sowing depth is shallow enough to allow all commonly grown varieties to establish well. However, there are some instances where deeper sowing may be warranted: when there is a chance of furrow fill by wind or rain, chasing receding moisture profiles, anticipating uneven sowing depths across a seeding bar on renovated soils or, when trying to achieve adequate pre-emergent herbicide separation. Shorter coleoptile varieties may not be as well suited compared to longer coleoptile varieties in these situations. It should be noted that coleoptile length is negatively impacted by warmer soils, particularly in early sowing situations.

AGT have developed the variety Calibre as an elite yielding Scepter replacement, which is agronomically very similar to Scepter, but importantly, has a longer coleoptile, like Magenta. This trial was designed to assess the value of Calibre's longer coleoptile under deep sowing and the benefit of this to reduce incidence of herbicide injury.

Trial Details

Trial location	Kael Crees, Merredin
Plot size & replication	12m x 1.52m x 3 replications
Soil type	Chocolate loam over clay
Paddock rotation	2020 Canola, 2021 Canola, 2022 Wheat
Sowing date	27/05/2022
Sowing rate	80 kg/ha, Scepter and Calibre
Fertiliser	130 kg/ha K-Till Extra (13.3 N, 15.6 P, 14.6 K, 7.8 S), 50 kg/ha Urea (23 N)
Herbicides, Insecticides & Fungicides	Pre-emergent: See treatment list. 2.0 L/ha Roundup Ultramax Post emergent: 2.3 L/ha Boxer Gold, 800 ml/ha Velocity (23/06/22), 200 ml/ha Propiconazole (2/06/22), 285 ml/ha Propiconazole (2/09/22)
Harvest date	16/11/2022

Treatments

Treatment	Description
1	Scepter; DEEP 110mm; GROWER STANDARD*
2	Scepter; DEEP 110mm; OVERWATCH
3	Scepter; DEEP 110mm; LUXIMAX
4	Scepter; SHALLOW 20mm; GROWER STANDARD
5	Scepter; SHALLOW 20mm; OVERWATCH
6	Scepter; SHALLOW 20mm; LUXIMAX
7	Calibre; DEEP 110mm; GROWER STANDARD
8	Calibre; DEEP 110mm; OVERWATCH
9	Calibre; DEEP 110mm; LUXIMAX
10	Calibre; SHALLOW 20mm; GROWER STANDARD
11	Calibre; SHALLOW 20mm; OVERWATCH
12	Calibre; SHALLOW 20mm; LUXIMAX

**Grower standard practice = Treflan 1.5 L/ha + Sakura 210 ml/ha*

No.	Treatment Name	Form Type	Rate	Rate Unit
C1:	TREF	EC	1.5	l/ha
1, 4, 7, 10	SAKURA	SC	210	ml/ha
C2	OVERWATCH	SC	1.25	l/ha
2, 5, 8, 11				
C3	LUXIMAX	EC	500	ml/ha
3, 6, 9, 12				

Results

Due to good moisture and ideal growing conditions, early ratings on phytotoxicity and emergence showed very little difference between treatments. Scepter and Calibre emerged similarly, with no significant difference between the two. Emergence was expected to be reduced in deeper sown plots compared to shallow sown; however, deep sown plots emerged similarly to shallow sown plots, with no statistical difference.

Overwatch herbicide treatments alone experienced the greatest phytotoxicity but only impacted the overall emergence once the interaction between herbicide and sowing depth was measured. Plant numbers were reduced in shallow sown plots treated with Overwatch. However, this was similar to shallow sown treated with Luximax where there was a small, but not significant, reduction in plant numbers.

Growing conditions remained favourable throughout the season resulting in no significant impacts on yield or grain quality from any of the treatment or their interactions. All results can be found in the results appendinx.

Comments

Future research into the impact of sowing depth on wheat varieties with varying coleoptile lengths could benefit from including multiple times of sowing, and different Sowing rates. Including more than one time of sowing would aim to provide a greater understanding on the impact of sowing depth on delay in emergence and maturity. The inclusion of different Sowing rates will help identify the ideal plant density to achieve high yields and good grain quality, at different sowing depths.

Continual research into this topic will assist in developing industry rules of thumb, and help growers assess the suitability of a longer coleoptile wheat variety in their farming system.

Acknowledgements
Thank you to Living Farm for sowing and managing the demonstration on behalf of AGT, and Kael Crees and MADFIG for hosting this trial.

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Appendix - Calibre Depth of Sowing and Herbicide Interaction, Merredin

Table 1: Impact of variety on yield and grain quality

Table of A (Variety) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
1 - Scepter	6	77	6.3	10	10.7	78	1.92
2 - Calibre	5	77	6.29	9.9	10.7	77.9	1.69
Tukey's HSD P=0.05	1.6	8.2	0.27	0.38	0.15	1.55	0.384
Standard Deviation	2.3	11.9	0.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	20.6	2.87	30.762

Table 2: Impact of sowing depth on yield and grain quality

Table of B (Depth) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
1 - Deep 110	5	79	6.36	9.9	10.7	78	1.92
2 - Shallow 20	6	75	6.22	9.9	10.8	78.7	1.68
Tukey's HSD P=0.05	1.6	8.2	0.27	0.38	0.15	1.55	0.384
Standard Deviation	2.3	11.9	0.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	2.06	2.87	30.762

Table 3: Impact of herbicide on yield and grain quality

Table of C (Herbicide) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
1 - Treflan, Sakura	0^{b}	80	6.38	9.7	10.7	78.6	1.71
2 - Overwatch	16^{a}	77	6.15	10	10.7	77	1.98
3 - Luximax	0^{b}	75	6.35	10	10.7	78.2	1.73
Tukey's HSD P=0.05	2.4	12.2	0.401	0.57	0.23	2.3	0.569
Standard Deviation	2.3	11.9	0.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	2.06	2.87	30.762

Table 4: Impact of variety and sowing depth on yield and grain quality

Table of A (Variety) B (Depth) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
Scepter; Deep 110mm	5	80	6.33	9.9	10.6	77.6	2.06
Calibre; Deep 110mm	4	78	6.39	9.9	10.7	76.8	1.79
Sceptre; Shallow 20mm	6	75	6.26	10	10.8	78.4	1.77
Calibre; Shallow 20mm	6	75	6.19	9.8	10.8	78.9	1.59
Tukey's HSD P=0.05	3	15.5	0.512	0.72	0.29	2.93	0.727
Standard Deviation	2.3	11.9	0.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	2.06	2.87	30.762

Table 5: Impact of variety and herbicide on yield and grain quality

Table of A (Variety) C (Herbicide) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
Scepter; Treflan, Sakura	0	84	6.36	9.8	10.7	78.9	1.81
Calibre; Treflan, Sakura	0	75	6.4	9.7	10.8	78.3	1.61
Scepter; Overwatch	17	76	6.28	9.9	10.8	77.7	1.94
Calibre; Overwatch	15	78	6.03	10.1	10.6	76.4	2.02
Scepter; Luximax	0	73	6.25	10.3	10.7	77.6	2.01
Calibre; Luximax	0	77	6.45	9.8	10.8	78.9	1.45
Tukey's HSD P=0.05	4.2	21.4	0.703	0.99	0.4	4.03	0.998
Standard Deviation	2.3	11.9	00.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	2.06	2.87	30.762

Table 6: Impact of sowing depth and herbicide on yield and grain quality

Table of B (Depth) C (Herbicide) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
Deep 110; Treflan, Sakura	0	74	6.36	9.8	10.6	77.9	1.9
Shallow 20; Treflan, Sakura	0	85	6.4	9.6	10.9	79.4	1.52
Deep 110; Overwatch	15	85	6.1	10.1	10.7	75.7	2.19
Shallow 20; Overwatch	18	69	6.21	9.9	10.7	78.3	1.76
Deep 110; Luximax	0	78	6.63	9.8	10.7	78.2	1.69
Shallow 20; Luximax	0	71	6.07	10.3	10.8	78.3	1.77
Tukey's HSD P=0.05	4.2	21.4	0.703	0.99	0.4	4.03	0.998
Standard Deviation	2.3	11.9	0.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	2.06	2.87	30.762

Table 7: Interaction effect of variety, sowing depth and herbicide on yield and grain quality

Table of A (Variety) B (Depth) C (Herbicide) means	Phytotoxicity (%)	Emergence (plants/m²)	Yield (t/ha)	Protein (%)	Moisture (%)	Hectolitre weight (kg/hl)	Screenings % (<2.0mm screen)
Scepter; Deep 110mm Treflan, Sakura	0	79	6.3	9.9	10.5	78.8	2.07
Calibre; Deep 110mm Treflan, Sakura	0	70	6.42	9.8	10.7	76.9	1.72
Scepter; Shallow 20mm Treflan, Sakura	0	89	6.42	9.6	10.8	79.1	1.55
Calibre; Shallow 20mm Treflan, Sakura	0	81	6.37	9.6	10.9	79.7	1.5
Scepter; Deep 110mm Overwatch	16	85	6.14	9.9	10.9	76.5	2.07
Calibre; Deep 110mm Overwatch	13	85	6.06	10.3	10.6	74.9	2.31
Scepter; Shallow 20mm Overwatch	18	67	6.42	9.8	10.8	78.9	1.8
Calibre; Shallow 20mm Overwatch	17	71	5.99	10	10.6	77.8	1.72
Scepter; Deep 110mm Luximax	0	76	6.56	9.9	10.6	77.7	2.05
Calibre; Deep 110mm Luximax	0	80	6.7	9.7	10.8	78.7	1.33
Scepter; Shallow 20mm Luximax	0	69	5.93	10.6	10.7	77.4	1.97
Calibre; Shallow 20mm Luximax	0	73	6.2	9.9	10.8	79.2	1.56
Tukey's HSD P=0.05	6.9	35.3	1.162	1.64	0.65	6.66	1.648
Standard Deviation	2.3	11.9	0.391	0.55	0.22	2.24	0.555
CV	43.3	15.4	6.215	5.56	2.06	2.87	30.762

CANOLA & PULSES RESEARCH RESULTS

Rewards of Early Sown Canola at Xantippe

Chris O'Callaghan and Juniper Kiss, Liebe Group

Key Messages

- **All six early sown canola varieties were higher yielding than all later sown ones.**
- **As expected, Emu and Battalion flowered much earlier than 44Y27, Invigor 4022P, R4520P and GT53, especially when they were sown early.**
- **44Y27 sown early had the longest flowering and was the highest yielding variety in this trial.**

Aim

To evaluate and demonstrate the benefits of very early sown canola.

Background

A tropical cyclone system (Charlotte) from 26-30 March 2022 brought significant rainfall to the region, with 114mm falling over a 3 day period in the Dalwallinu region. These weather events may be becoming more common as changes to climate see more late tropical low systems coming through further south and as such providing a non-traditional season break.

A small plot trial was implemented in Xantippe to support grower decision-making when presented with early sowing canola opportunities such as this. The first time of sowing (TOS1) treatment was sown on the 5th April 2022. The second time of sowing treatment (TOS2) was sown on the 6th May 2022.

The following varieties were used in the trial:
Emu is an early-maturing (3) Glyphosate tolerant hybrid canola with TruFlex® (TF)
Battalion is an early-maturing (3.5) Glyphosate tolerant hybrid TruFlex® canola with Clearfield® tolerance. (TF+CL)
Pioneer 44Y27 is an early-mid (4) maturing Glyphosate tolerant hybrid canola. (RR)
Invigor R4022P is an early-mid (4) maturing Glyphosate tolerant hybrid canola with TruFlex®. (TF)
Invigor R4520P is an early-mid (4.5) maturing Glyphosate tolerant hybrid canola with TruFlex®. (TF)
GT53 is a mid-maturing (5) Glyphosate tolerant hybrid canola. (RR)

Trial Details

Trial location	Carter Family Property, Xantippe
Plot size & replication	1.5m x 10.15m, 6 varieties x 3 replications
Soil type	Sandy loam
Sowing date	TOS1: 05/04/2022, TOS2: 06/05/2022
Sowing rate	7.8 kg/ha
Fertiliser	05/04/2022: 70 kg/ha Urea, 100 kg/ha Macropro Xtra 23/06/2022: 60 L/ha Flexi N
Herbicides, Insecticides & Fungicides	05/04/2022: 2 L/ha Roundup Ultramax, 1 L/ha Rustler, 100 g/ha Lontrel 750SG, 800 mL/ha chlorpyrifos, 150 mL/ha Bifenthrin, 400 ml/ha Flutriafol on fert 15/04/2022: 1 L/ha Crucial, 50 ml/ha Alpha Cypermethrin 250SC 21/05/2022: 1.5 L/ha Crucial, 50 ml/ha Alpha Cypermethrin 100EC 10/09/2022: 100 g/ha Mainman, 150 ml/ha Affirm
Harvest date	TOS1: 19/10/2022, TOS2: 07/11/2022

Growing Season Conditions

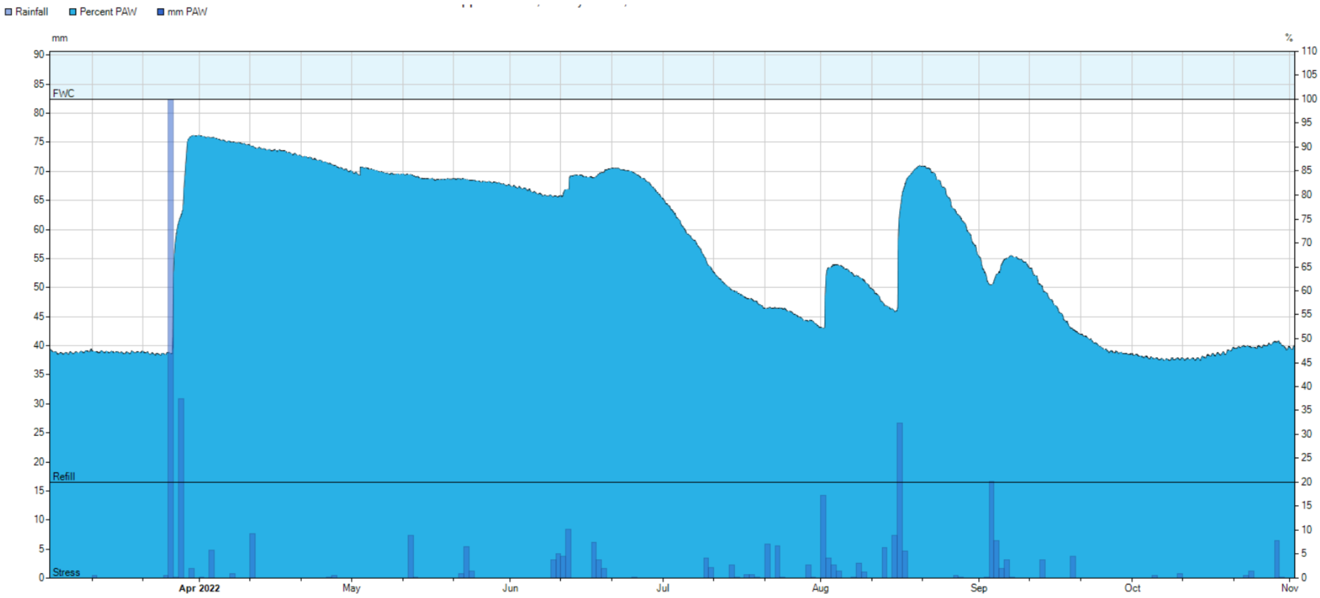

Figure 1. Rainfall and plant available moisture at Xantippe between 1 March and 1 November 2022.

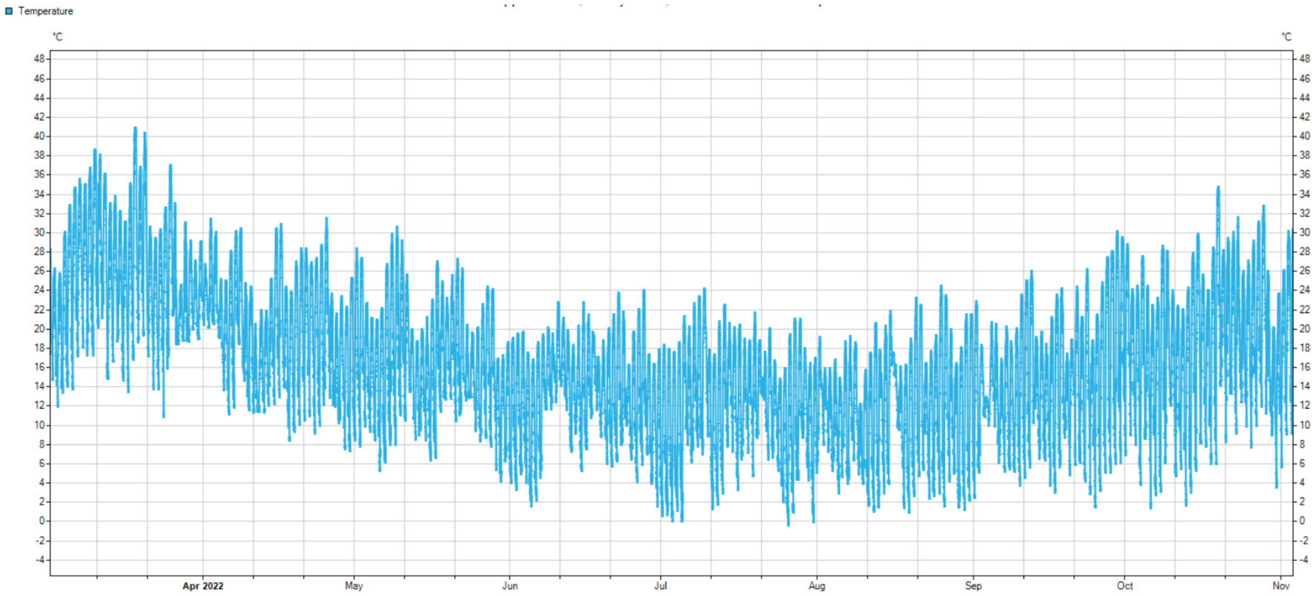

Figure 2. Daily temperature at Xantippe between 1 March and 1 November

Results

Overall establishment was lower for TOS1, possibly due to higher temperatures, however the difference in plant counts was less apparent as the season progressed. The plant establishment was greatest for Battalion and R4520P for the early-sown (TOS1) varieties (Figure 3). Amongst the later sown (TOS2) varieties, Battalion, R4520P, and 44Y27 had the greatest establishment (Figure 4).

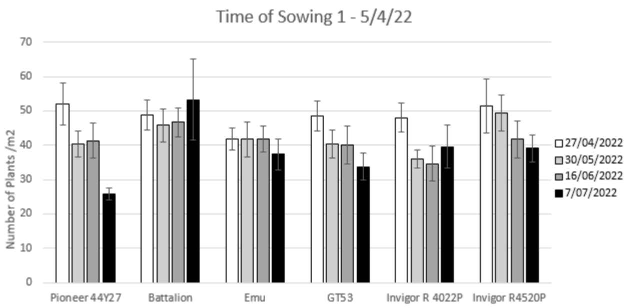

Figure 3. The crop establishment of six early sown canola (TOS1) varieties measured between 27 April and 7 July 2022 at Xantippe. Error bars represent ± SEM.

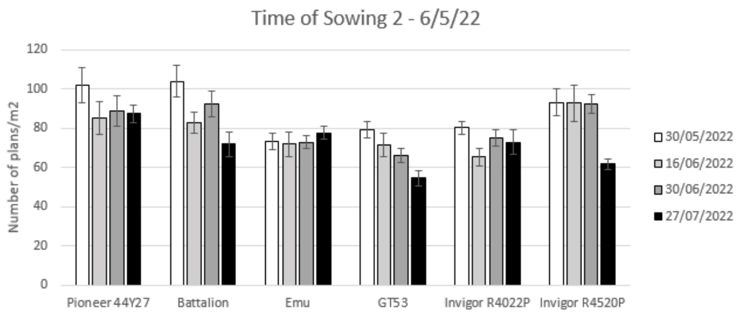

Figure 4. The crop establishment of six canola (TOS2) varieties measured between 30 May and 27 July 2022 at Xantippe. Error bars represent ± SEM.

General observations on weed and pest numbers were made throughout the season. The main weeds noted were wild radish and annual ryegrass whilst bromegrass and capeweed were less common. Generally, TOS2 had more weeds. Some mice damage was noted and the whole paddock was baited on 4th May. Diamond Back Moths were noted on 30 May and chewing damage was observed on 16 June. The entire paddock was sprayed with insecticide on the 10th September.

The flowering phenology (% of flowering plants) was recorded weekly from 1 June 2022 until 28 September 2022. Emu and Battalion started flowering in late May and were in full flower earlier than any other variety for TOS1 (Figure 5). The phenological differences were less pronounced between the varieties for TOS2 (Figure 6).

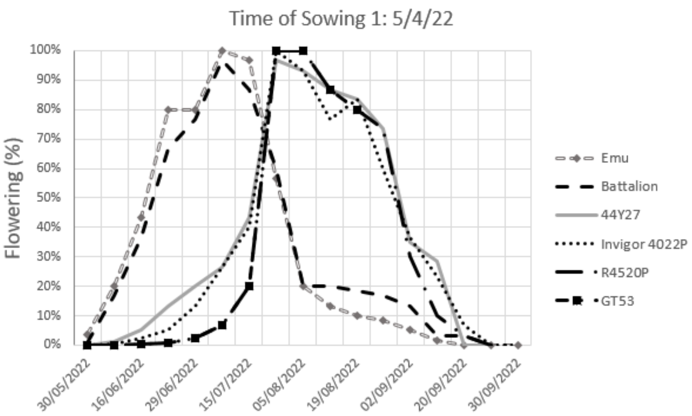

Figure 5. The flowering phenology of early sown (TOS1) six canola varieties differed. Emu and Battalion varieties were in full flower much earlier than GT53, Invigor 4022P and R450P.

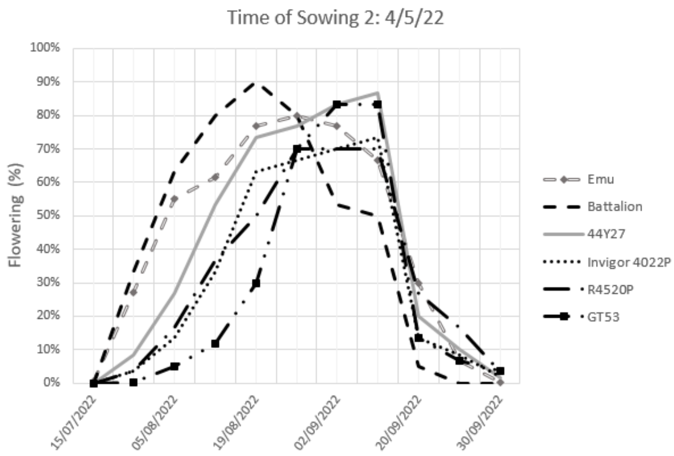

Figure 6. The difference in flowering phenology was less pronounced between the later sowing (TOS2) in comparison to TOS1. Emu, Battalion, and 44Y27 flowered statistically at a different time compared to GT53, Invigor 4022P, and R4520P.

All varieties were higher yielding at TOS1 than TOS2. At TOS1, 44Y27 yielded the highest and had the longest flowering time. GT53 was the second highest yielding, despite being later to start flowering and earlier to finish flowering than 44Y27. 44Y27 flowered for approximately 49 days in TOS1, compared to GT53 which flowered for approximately 39 days (25% - 75% flowering).

In TOS2 there was no difference in yields between varieties.

Table 2. Yield and quality analysis of Canola sown at 2 times at Xantippe 2022. The ab represents statistical difference (P<0.05) according to the one-way ANOVA test and Least Significance Test posthoc test.

Variety	Yield (t/ha)	Protein	Moisture	Oil	Large admix (%)	Admix (%)
Time of Sowing 1 - 5/4/22						
44Y27	3.02^{a}	19.87	5.47	46.80	0.49	1.01
GT53	2.93^{ab}	18.50	5.60	45.00	0.35	0.72
Battalion	2.63^{bc}	21.00	5.20	46.23	0.37	1.17
Emu	2.60^{bcd}	22.77	5.10	46.60	0.55	1.41
Invigor_4022P	2.50^{cd}	19.30	5.37	47.83	0.46	0.85
R4520P	2.41^{cd}	20.67	6.23	44.13	1.16	1.72
Time of Sowing 2 - 6/5/22						
GT53	1.86^{a}	19.83	5.00	46.83	0.48	0.66
R4520P	1.83^{a}	19.95	5.35	46.25	0.47	0.80
Battalion	1.82^{ab}	19.90	5.30	46.47	0.41	0.55
44Y27	1.80^{ab}	19.67	5.20	46.07	0.36	0.70
Emu	1.78^{ab}	20.80	5.15	47.40	0.46	0.96
Invigor_4022P	1.64^{b}	20.77	5.13	45.70	0.35	0.67

Comments

Yield data in this trial suggests that sowing any variety in early April would have outperformed any variety sown in early May.

Straight thermal varieties like Emu flowered significantly earlier in TOS1 when compared to TOS2. This is due to quicker accumulation of temperature when sown earlier into a warmer environment. Thermal varieties require a set number of degree days for growth, whilst other lines require vernalisation. Canola varieties have a varying degree of thermal and vernalisation requirements, and their phenology adjusts accordingly.

The nearby weather station & moisture probe showed quite a few cooler days at the beginning of June, July, and the end of August (Figure 2). Plant available water dipped in mid-July and was variable throughout August (Figure 1).

There was a seeding rate calculation error made at TOS1 and it was sown at nearly 8 kg/ha. This rate would have been expected to produce plant counts much higher than what was measured, so it is likely that there was some plant mortality as a result of higher temperatures at the start of April. The decision was made to sow TOS2 at the same higher rate for the sake of experimental consistency. This returned higher plant counts than TOS1, suggesting less plant mortality with slightly lower temperatures at TOS2 than TOS1. Potentially, the higher plant count had an impact on the final yields of TOS2.

Furthermore, a calculation error led to extra N fertilizer being applied to Rep 1. This did not appear to have any influence on yield or quality, suggesting nutrition was adequate for this site.

The Liebe Group will be implementing this trial again in 2023 if an early rainfall event occurs.

An in-season field walk was held on 22 June 2022 to view both the early sown canola trial as well as Jackie Bucat's co-located DPIRD trial on canopy management. This had great attendance of 17 people participating in the afternoon session in the paddock.

Acknowledgments

This is a Grains Research & Development Corporation invested project. Thank you to those who donated the seed for this trial and the Carter family for hosting the site.

Peer review

Jackie Bucat, Department of Primary Industries and Regional Development.

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Hyola Innovations Systems Technology Trial

Andrew Heinrich, Technical Specialist - Canola WA, Pacific Seeds &
Justin Kudnig, National Canola Technical Manager, Pacific Seeds

Aim
To assess the performance of a range of leading commercial varieties of canola and elite pre-commercial germplasm in a single trial. These trials allow direct comparison of yield and quality irrespective of herbicide technology and production system, (OP v Hybrid, GM v non-GM) where the appropriate herbicide chemistry is applied at full label rates and timings to each technology group including multiple chemistries applied to stacked hybrids.

Background
Although this is a single site with multiple technologies, and the results are presented as a single site level, Pacific Seeds prefers the use of Multi-environment (MET) analysis results. Multiple sites across different regions and years with concurrent varieties that allows the MET analysis to be conducted. The MET analysis gives the most robust assessment of varietal performance across environments and seasons. 11 Hyola Innovation System Trials were conducted across Australia in 2021 and 20 trials in 2022. A further 20 trials are planned for 2023, developing a large, robust data set across environments, locations, and years, adding greater strength to the MET analysis. The full MET analysis, over 2 years and multiple environments, will be available in early 2023 by contacting Pacific Seeds for the full details.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	5m x 1.8m, 2 replicates in RCB spatial design with randomised controls
Soil type	Sandy Loam
Paddock rotation	2020 Wheat, 2021 Wheat
Sowing date	21/04/2022
Sowing rate	Variable targeting 40 plants/m^2
Fertiliser	21/04/2022: Urea 100 kg/ha, Macro-pro 120 kg/ha 13/07/2022: Flexi-N 192 L/ha 09/08/2022: Flexi-N 100 L/ha
Herbicides, Insecticides & Fungicides	21/04/2022: Clopyralid 100 g/ha, Glyphosate (540 g/l) 1.5 L/ha, Propyzamide 1 L/ha, Bifenthrin 100 mL/ha, Trifluralin 2 L/ha, Propionic acid 1 L/100L, Chlorpyrifos 1 L/ha 01/05/2022: Zinc phosphide 1 kg/ha 13/07/2022: Sulfoxaflor 50 g/ha, Bixafen + prothioconazole 600 mL/ha, Emamectin 300 mL/ha 11/10/2022: Diquat 3 L/ha
Harvest date	23/10/2022

Soil Composition Test Results

Depth (cm)	pH ($CaCl_2$)	Col P (mg/kg)	Col K (mg/kg)	S (mg/kg)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	EC (ds/m)	OC (%)
0-10	6.7	54	35	8.3	2	10	0.131	0.55

Herbicide treatments applied to each Technology Block
Where specific adjuvants are not listed below with particular treatments, then recommended adjuvant as per the label has been used.

Treatment Date	Treatment Active	Product Conc	Product Unit	Product Type	Application Rate	Application Unit	Other Rate(ai)	Other Rate Unit	Growth Stage
Roundup Ready Block (RR)									
19/05/2022	Glyphosate	690	g/Kg	SG	0.9	kg/ha	621	g ai/ha	GS10-14
02/06/2022	Glyphosate	690	g/Kg	SG	0.9	kg/ha	621	g ai/ha	GS14-18
TruFlex Technology Block (XX)									
19/05/2022	Glyphosate	540	g/L	SL	1.67	l/ha	902	g ai/ha	GS10-14
23/06/2022	Glyphosate	540	g/L	SL	1.67	l/ha	902	g ai/ha	GS60-61
TruFlex + Clearfield Block (XC)									
19/05/2022	Imazamox + Imazapyr	48	g/L	SL	0.75	l/ha	36	g ai/ha	GS10-14
19/05/2022	ethyl & methyl ester of vegetable oil + non-ionic surfactants	900	g/l	OD	1	% v/v	900	g ai/ha	GS10-14
19/05/2022	Glyphosate	540	g/L	SL	1.67	l/ha	902	g ai/ha	GS10-14
23/06/2022	Glyphosate	540	g/L	SL	1.67	l/ha	902	g ai/ha	GS60-61
Clearfield Block (CL)									
19/05/2022	Imazamox + Imazapyr	48	g/L	SL	0.75	l/ha	36	g ai/ha	GS10-14
19/05/2022	ethyl & methyl ester of vegetable oil + non-ionic surfactants	900	g/L	OD	1	% v/v	900	g ai/ha	GS10-14
Clearfield + Triazine Tolerant Block (CT)									
19/05/2022	Imazamox + Imazapyr	48	g/L	SL	0.75	l/ha	36	g ai/ha	GS10-14
19/05/2022	Atrazine	900	g/kg	WG	1.1	kg/ha	990	g ai/ha	GS10-14
19/05/2022	ethyl & methyl ester of vegetable oil + non-ionic surfactants	900	g/l	OD	1	% v/v	900	g ai/ha	GS10-14
Triazine Tolerant Block (TT)									
19/05/2022	Atrazine	900	g/kg	WG	2.2	kg/ha	1980	g ai/ha	GS10-14
19/05/2022	ethyl & methyl ester of vegetable oil + non-ionic surfactants	900	g/L	OD	1	% v/v	900	g ai/ha	GS10-14
02/06/2022	Clethodim	240	g/L	EC	500	ml/ha	120	g ai/ha	GS14-18
02/06/2022	Clopyralid	600	g/L	SC	150	ml/ha	90	g ai/ha	GS14-18
02/06/2022	Paraffinic Oil, Alkoxylated alcohol non-Ionic surfactants	822	g/L	OL	0.5	% v/v	411	g ai/ha	GS14-18

Trial Results

Table 1: 2022 Miling WA – Hyola Innovation System Technology Trial analysed Grain Yield in t/ha of commercial varieties.

Entry	Herbicide Technology	Grain Yield (t/ha)	Sign
44Y94	Clearfield	4.460	a
HYOLA REGIMENT XC	TruFlex Clearfield stack	4.408	ab
HYOLA SOLSTICE CL	Clearfield	4.330	abc
45Y95	Clearfield	4.113	a-d
44Y30	Roundup Ready	4.104	a-d
HYOLA GARRISON XC	TruFlex Clearfield stack	4.088	a-e
HYOLA EQUINOX CL	Clearfield	4.035	a-f
HYOLA BATTALION XC	TruFlex Clearfield stack	4.018	a-f
44Y90	Clearfield	3.993	a-g
45Y28	Roundup Ready	3.897	b-h
HYTTEC TRIFECTA TT	Triazine Tolerant	3.847	c-i
HYOLA BLAZER TT	Triazine Tolerant	3.816	c-i
HYOLA ENFORCER CT	Triazine Clearfield stack	3.730	d-i
44Y27	Roundup Ready	3.729	d-i
HYTTEC TROPHY TT	Triazine Tolerant	3.675	d-j
NUSEED CONDOR TF	TrueFlex	3.626	d-k
INVIGOR T4510	Triazine Tolerant	3.553	e-k
DG LOFTY TF	TrueFlex	3.523	f-k
HYTTEX TRIDENT TT	Triazine Tolerant	3.519	f-k
HYOLA 410XX	TrueFlex	3.497	f-k
INVIGOR R 4520P	TrueFlex	3.454	g-k
DG BINDO TF	TrueFlex	3.421	h-k
NUSEED RAPTOR TF	TrueFlex	3.406	h-k
INVIGOR LT 4530P	Liberty Triazine stack	3.391	h-k
INVIGOR R 4022P	TrueFlex	3.388	h-k
SF IGNITE TT	Triazine Tolerant	3.368	h-k
INVIGOR T6010	Triazine Tolerant	3.346	ijk
ATR BONITO	Triazine Tolerant	3.147	jkl
DG BIDGEETT	Triazine Tolerant	3.129	kl
ATR WAHOO	Triazine Tolerant	2.724	l
DG MURRAY TT	Triazine Tolerant	2.656	l
	CV	7.873	
	LSD	0.541	
	MEAN	3.699	

Results of any elite germplasm lines are not released until the hybrid is officially released into the market.

The oil content analysis is yet to be completed for these varieties. The oil content analysis results will be available early in February 2023, by contacting Pacific Seeds for the full details.

Comments

The 2022 Miling Hyola Innovation Systems Technology Trial was conducted as part of a series of Multi Environment Trials (MET) over years and locations to assess the performance of a range of leading canola varieties across the industry and elite germplasm. This is a single site result and should be treated with caution, as it simply reflects the performance of each variety in this one location, one season, under this particular set of management options.

Each variety may be compared to another, keep in mind the LSD when deciding if the two particular varieties are "actually" different from each other for yield in this trial. These results, table 1, show that the 9 top yielding varieties are not significantly different from each other at this site and should be treated as though their yields are "equivalent".

Use the MET analysis for your selection of varieties is the best way going forward. The 2022 MET analysis of this trial series (including the 2021 trials) will be available from Pacific Seeds in early 2023.

Based on the 2021 MET of this series [1] and this trial result (with caution) indicates that the selection of the herbicide tolerance trait/s you require for your rotation will have a higher priority than a specific variety selection. The top yielding varieties are not significantly different to each other. Choosing a stacked variety increases your weed management options and risk management associated with soil herbicide carryover.

References

1: Hyola Innovation Systems Technology Trial Results 2021/22
https://www.pacificseeds.com.au/wp-content/uploads/2022/05/Pacific-Seeds-2021-22-Hyola-Innovation-Systems-Technology-Results-Technote.pdf

Acknowledgements

Liebe Group and Sam Reynolds, for hosting the trial
Living Farm for trial management

Peer review

Please note this article has not been peer-reviewed.

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Pacific Seeds
Growing possibilities

Increasing the Profitability of the Double-Break Rotation Through the Incorporation of an Early Sown High-Value Pulse

Chris O'Callaghan, Liebe Group

Key Messages
- The wheat on wheat rotation in this trial showed a reduction in yield compared to wheat on legumes.
- Frost was an issue on many early sown wheat on wheat paddocks in the area.
- Yellow spot inoculum had built up in the wheat on wheat plot.

Aim
To demonstrate that growing either canola or fallow (with effective weed control options) followed by a high-value legume (with higher economic value) can lead to an effective and profitable double-break crop sequence. The second part of this trial is to determine the impact of this rotation on the grain yield and profitability of a cereal crop in the first year following the double break crop sequence.

Background
One of the constraints in the use of a single or double break crop sequence is that the gross margin of the most used break crops is generally less than growing a cereal crop. As a result, break crops are used sparingly by growers in crop rotations with the aim of maintaining the most profitable sequence of crops while maintaining reasonable control of weeds and diseases. However, the short-term decrease in economic return from growing a break crop is likely to be offset by the longer-term benefits of decreased production costs and increased productivity of cereal crops for the following seasons.

The most desired traits of a break crop are to be highly effective in controlling weeds and disease while also being highly profitable. Current highly effective break crop options of canola and lupin are rated as moderate to low profitability (respectively) by growers, while pasture phases or fallow periods generally result in a low or negative gross margin. The integration of high-value legumes such as chickpeas or lentils has been successful in medium to low-rainfall environments of Eastern Australia to improve crop rotation profitability while maintaining effective weed control.

Recent studies in WA found that profitable grain yields of chickpeas are achievable in the medium rainfall zone (MRZ) of the WA Wheatbelt. The impact of earlier sowing of these pulses has also been demonstrated to significantly increase in the profitability of these high-value legumes. The downside of high-value legumes is that potentially these break crop options have less developed (and therefore less effective) weed management packages for the WA environment.

Trial Details

Trial location	Matthew Hyde, Dalwallinu		
Plot size & replication	18.3m x 200m, not replicated		
Soil type	Medium Clay Loam		
Paddock rotation	2017: Field Peas	2018: Wheat	2019: Barley
	2020: Fallow	2021: Treatments	2022: Wheat
Sowing date	09/05/2022		
Sowing rate	65 kg/ha Sceptre Wheat		
Fertiliser	09/05/2022 - Flexi 40 L/ha, Map Zn 60 kg/ha 16/06/2022 - Urea: 60 kg/ha		
Herbicides, Insecticides & Fungicides	09/05/2022: 2 L/ha Treflan, 2.5 L/ha Boxergold 27/05/2022: Trident 1 L/ha 09/05/2022: 400 ml/ha Flutriafol		
Harvest date	10/01/2023		

Treatments applied in 2021

T1: Cereal Crop
T2: Chickpeas – Early Sown
T3: Chickpeas – Late Sown
T4: Field Pea – Late Sown (Standard Practice)

Soil composition in 2021

Depth (cm)	pH ($CaCl_2$)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	Col P (mg/kg)	Col K (mg/kg)	KCl S (mg/kg)	EC (ds/m)	OC (%)	PBI
0 - 10	7.7	7	2	22	704	2.8	0.129	1.05	160.5
10 - 30	7.8	4	1	7	549	3.7	0.121	0.81	156.2
30 - 50	7.8	2	1	6	409	7.1	0.133	0.71	154.1

Results

In 2021, the wheat treatment was the highest yielding of the four treatments averaging 4.4 t/ha. The field peas averaged 1.8 t/ha, early sown chickpeas 1.1 t/ha and late sown chickpeas 0.6 t/ha (Figure 1). *Please note in the 2021 Liebe Group Research & Development Booklet, these yields were reported incorrectly due to a labelling error.*

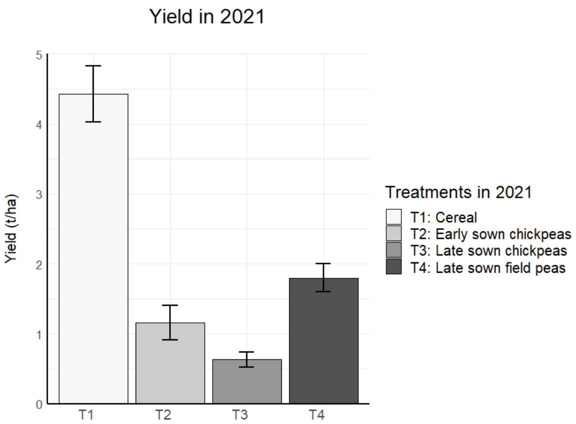

Figure 1. The yields significantly differed between the four treatments in 2021* at Hyde's property in Dalwallinu. **Please note that the data was mis-labelled in the Liebe Group's R&D book in 2021-2022.*

In the 2022 wheat, there were some differences in plant establishment (Figure 2), NDVI (Figure 3), and weed densities (Figure 4) between the treatments.

Figure 2. Wheat crop establishment at 6 weeks after sowing (6WAS) was lower for T2 (early sown chickpeas in 2021). Error bars are ± SEM. The ab represents statistical difference (P<0.05) according to the one-way ANOVA test and Least Significance Test posthoc test.

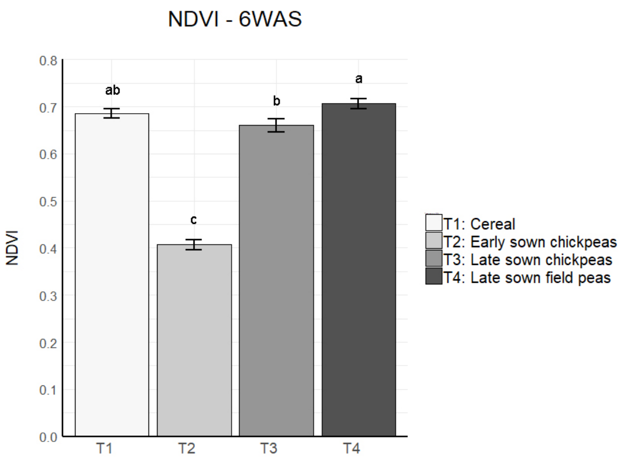

Figure 3. The NDVI was lower for T2 (early sown chickpeas in 2021) compared to the three other treatments at 6WAS. Error bars are ± SEM. The ab represents statistical difference (P<0.05) according to the one-way ANOVA test and Least Significance Test posthoc test.

Overall, plant establishment and NDVI were lower for T2 (early sown chickpeas in 2021) in comparison to the other three treatments but T1 and T4 had the most weeds at GS30. This did not however result in any yield penalty, with T1 (wheat on wheat) yielding the lowest of the four treatments (Figure 5).

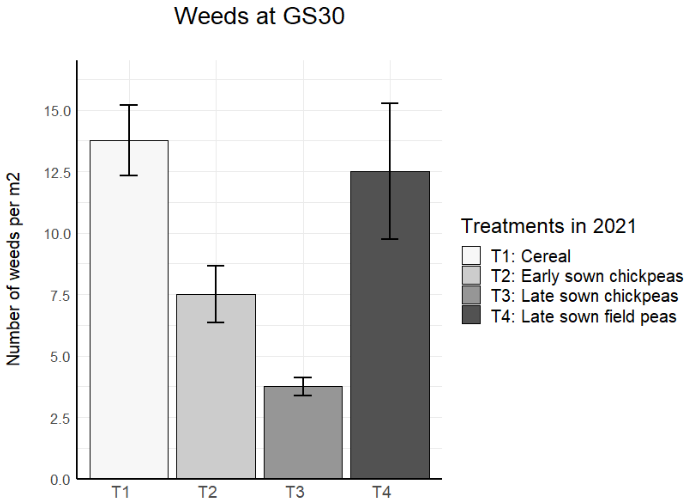

Figure 4. Weed density at GS30 was lowest for T3 (late sown chickpeas in 2021), followed by T2 (early sown chickpeas in 2021). Error bars are ± SEM.

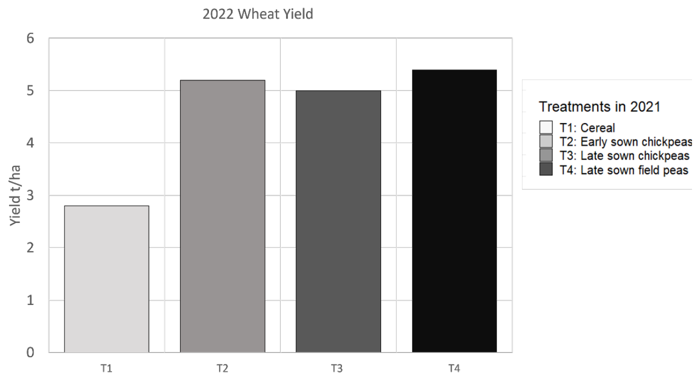

Figure 5. 2022 Wheat yield taken from host farmers yield monitor show lower yield associated with the fallow/ wheat/wheat rotation. Note this data is unreplicated.

Comments

The yield results in 2022 show a yield decline in the fallow/wheat/wheat rotation compared to the other fallow/legume rotation treatments. The host farmer commented that this was likely due to frost, which was a common issue for them in their early sown wheat on wheat crops this season. Possible explanation for this was the higher stubble load from 2021 led to increased inter-row shading and subsequently lower ground temperatures.

Plant establishment and NDVI was significantly lower for the fallow/early sown chickpea rotation however this did not have an overall effect on yield when compared to the other fallow/legume treatments.

In 2021, Predicta B testing found Crown rot to be a medium disease risk in this paddock and *Pratylenchus neglectus* and charcoal rot posed low disease risk. No other diseases or pests were found in 2021. In 2022, however predicta B testing showed increased levels of Pyrenophora tritici-repentis (yellow spot) had built up in the continuously cropped wheat strips compared to the other treatments. In the fallow/legume treatments, Ascochyta blight fungi had established.

Acknowledgments

This is a GRDC-invested project, WMG2003-001SAX, led by the West Midlands Group. This site is managed by the Liebe Group as one of four sites across the Wheatbelt that aims to evaluate the crop rotation benefit of a double break crop rotation. Thanks to the Hyde family for their assistance, hosting, implementing and managing the trial.

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NATIONAL VARIETY TRIALS

National Variety Trials - Liebe Group Main Trial Site Dalwallinu

Pip Payne, NVT Coordinator, Living Farm

Aim

The aim of the National Variety Trials (NVT) is to generate independent information for growers and industry about newly released varieties of field crops to the current commercial varieties grown in the area.

Background

The NVT program has been designed to identify the highest yielding varieties, free from the constraints of nutrition and disease. As a result, the nutrition and crop protection packages applied to NVT trials are typically higher than may be applied by the average grower. Management is the same for all plots with no differences in timing for crop protection or nutrition.

All trials have 3 replicates of each variety and all plots are sown (and subsequently harvested) on the same day. Timing of sowing is dependent upon the season, but is typically done within an average district "best practice" window and located on a typical soil type for the area.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	10m x 1.72m x 3 replicates
Soil type	Wheat - Sandy loam, Canola – Sandy loam
Paddock rotation:	Wheat – 2021 Canola; Canola – 2021 Wheat
Sowing date	Wheat 18/05/2022, Canola 19/04/2022
Sowing rate	Wheat 200 seed/m^2, Canola 40 seed/m^2
Fertiliser	Wheat: 18/05/2022: Urea 100 kg/ha, K-Till Extra 130 kg/ha + Impact 15/06/2022: Flexi N 150 L/ha 09/08/2022: Flexi N 100 L/ha Canola: 19/04/2022: K-Till Extra 130 kg/ha + Flutriafol, Urea 100 kg/ha 15/06/2022: Flexi N 190 l/ha 09/08/2022: Flexi N 100 l/ha
Herbicides, insecticides & fungicides	Details of chemicals used and rates available at https://nvt.grdc.com.au/trials/results

Soil Composition

Depth cm	Texture 1 sand, 2 sandy loam, 3 loam, 4 loamy clay, 5 clay	Total Nitrogen mg/kg	Phosphorus mg/kg	P Test Type	Organic Carbon %	pH (water)	pH ($CaCL_2$)	Conductivity (EC) dS/m
				Wheat trial site				
0-10	1.5	13	20	Colwell	0.89	6.8	6.1	0.084
10-30	1.5	4				5.7	4.9	0.035
				Canola trial site				
0-10	3.5	12	54	Colwell	0.55	7.4	6.7	0.131
10-30	1.5	7				6.1	5.7	0.174

Variety Descriptions

For variety descriptions and information see the 2023 WA Crop Sowing Guide.

New Wheat Varieties

Brumby is an APW wheat variety released by InterGrain in 2022. Brumby was included in the WA NVT for the first time in 2021 where it yielded similar to RockStar.

InterGrain suggest that Brumby has a maturity between Scepter and RockStar, however DPIRD 2021 data indicates the variety to be of similar maturity to RockStar. Powdery mildew resistant (Rp), very good resistance to stem (MRp) and stripe (RMRp) rust, as well as excellent yellow spot resistance (MRMSp).

LRPB Anvil CL Plus was released by LongReach in 2022 and is a quick maturing AH wheat with tolerance to imidazolinone herbicide. It was included in the 2020 WA NVT in Agzones 2,4 and 5 and all agzones in 2021. It achieved the highest yields of the current IMI tolerant varieties but was marginally lower yielding than Scepter. LongReach suggests that LRPB Anvil is well suited to the harsh finishing conditions of the low to medium rainfall areas of WA. LRPB Anvil has a similar disease profile to Hammer CL Plus, although weaker for leaf rust and yellow spot.

Calibre is an AH wheat released by Australian Grains Technologies (AGT) in 2021, which is derived from Scepter with a slightly shorter maturity, similar to Mace. Calibre was included in the WA NVT for the first time in 2020, where it was one of the highest yielding varieties. It has a similar disease package to Scepter with provisional ratings of RMRp for stem and stripe rust, Sp for leaf rust and powdery mildew but a slightly poorer yellow spot rating (MSp) than Scepter. Calibre has a longer coleoptile than Scepter and Mace, similar to Magenta.

Valiant CL Plus is an imidazolinone herbicide tolerant AH wheat released by InterGrain in 2021. Valiant CL Plus was included in the WA NVT for the first time in 2020, in Agzones 2, 3, 5 and 6. InterGrain suggests that Valiant CL Plus has a slower/longer maturity than Cutlass and has provisional ratings of RMRp for stripe rust, MRp for stem rust and MSSp for leaf rust. Valiant CL Plus yields similar to Cutlass and Denison when sown in NVT main season trials and slightly lower than other CL Plus varieties of shorter/quicker maturity in main season sowing times. Valiant CL Plus provides a longer coleoptile length and is a new option for maximising early sowing opportunities in a Clearfield system.

LRPB Avenger is an APW and APWN wheat variety released by Longreach in 2021. LRPB Avenger offers a maturity between Corack and Vixen. LRPB Avenger has been tested in the NVT since 2019, where it outyields Scepter and Mace under tight finishes when yield potentials are <2.5 t/ha. Disease ratings are MS for yellow spot and stem rust, MRMS for stripe rust and S for leaf rust, with provisional rating of Sp for powdery mildew. LRPB Avenger has a longer coleoptile length similar to Magenta.

New Canola Varieties

TT OP varieties

Bandit TT is an early maturity variety released by AGT. It was the highest yielding OP in Low-Med Rainfall NVT, more than 10% higher yielding than ATR Bonito. Bandit TT is suited to low pressure blackleg situations.

Renegade TT is an early-mid maturity variety released by AGT. It out-yielded ATR Bonito by 7% in Low-Med Rainfall NVT and by 4% in Med-High Rainfall NVT. It has a higher blackleg rating (MRMS bare seed) than ATR Bonito.

ATR Bluefin is an early maturity variety released by Nuseed in late 2021. Its yield is behind ATR Bonito, but it has a blackleg resistance rating of RMR, and an oil content 1% above the TT average (44.6%)

TT hybrids

HyTTec Velocity is an early maturity release from Nuseed. It was the third highest yielding variety in the Low-Med Rainfall NVT.

InVigor T 4511 has similar early-mid maturity and comparable yields to InVigor T4510. However, InVigor T4511 has a higher blackleg resistance rating (R vs MR), and a higher oil content than InVigor T 4510.

RGT Baseline TT is a mid-late maturity variety from SeedForce.

GT

Nuseed Hunter TF is an early-mid maturity TruFlex variety and achieved the highest yields of the Low-Med Rainfall NVT.

Wheat Entries – WMaA22DALW6

1	17Q2H1081	18	EDGE19WB-4112	35	OAGT0049R
2	17Q2H1490	19	Emu Rock	36	RAC3070
3	17Q2H1505	20	Hammer CL Plus	37	RAC3261
4	17Q2H1509	21	Kinsei	38	Razor CL Plus
5	17Q2H1513	22	LPB17-6157	39	RockStar
6	Ballista	23	LPB18-0818	40	Scepter
7	Borlaug 100	24	LPB18-3055	41	Sheriff CL Plus
8	Brumby	25	LPB18-4160	42	Sting
9	Calibre	26	LRPB Avenger	43	Supreme
10	Catapult	27	LRPB Cobra	44	Tungsten
11	Chief CL Plus	28	LRPB Havoc	45	Valiant CL Plus
12	Cutlass	29	LRPB Nyala	46	Vixen
13	Denison	30	LRPB Oryx	47	Wedin
14	Devil	31	LRPB Trojan	48	Yitpi
15	EDGE16Q-0155	32	Mace	49	Zen
16	EDGE19SA-0178	33	Magenta		
17	EDGE19SA-1098	34	Ninja		

Triazine Tolerant Canola Entries CHTA22DALW6

1	AFP Cutubury	16	NCH20T711
2	AGTC0006	17	NCH22T918
3	AGTC0034	18	NCH22T919
4	ATR Bluefin	19	NCH22T920
5	ATR Bonito	20	NCH22T921
6	DG1932TT	21	NCH22T922
7	Hyola Blazer TT	22	NMH20T678
8	Hyola Enforcer CT	23	NT0504
9	HyTTec Trident	24	PS-22CT107
10	HyTTec Trophy	25	RGT Capacity TT
11	InVigor LT 4530P	26	SF Dynatron TT
12	InVigor T 4510	27	SF Spark TT
13	InVigor T 4511	28	SFR65-059TT
14	Monola 422TT	29	SFR65-063TT
15	NCH19T588		

Glyphosate Tolerant Canola Entries CHGA22DALW6

1	72687
2	AN22LR007
3	AN22LR008
4	DG Bindo TF
5	DG Lofty TF
6	DG2201TF
7	Hyola 410XX
8	Hyola Battalion XC
9	Hyola Garrison XC
10	InVigor R 4022P
11	InVigor R 4520P
12	NCH20Q733
13	Nuseed Emu TF
14	Nuseed Raptor TF
15	Pioneer 44Y27 (RR)
16	Pioneer 44Y30 RR
17	PS-22XC320

Acknowledgements
Thanks to property owner Sam Reynolds and the Liebe Group for providing the site to Living Farm for the trial. Participating companies, GRDC and the NVT program coordinators. Individual trial results are available online.

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WEEDS RESEARCH RESULTS

Annual Ryegrass and Broadleaf Weed Control in Cereals

Tristan Clarke and Clare Antonio, Agronomists, Elders Dalwallinu

Key Messages
- Luximax effect on plant numbers evident as sandy soil types often show.
- Pre-emergent ryegrass control standout was Sakura + Avadex.
- Premium type pre-emergent products offered similar levels of control.

Aim
Determine differences in efficacy of a range of pre and early post emergent herbicides and herbicide mix options for grass and broadleaf weed control in wheat.

Background
Annual ryegrass continues to be one of the biggest challenges facing farmers in WA, with increasing resistance to many of our current herbicides and a range of new herbicides being released in the past few years this trial seeks to investigate the different interactions between use patterns different grass herbicides have on annual ryegrass in wheat. There is also a scattered population of volunteer canola in the trial that helps to show some of the broadleaf weed control attributes of some of the commonly used mixes.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	10m x 2m x 3 replications
Soil type	Sand
Paddock rotation	2021 canola, 2020 wheat
Sowing date	18/05/2022
Sowing rate	85 kg/ha Hammer wheat
Fertiliser	18/05/2022: 120 kg/ha K-Till, 100 kg/ha Urea. 14/06/2022: 150 L/ha Flexi-N
Herbicides, Insecticides & Fungicides	17/05/2022: 500 mL/ha Velocity, 1.5 L/ha Roundup Ultra Max, 150 mL/ha bifenthrin, 1 L/ha chlorpyrifos. 18/05/2022: Application T1 timing as per protocol. 14/06/2022: 285 mL/ha propiconazole, 20 mL/ha Trojan. 14/06/2022: Application T2 timing as per protocol.

Treatments

Trt No.	Treatment Name	Rate	Unit	Appl Timing
1	Untreated control			
2	Trifluralin	2	l/ha	T1
	Callisto	200	ml/ha	T1
3	Trifluralin	2	l/ha	T1
	Voraxor	200	ml/ha	T1
4	Trifluralin	2	l/ha	T1
	Avadex Xtra	3.2	l/ha	T1
	Terrain Flow	125	ml/ha	T1
5	Trifluralin	2	l/ha	T1
	Mateno Complete	1	l/ha	T2
6	Trifluralin	2	l/ha	T1
	Luximax	500	ml/ha	T1
7	Trifluralin	2	l/ha	T1
	Sakura Flow	210	ml/ha	T1
8	Overwatch	1.25	l/ha	T1
9	B Power	100	ml/ha	T1
	Luximax	500	ml/ha	T1
10	Trifluralin	2	l/ha	T1
	Prosulfocarb	2.5	l/ha	T2
11	Trifluralin	2	l/ha	T1
	Prosulfocarb	2.5	l/ha	T2
	Colt	1	l/ha	T2
12	Trifluralin	2	l/ha	T1
	Sakura Flow	210	ml/ha	T2
13	Boxer Gold	2.5	l/ha	T1
14	Villian	2	l/ha	T1
15	Sakura Flow	210	ml/ha	T1
	Voraxor	200	ml/ha	T1
16	Sakura Flow	210	ml/ha	T1
	Terrain Flow	125	ml/ha	T1
17	Product X	500	ml/ha	T1
	Product X	500	ml/ha	T2
18	Mateno Complete	1	l/ha	T2
	Intercept	500	ml/ha	T2
	Hasten	0.5	% v/v	T2
19	Sakura Flow	210	ml/ha	T1
	Avadex	2	l/ha	T1

Comments

Table 1: Annual ryegrass control (%) 36, 62 & 114 Days After Application (DAA-A).

Trt No.	Treatment Name	Appl. Rate	Appl. Timing	36 DAA-A 9 DAA-B	62 DAA-A 35 DAA-B	114 DAA-A 87 DAA-B
1	Untreated control			0^{i}	0^{f}	0^{i}
2	Trifluralin + Callisto	2 L/ha 200 mL/ha	1	86^{ab}	88^{ab}	87^{b-f}
3	Trifluralin + Voraxor	2 L/ha 200 mL/ha	1	73^{b-e}	76^{cde}	80^{fg}
4	Trifluralin + Avadex Xtra + Terrain Flow	2 L/ha 3.2 L/ha 125 mL/ha	1	79^{a-d}	88^{ab}	87^{b-f}
5	Trifluralin fb Mateno Complete	2 L/ha 1 L/ha	1 2	84^{abc}	92^{ab}	83^{abc}
6	Trifluralin + Luximax	2 L/ha 500 mL/ha	1	79^{a-d}	87^{abc}	82^{efg}
7	Trifluralin + Sakura Flow	2 L/ha 210 mL/ha	1	80^{a-d}	94^{a}	94^{ab}
8	Overwatch	1.25 L/ha	1	84^{abc}	85^{abc}	86^{c-f}
9	B Power + Luximax	100 mL/ha 500 mL/ha	1	80^{a-d}	72^{de}	70^{h}
10	Trifluralin fb Prosulfocarb	2 L/ha 2.5 L/ha	1 2	83^{abc}	81^{bcd}	81^{fg}
11	Trifluralin fb Prosulfocarb Colt	2 L/ha 2.5 L/ha 1 L/ha	1 2 2	60^{fg}	93^{a}	89^{a-e}
12	Trifluralin fb Sakura Flow	2 L/ha 210 mL/ha	1 2	57^{g}	86^{abc}	88^{b-f}
13	Boxer Gold	2.5 L/ha	1	40^{h}	67^{e}	77^{gh}
14	Villain	2 L/ha	1	81^{a-d}	91^{ab}	84^{d-g}
15	Sakura Flow Voraxor	210 mL/ha 200 mL/ha	1 1	70^{def}	87^{ab}	90^{a-e}
16	Sakura Flow Terrain Flow	210 mL/ha 125 mL/ha	1 1	72^{c-f}	82^{a-d}	91^{a-d}
17	Product X fb Product X	500 mL/ha 500 mL/ha	1 2	83^{abc}	87^{abc}	92^{abc}
18	Mateno Complete fb Intercept + Hasten	1 L/ha 500 mL/ha 0.5% v/v	2 2 2	62^{efg}	87^{abc}	93^{abc}
19	Sakura Flow Avadex	210 mL/ha 2 L/ha	1 1	90^{a}	93^{a}	96^{a}
			l.s.d	13.3	11.5	8.0
			c.v.	11.4	8.6	5.9
			f-prob	<0.001	<0.001	<0.001

Table 2: Annual ryegrass counts (panicles/m^2) 114 Days After Application (DAA-A) with Abbotts transformation.

Trt No.	Treatment Name	Appl. Rate	Appl. Code	Panicles/ m^2*	Abbotts transformation (% of UTC)
				114 DAA-A 87 DAA-B	
1	Untreated control			128^{a}	0^{f}
2	Trifluralin + Callisto	2 L/ha 200 mL/ha	A A	53^{d-g}	56^{abc}
3	Trifluralin + Voraxor	2 L/ha 200 mL/ha	A A	83^{a-d}	34^{c-f}
4	Trifluralin + Avadex Xtra + Terrain Flow	2 L/ha 3.2 L/ha 125 mL/ha	A A A	75^{b-e}	41^{b-e}
5	Trifluralin fb Mateno Complete	2 L/ha 1 L/ha	A B	34^{fg}	72^{ab}
6	Trifluralin + Luximax	2 L/ha 500 mL/ha	A A	77^{a-e}	39^{b-e}
7	Trifluralin + Sakura Flow	2 L/ha 210 mL/ha	A A	39^{efg}	69^{abc}
8	Overwatch	1.25 L/ha	A	69^{b-f}	43^{a-d}
9	B Power + Luximax	100 mL/ha 500 mL/ha	A A	117^{ab}	8^{ef}
10	Trifluralin fb Prosulfocarb	2 L/ha 2.5 L/ha	A B	61^{c-g}	53^{a-d}
11	Trifluralin fb Prosulfocarb Colt	2 L/ha 2.5 L/ha 1 L/ha	A B B	36^{fg}	73^{ab}
12	Trifluralin fb Sakura Flow	2 L/ha 210 mL/ha	A B	53^{d-g}	59^{abc}
13	Boxer Gold	2.5 L/ha	A	101^{abc}	19^{def}
14	Villain	2 L/ha	A	69^{b-f}	47^{a-d}
15	Sakura Flow Voraxor	210 mL/ha 200 mL/ha	A A	54^{d-g}	56^{abc}
16	Sakura Flow Terrain Flow	210 mL/ha 125 mL/ha	A A	62^{c-g}	52^{a-d}
17	Product X fb Product X	500 mL/ha 500 mL/ha	A B	29^{g}	77^{a}
18	Mateno Complete fb Intercept + Hasten	1 L/ha 500 mL/ha 0.5% v/v	B B B	52^{d-g}	58^{abc}
19	Sakura Flow Avadex	210 mL/ha 2 L/ha	A A	34^{fg}	73^{ab}
			l.s.d	-	34.4
			c.v.	20.3	42.5
			f-prob	0.001	0.001

*Data presented as back transformed means (square root).

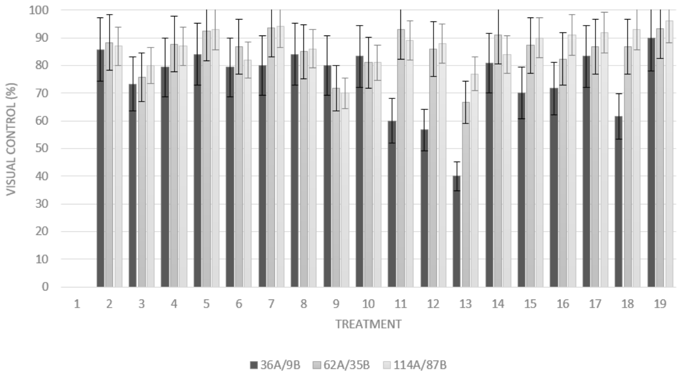

Figure 1: Visual control ratings of annual ryegrass as at 23/06/2022, 19/07/2022 an 09/09/2022. Untreated control = 0%. 23/6 rating was 36 days after IBS and 6 days after post emergent application. 19/7 rating was 62 days after IBS and 35 days after post emergent application. 9/9 rating was 114 days after IBS and 87 days after post emergent application. Error bars show LSD for each rating date.

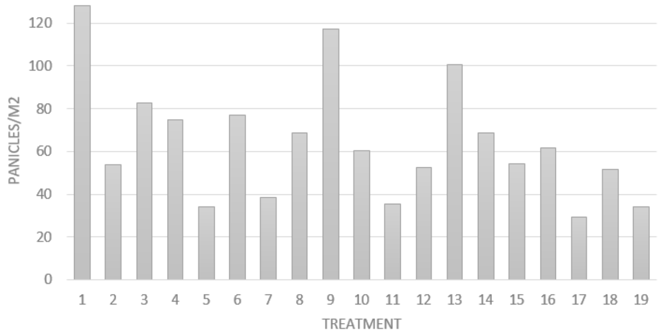

Figure 2: Panicles/m^2 as at 9/9/2022 (114 days after IBS and 87 days after post emergent application).

Comments

It is evident from the above results that premium type pre-emergent chemistry is still the best bet for annual ryegrass control. Tref/Sakura and Avadex/Sakura resulted in excellent overall control of ryegrass at this trial site. The new Mateno Complete applied post-em following Trifluralin IBS was also a very good performer, however, the additional aclonifen did little to improve the control level observed. The value of combined grass and broadleaf products like Mateno Complete is picking up additional broadleaf weed control, however, we saw a very sporadic germination of canola across the site and as such it was not a measured control figure. Another standout performer was Trifluralin, followed by Prosulfocarb and Colt, this treatment is becoming increasingly popular and it was again evident that the EC Diflufenican in Colt improved ryegrass control when added to Prosulfocarb. This treatment is a really solid option for growers looking for a one pass post-em grass and broadleaf strategy.

Disappointingly, at this site Luximax resulted in significant crop effect that led to a lack of competitive crop and resulted in very poor overall weed control. It highlights the fact that this product is not suited to light sandy soil types, as this trial site was, and extreme care needs to be taken when using it. Overwatch also struggled with overall control and showed that it also needs a solid tank mix partner to get the higher level of control we expect. Boxer Gold in solidarity performed very poorly too at this site and was probably due to lack of rain following the pre-emergent application of Boxer Gold allowing the ryegrass to get too big before the chance to control them once it rained and the chemical was washed into the root zone. Interestingly, treatment 18 showed an exceptional result without any pre-emergent chemistry and probably highlighted what foliar activity Aclonifen has on ryegrass. This is an interesting brew and may be a good consideration for a post-em tank mix following amelioration where pre-emergent chemistry can be very risky for crop establishment.

Acknowledgements

Thank you to the Reynolds family for hosting the site and Living Farm for seeding and managing the trial.

Peer review

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Elders Dalwallinu

Assessing the Efficacy of Multiple Pesticide Additives Across In-Crop Spray Applications

Robert Pattison, Sales Agronomist, Spraytec Australia

Key Messages

- Fulltec Max performed equivalently to the industry standard in-crop foliar spray additive Hasten®.
- TOPZinc Max, CUBO, CUBO IR and Absortec offer as phytostimulant alternatives for specific applications.
- Replacing existing pesticide additives recommendations will benefit overall return on investment.
- On-farm practicality, full pesticide compatibility and quality spray performance assist productivity.
- Favourable growing conditions attributed to no significant differences between treatments.
- All treatments were 100% crop safe with no detrimental impact on crop vigour or NDVI.

Aim

- To determine the efficacy of a post-em herbicide application using Velocity® and Spraytec's additives; Fulltec Max, TOPZinc Max, CUBO, CUBO IR and Absortec, in comparison to an industry recommended adjuvant.
- To determine the efficacy of a post-em fungicide application using Prosaro® and Spraytec's additives; Fulltec Max, TOPZinc Max, CUBO, CUBO IR and Absortec, in comparison to an industry recommended adjuvant.

Background

It is well-known that spray adjuvants improve the performance of agricultural chemical applications. However, with over 400 adjuvants currently registered in Australia that incorporate more than 30 different active ingredients, the space is becoming saturated and confusing to producers (Congreve et al., 2019). Producers are seeking alternative options to streamline the operational efficiency, ease their costs, and ultimately improve their productivity. Making use of products that feature low use rates, offer a complete blend of adjuvant characteristics, and allow use all-year-round are just a few notable points to explore that would bring convenience to producers. This trial aims to showcase Spraytec's product range when compared against the industry's staple adjuvant; Hasten®. Assessing differences across 2 application timings; post-em herbicide and post-em fungicide, will provide producers with multiple options to consider within their own operations. Key performance indicators investigated will include weed and disease control, overall yield, and simplicity of use.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	12m x 2m x 3 replications
Soil type	Pale yellow sand
Paddock rotation	2020 wheat, 2021 canola, 2022 wheat
Sowing date	18/05/2022
Sowing rate	80 kg/ha Calibre wheat
Fertiliser	Pre-emergent = K-Till Extra (130 kg/ha), urea (50 kg/ha) Post-emergent = UAN (150 L/ha)
Herbicides & Fungicides	Velocity (Bromoxynil as its mixed heptanoic acid and octanoic acid esters 210 g/L Pyrasulfotole 37.5 g/L) @ 670 mL/ha on, Prosaro (Prothioconazole 210 g/L, Tebuconazole 210 g/L) @ 150 mL/ha on
Harvest date	N/A

Treatment Descriptions

Treatment	Post-em Herbicide Application	Post-em Fungicide Application
1	UTC	UTC
2	Velocity 670 mL/ha	Prosaro 150 mL/ha
3	Velocity 670 mL/ha + Hasten 1%	Prosaro 150 mL/ha + Hasten 1%
4	Velocity 670 mL/ha + Fulltec Max 100 mL/ha	Prosaro 150 mL/ha + Hasten 1%
5	Velocity 670 mL/ha + TOPZinc Max 500 mL/ha	Prosaro 150 mL/ha + Hasten 1%
6	Velocity 670 mL/ha + Hasten 1%	Prosaro 150 mL/ha + Fulltec Max 100 mL/ha
7	Velocity 670 mL/ha + Hasten 1%	Prosaro 150 mL/ha + CUBO 700 mL/ha
8	Velocity 670 mL/ha + Hasten 1%	Prosaro 150 mL/ha + CUBO IR 300 mL/ha
9	Velocity 670 mL/ha + Hasten 1%	Prosaro 150 mL/ha + Absortec 2 L/ha

Results

As a result of low germination, there were no observable treatment differences relating to weed control. Consequently, data was not collected. Ryegrass did become an issue across the entire site upon fresh germination post early-August rainfall. However, as this was well after the period where weed control assessments would have been made, no findings were able to be explored.

There were no significant treatment differences pertaining to disease severity or incidence (Figure 1). This was due to very low disease incidence. Across each plot, 1 metre crop parts were conducted at 3 random locations, with the upper canopy rated for percent leaf area infected with yellow leaf spot; where 0 = no infection, and 100% = total infection. The untreated control (UTC) and Prosaro® with no addition of an additive, demonstrated numerically greater disease incidence than all other treatments. All Spraytec products delivered commercially acceptable levels of control. Out of all treatments that included the addition of an additive (as per industry recommendations), Prosaro® + Fulltec Max was the most cost effective *(see Table 1).*

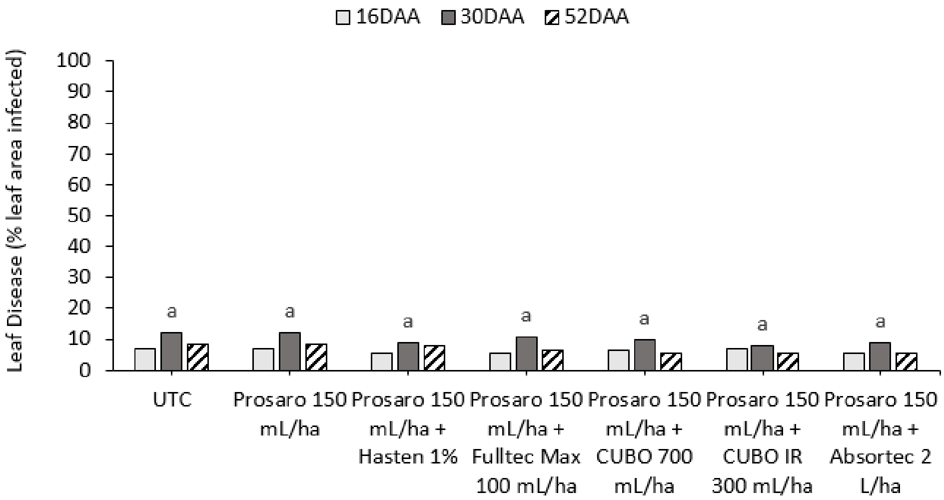

Figure 1: Disease incidence comparison of late post-em fungicide applications with Prosaro®.

Ascertaining crop yield (t/ha) was the final opportunity to explore potential treatment differences *(Figures 2 & 3).* Although there was a numerical difference between the UTC and all treatments, no significant differences were found between any of the treatments. The best performing Spraytec treatment was the early post-em application of Velocity® + TOPZinc Max which achieved a yield of 4.09 t/ha. Out of all treatments in combination with an additive, Velocity® + Fulltec Max was the most cost effective *(see Table 1)* and delivered a yield of 4.02 t/ha (Figure 1).

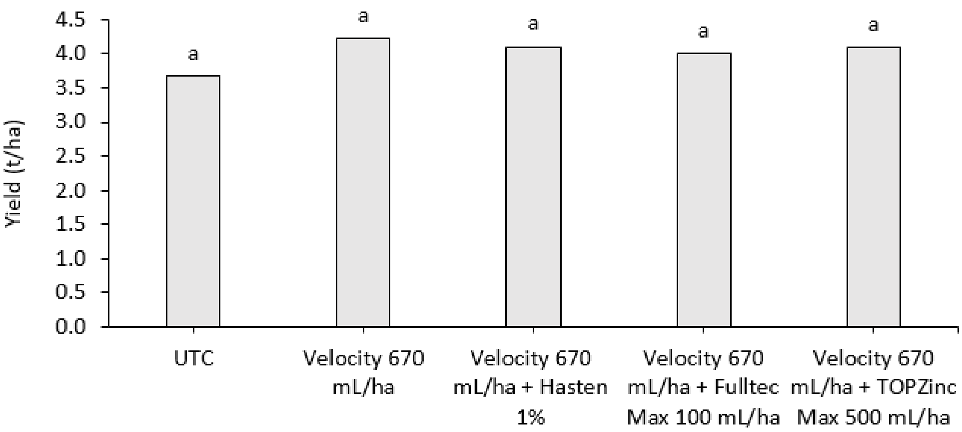

Figure 2: Crop yield comparison of early post-em fungicide applications with Velocity®.

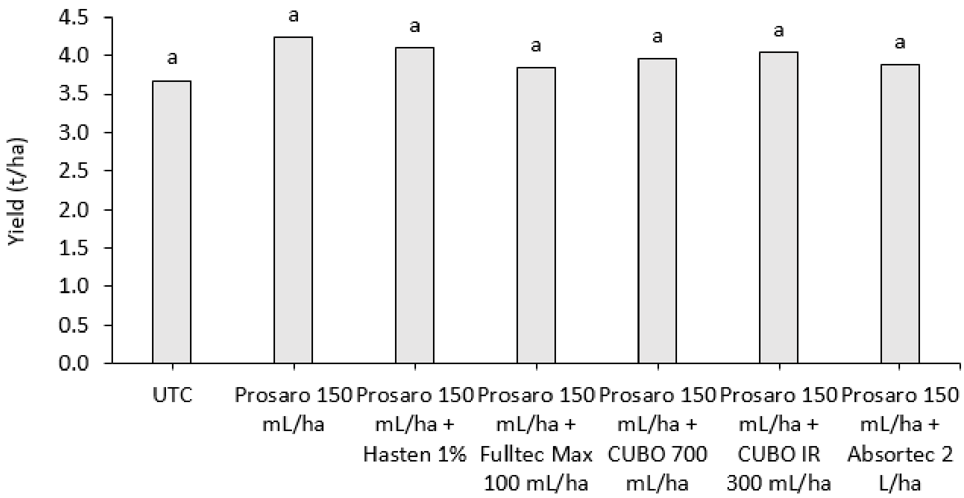

Figure 3: Crop yield comparison of late post-em fungicide applications with Prosaro®.

All treatments were assessed as being 100% crop safe with no detrimental impact on crop vigour or normalised difference vegetation index (NDVI).

All data analysis in this trial was conducted using Agriculture Research Manager (ARM). Significant difference was represented by letters assigned to each treatment mean. As all letters were the same, this indicated significance was not detected at 95% confidence.

Comments

With industry predictions for WA's harvest set to reach an incredible 24.7 million tonnes, it was little surprise to note equivalent yields across all treatments in this trial. Favourable rainfall and growing conditions ensured that all plots were given the best opportunity to maximise their yield potential. A lack of weed presence across plots reduced competition, whilst disease incidence was also very low, reflective of the Dalwallinu area which is not known to have profound disease issues. Nutritional issues were also not a factor across the site, which meant that the chelated compounds present in Spraytec products were not as vital for improved uptake or translocation. Additionally, there were no macro- or micro-nutrient responses with the soil being well-managed previously.

Despite no significant treatment differences in pest control and yield, this trial highlights the durability of Fulltec Max. Producers will be confident Fulltec Max is able to be used across in-crop foliar spray applications, as it demonstrated 100% compatibility with two of the most common pesticides in Velocity® and Prosaro®. Offering as the most cost-effective additive in this trial, Fulltec Max also showcased its ability to match the quality of the industry's staple adjuvant Hasten®. This is significant when comparing total cost, volume and ease of use between the two products. A rate comparison and approximate cost analysis is derived on the following page.

Table 1: Treatment comparisons and cost analysis for in-crop foliar spray considerations.

Product	Type	Application Timing	Rate	L/1000ha	Cost/L ($)	Cost/ha ($)
Fulltec Max	Hybrid	All-Year	0.1 L/ha	100	$33.50	$3.35
TOPZinc Max	Phytostimulant	Early Post-Em	0.5 L/ha	500	$17.00	$8.50
CUBO	Phytostimulant	Late Post-Em	0.7 L/ha	700	$13.00	$9.10
CUBO IR	Phytostimulant	Late Post-Em	0.3 L/ha	300	$30.00	$9.00
Absortec	Phytostimulant	Late Post-Em	2 L/ha	2000	$9.50	$19.00
Hasten®	Oil	-	1 %v/v	1000	$6.00	$6.00

Note: Hasten® costs are estimated according to current market averages.

To further this in-crop performance, Fulltec Max is also suited to summer and knockdown spray applications due to its complete application technology package that is complemented by chelated nutrients and phosphites. This patented formulation allows Fulltec Max to act as a spike in herbicide applications, ensuring herbicide molecules utilise the chelates and phosphites as carriers directly into target weeds; improving uptake, translocation and ultimately burndown. Incorporating such dynamism provides producers with the option of utilising only one additive across the entire year for the entire spray program, as opposed to stocking multiple additives that serve different purposes and suit specific applications.

The performance of TOPZinc Max, CUBO, CUBO IR and Absortec were reflective of the favourable growing conditions experienced this year. Subtle differences in trace element inclusion on top of effective application technology were not as vital for improved crop uptake and translocation. In more challenging conditions these products may have showcased their full potential in maximising crop productivity and profitability.

Agriculture trials vary depending on location and environmental conditions, so please take this into consideration. If you are interested in exploring more of our trials where greater variability and treatment differences were present, they are all available on our website spraytecaustralia.com.au.

Acknowledgements
Special thanks to the Reynolds Family, for offering the site to the Liebe Group and to Living Farm for facilitating the trial. We are also very appreciative of the Liebe Group for taking us on as a Silver Sponsor this year; our first. We look forward to supporting the group going forward and developing the relationship.

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Peer Review
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Tenet 500SC for Post-Emergence Grass Control in Canola

Bevan Addison, Market Development Manager WA, Adama

Key Messages

- Tenet® 500SC (Metazachlor 500 g/L) was recently registered for early post-em application in Canola.
- The label rate is 750 mL/ha and is currently registered for mixing with Clethodim and Hasten spray oil.
- It can be tank mixed with other herbicides such as grass selectives, triazines, imidazolinones and some of the glyphosates used in the glyphosate tolerant systems. More validation work is underway for label extension with these products.
- This trial is in a RR/TF and CL crops so covers both key productions systems.

Aim

This trial is designed to showcase the stand alone weed control of Tenet 500SC when applied early post-em in canola as well as the control achieved in mixtures with key herbicides used in either of the RR/TF or CL canola systems.
Observations on crop tolerance in mixtures will also be made.

Background

Metazachlor has been registered for pre-sowing use in canola for a few years but has not been widely adopted. This year was the first year of registration of early post emergence use in all types of canola. Tenet is primarily a root and shoot absorbed product but is relatively soluble compared to many other options. This can enable a post-em use pattern which can enhance the weed control performance when mixed with products such as Platinum Xtra, Atrazine or Intervix. It can also provide some more short-term residual to help control and suppress weeds which may germinate shortly after application of a non-residual product.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	The trial was sprayed as a 3 replicate randomised block design with replicates triple banked. Unfortunately, replicate 3 was over sprayed so only 2 reps were useful. While we were able to run the results through the ARM statistics programm, this reduced replication will have compromised the statistical outcomes. Due to this loss of a replicate, we did not take this trial through to harvest
Soil type	Sandy Loam
Paddock rotation	2020 Wheat, 2021 Wheat
Sowing date	18/04/2022
Sowing rate	2.2 kg/ha Battalion XC Canola
Fertiliser	As per farmer practice.
Herbicides, Insecticides & Fungicides	20/05/2022, 11:40am – 12:20pm. Treatments applied using a handboom at 80 L/ha water rate through Airmix AI001 nozzles. Good spray conditions with soil moisture at 5cm and delta T of 6. No pre sowing herbicides had been applied and the crop was treated with chlorpyriphos at 500 mL pre sowing and was sprayed with a Trojan + Chlorpyriphos treatment on 20 September by air. Annual ryegrass 2L to early tillered, Majority 4L-early tillering.
Harvest date	23/10/2022

Treatments

	Treatment
1	UTC
2	Platinum Xtra 360 330 mL/ha+ Hasten 1%
3	Roundup ready Plantshield 900 g/ha
4	Intervix 750 mL/ha + Hasten 1%
5	Tenet 750 mL/ha + Hasten 1%
6	RR Plantshield 900 g/ha + Platinum Xtra 360 330 mL/ha + Hasten 1%
7	RR Plantshield 900 g/ha + Tenet 750 mL/ha + Hasten 1%
8	RR Plantshield 900 g/ha + Tenet 750 mL/ha + Platinum Xtra 360 330 mL/ha + Hasten 1%
9	Intervix 750 mL/ha + Platinum Xtra 360 330 mL/ha + Hasten 1%
10	Intervix 750 mL/ha + Tenet 750 mL/ha + Hasten 1%
11	Intervix 750 mL/ha + Tenet 750 mL/ha + Platinum Xtra 360 330 mL/ha + Hasten 1%
12	Tenet 750 mL/ha + Platinum Xtra 360 330 mL/ha + Hasten 1%

Tenet – Metazachlor 500 g/L
Platinum Xtra –Clethodim 360 g/L
Roundup Ready herbicide with Plantshield – Glyphosate 690 g/kg as Mono ammonium Salt
Intervix - Imazamox 33 g/L + Imazapyr 13 g/L

Observations
Visual observation of crop phytotoxicity and weed control were undertaken at 11, 48 and 125 days after application.

Results
Crop establishment was somewhat patchy due to seasonal factors and crop and weeds were variable sizes, with many beyond the target window when sprayed. Despite this the herbicide treatments have worked well and there were clear visual differences between treatments.
Brome grass was present in the trial however was very patchy so could not be accurately assessed.

At no stage were there any crop effects caused by any of the treatments.

After 48 days, all treatments provided significantly improved ryegrass control when compared to UTC. Platinum Xtra applied at the highest label rate for canola (330 mL/ha) gave a somewhat disappointing 67.5% control after 48 days. This is probably representative of many situations in the region where Clethodim efficacy is starting to wane due to resistance build up after a long history of use.

Roundup Ready Plantshield was the fastest acting product and provided 77.5% control of annual ryegrass after 48 days, which was slightly concerning given the rates applied and the weed size at application. The addition of Tenet, Platinum Xtra, or a combination of both to the Roundup Ready treatment resulted in a significant increase in control to 90% or greater.

Stand-alone Tenet at 750 mL/ha performed relatively well in this trial providing 67.5% control of ryegrass. While this may not seem a high level of control, this is about as much as could be expected from this herbicide as a stand-alone post emergent application. Tenet provided the same level of control as Platinum Xtra 360 at 330 mL/ha.

The treatments involving Intervix provided a lower level of control than the Roundup based treatments, but this is to be expected as Intervix is never considered as a perfect ryegrass control product. Addition of Tenet to Intervix gave a significant improvement in control as did the addition of Platinum Xtra.

The trends seen at 48 days after application continued through to the final visual assessment at 125 days after application. This was close to the timing for swathing and or desiccation of the canola. By the end of the season the Platinum Xtra and Intervix treatments were significantly improved by the addition of Tenet.

Addition of Tenet to Platinum Xtra improved control by 25% compared to Platinum Xtra alone. Adding Tenet at 750mL to Intervix resulted in 32.5% improvement in ryegrass control and taking very average looking treatments to an acceptable level of control.

Roundup Ready plots already had a higher level of control, and the addition of Tenet gave a visual but non-significant improvement of 15%. Roundup Ready Plantshield + Tenet gave the highest level of ryegrass control at 95%.

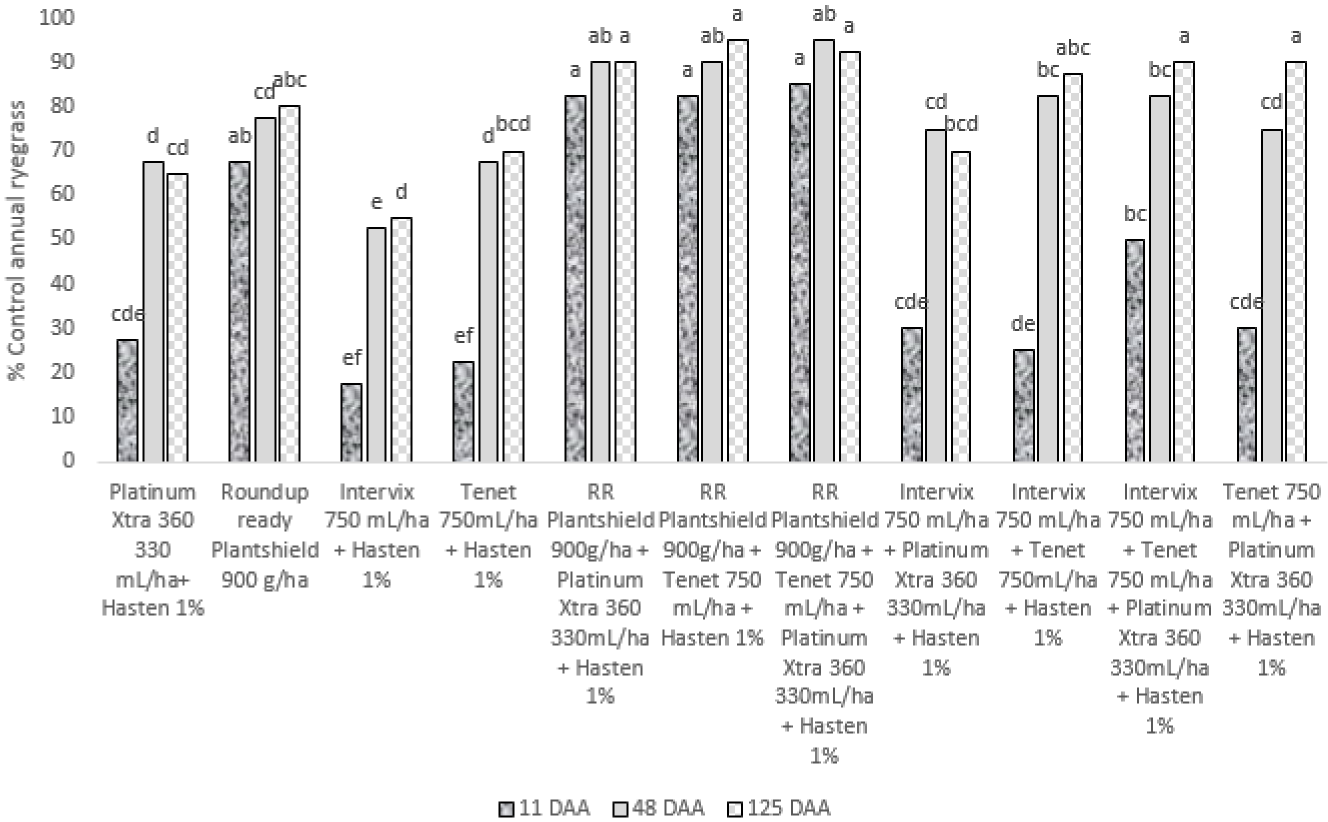

Figure 1: Annual ryegrass % control 11, 48 and 125 days after application.

Comments

Tenet provides a level of control when applied stand-alone but is a far better option as a mixing partner with other in crop herbicide options.

Addition of Tenet to Roundup ready or Intervix herbicides can provide a similar level of control Tenet can provide a similar level of control to the addition of clethodim, especially if ryegrass is developing resistance to clethodim.

It was not an issue in this instance but in non-wetting soils and high rainfall zones, the addition of the residual product Tenet in an early spray window has helped reduce the weed burden associated with second germinations which can often occur with rainfall just post spraying the early in crop herbicides.

Use on small weeds early in the crop is essential for best results before weeds get too big, canopy cover prevents the product from hitting the ground where you need it to be for maximum performance.

Being primarily root absorbed, best results occur with some rain post spraying to wash into the root zone of the weeds.

Peer Review

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Control of Annual Ryegrass in Wheat Using Different Formulations of Overwatch Herbicide Applied Alone or in a Two-Way Tank Mix

Stephen Pettenon, Senior Technical Extension Specialist, FMC Australia

Key Messages

- Tank mix combinations of Overwatch® Herbicide with a range of different herbicide modes of action (MOA) was additive and significantly improved final weed control, with no reduction in plant counts or crop vigour in this trial.
- An unplanned speed tiller treatment prior to seeding resulted in lower-than-expected weed control as it buried some Annual Ryegrass (ARG) seed beneath the soil surface where the herbicide was applied.
- No differences in crop safety or ARG control was observed between the current suspension concentrate (SC) formulation and a newly developed water dispersible granule (WG) formulation of Overwatch® Herbicide when applied IBS in wheat.

Objective

Demonstrate how Overwatch® Herbicide performs against other widely used tank mixtures in a commercially sown wheat crop when applied IBS either alone or in combination with tank mix partners by measuring crop establishment, crop vigour and ARG weed control.

Background

Overwatch® is a unique group 13 MOA (formerly Q) herbicide that controls a wide range of grass and broadleaf weeds in wheat, barley, canola, field peas and faba beans. It is the only MOA of this type that is applied at crop establishment and incorporated by seeding, so it is a welcome alternative to cropping systems heavily reliant on pre-emergent herbicides. The active in Overwatch® Herbicide, branded Isoflex® inhibits the enzyme deoxy-d-xylulose phosphate synthase which results in lower carotenoid levels in plant tissue and results in subsequent cell damage by sunlight.

FMC demonstrated Overwatch® Herbicide in a commercially sown wheat crop at the Liebe Latham site (Dylan Hirsch) in 2020. In what was a very dry season, final reduction in ARG spikes/m^2 (10 WAA) compared to the untreated control across three replicates for Overwatch®, Sakura#, Boxer Gold#, Luximax# and trifluralin treatments averaged 85, 89, 86, 89 and 86 percent, respectively. The addition of trifluralin, triallate, pyroxasulfone and s-metolachlor to Overwatch® increased ARG control from 85 percent to 91, 91, 94 and 91 percent, respectively.

FMC has recently registered an additional water dispersible granule formulation of bixlozone for end users who prefer to handle granulated product. The commercial launch of Overwatch® eXL Granules is scheduled for 2024. This trial compared both Overwatch® Herbicide formulations side-by-side and demonstrated the benefits of tank-mixing and using multiple MOA's in managing ARG in intensive cropping rotations.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	2 m x 10 m Randomised Complete Block – 4 replicates
Soil type **Soil Amelioration**	Sand Speed Tiller Jan 2022 undertaken to manage canola stubble
Paddock rotation	2020: Wheat, 2021: Canola
Sowing date	27/05/2022
Sowing rate	90 kg/ha Vixen using DBS FPPW
Fertiliser **Application** **Spray Equipment**	90 kg/ha K-Till at seeding 27/05/2022, 2-3 pm, Cloud cover – 5%, Temp 22C , RH% - 46, Delta T(C) 6.5, Wind 17 kph, ENE, Moist Soil 34.8mm rain over 12 days prior. Hand boom, 110-015 Agrotop Flat Fan Air Induction, 2.2Bar, 100 L/ha – Coarse quality

FMC Trial 02HWA22 - Treatment Summary

Trt No.	IBS Treatment Description and Rate / Hectare	
1	Untreated Control	
2	Overwatch® SC	1250mL
3	Overwatch® eXL Granules	670g
4	Overwatch® SC + TriflurX®	1250mL + 2000mL
5	Overwatch® eXL Granules + TriflurX#	670g + 2000mL
6	Overwatch® eXL Granules + Avadex # Xtra	670g + 2000mL
7	Overwatch® eXL Granules + Voraxor#	670g + 200mL
8	Overwatch® eXL Granules + Coded	670g + n/a
9.	Overwatch® eXL Granules + Sakura#	670g + 118g
10	Sakura# + TriflurX#	118g + 2000mL
11	Luximax# EC + TriflurX#	500mL + 2000mL
12	Mateno# Complete + TriflurX#	1000mL + 2000mL
13	Overwatch® eXL Granules + TriflurX# + Callisto#	1250mL + 2000mL + 200mL

Results

Crop emergence counts across the treatments ranged from 33 to 39 wheat plants per metre row at four weeks after application (WAA). No statistical differences between treatments across four replicates was observed *(Data not presented).*

Crop bleaching was not seen at this site at 4 and 6 WAA for almost all treatments. The only exception was low levels of bleaching (14 percent) from a tank mix of Overwatch® eXL Granules with TriflurX# and Callisto# (Trt 13). This was observed at 4 WAA but not at the later assessment. No treatment related difference in crop vigour was observed *(Data not presented)*.

ARG control expressed as a percentage reduction versus the UTC is presented for plant numbers at 6 WAA and spike numbers at 14 WAA (Figure 1).

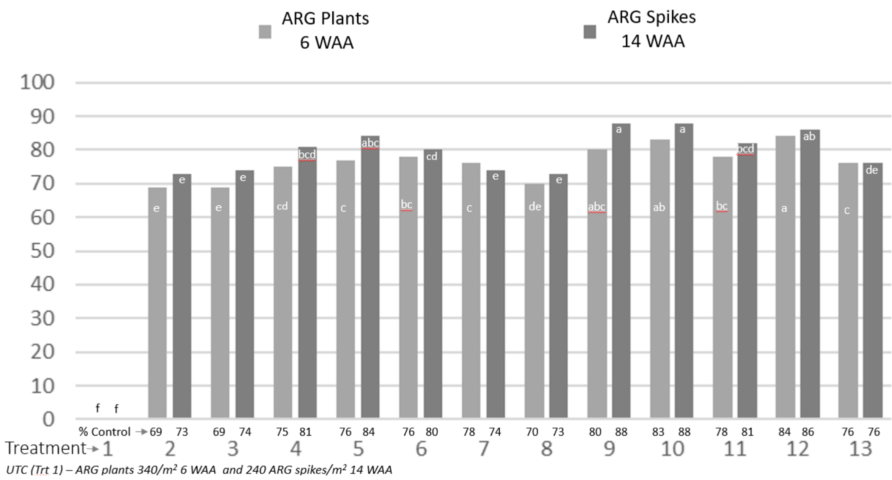

Figure 1: Percentage (%) reduction in annual ryegrass vs untreated control.
Nb – When comparing like assessment data at 6 WAA and 14 WAA, treatments that contain a common letter are considered statistically equivalent across the 4 replicates at a confidence limit of 95% (P < 0.05). Treatments with a different letter however, are considered statistically different.

Overwatch® Herbicide (Trt 2) and Overwatch® eXL Granules (Trt 3) provided equivalent levels of ARG control at both assessments.

The addition of TriflurX# (Trt 5), Avadex# Xtra (Trt 6), Voraxor# (Trt 7) and Sakura# (Trt 9) to Overwatch® eXL Granules (Trt 3) significantly enhanced (P <0.05) ARG control at **6 WAA** from 69 percent to 76, 78, 76 and 83 percent, respectively. All these tank mixes provided statistically similar levels of control.

The addition of TriflurX# (Trt 5), Avadex# Xtra (Trt 6), and Sakura# (Trt 9) to Overwatch® eXL Granules (Trt 3), significantly improved ARG ($P < 0.05$) control at **14 WAA** from 74 percent to 84, 80, and 88 percent, respectively. These tank-mixtures were statistically matched by Sakura# (Trt 10) and Mateno# Complete (Trt 12), with TriflurX#, which resulted in 88 and 87 percent control, respectively. Overwatch® plus Voraxor# (Trt7) and Overwatch® plus Coded (Trt 8) gave statistically lower levels of weed control compared to other tank-mix partners.

Comments

The level of weed control achieved by both Overwatch® Herbicide formulations at this site was about 10 percent lower than what one would expect of the product. Weed control for IBS products is highly dependent on the herbicide coming into contact with the weed seed. The speed tiller amelioration treatment that the site had would have redistributed seed located on or near the surface throughout the tillered profile. This resulted in reduced direct seed contact with the herbicide spray. Another possibility is that the speed tiller caused more ARG to germinate from a zone in the soil profile where no herbicide was present. Growers and advisers need to be aware of these factors and plan for a combination of herbicide approaches like using an EPE herbicide in such situations.

Soils with certain ameliorated treatments can be prone to more herbicide damage. This is due to a change in the soil profile such as relocating organic matter, loosening the soil or bringing up a soil zone that may be more toxic to plants. Less chemical binding, increased risk of furrow fill or chemical movement into fragile furrows can all lead to a higher herbicide dose and subsequent crop damage. These factors are listed because they are possible where soil amelioration is undertaken to address yield limiting constraints.

These trial results again demonstrate the benefits of combining different modes of action together. Certain tank mixes were found to give ARG control in the 80 to 88 percent range in this trial. Although it was somewhat lower than the 91 percent plus level of control observed in the 2020 Latham trial, the use of tank mixes have other benefits like - a higher level of confidence under difficult dry seeding situations, better control in high weed burdens, broader spectrum weed control and the ability to address weed control in high stubble situations.

Improved ARG efficacy from tank mixes is typically an additive effect in most situations as more herbicide results in better weed control. Another significant upside of tank mixing herbicides at full label rates, is that it seriously delays the onset of herbicide resistance, especially when used in conjunction with the other integrated weed management practices.

Acknowledgements

Thanks to Liebe Group for the opportunity to participate in the 2022 extension program, and the SLR team for establishing the trial and data collection, and to Sam Reynolds for providing access to his property to conduct and deliver this study.

Peer Review

Nick McKenna, Planfarm Consultant.

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Use of Callisto in Broadleaf Weed Management Programs

Owen Langley, Broadacre Development Lead, Syngenta

Key Messages

- Traditional post-emergent management of broadleaf weeds in cereals is challenged by resistance and reliance on many factors lining up at time of application for success.
- CALLISTO was released in 2020 as the first new pre-em herbicide for control of BLW, however has since been joined by a range of other products, both IBS and EPE, offering similar advantages.
- Understanding each solutions strengths, weaknesses and their main keys to success are critical to ensure the best possible weed control outcome.

Aim

This trial is aimed to compare the efficacy of various IBS and EPE options on a range of broadleaf weeds and volunteers at different timings and weed stages. But also show how CALLISTO® can be used in combination with other products and modes of actions to provide cost effective, robust, broad spectrum and sustainable weed management.

Background

For many years' broadleaf weed management in cereals has relied heavily on post-emergent herbicides mainly consisting of diflufenican, MCPA, bromoxynil and more recently pyrasulfotole. The efficacy of these products is being challenged by the continued development of herbicide resistance, but also the logistical challenges now faced by growers of applying them in at the optimal timing to maximise results.
The recent introduction of pre-emergent herbicides such as CALLISTO® has assisted in alleviating some of these issues, however they too come with their own constraints and limitations.
Understanding the different products limitations and strengths will give growers confidence to incorporate them into their integrated weed management systems knowing their investment in newer crop solutions can result in improved weed control results and a positive ROI.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	10m x 3m x 3 replications
Soil type	Sandy Loam
Paddock rotation	2021 canola, 2020 wheat
Sowing date	18th May 2022
Sowing rate	80 kg/ha Calibre Wheat
Fertiliser	TBA
Herbicides, Insecticides & Fungicides	All treatments had Trifluralin 2500ml IBS. Other herbicide applications as per treatment list below
Harvest date	N/A

Jurien Lupins and Hyola 540XC were top-dressed over the site pre-sowing to demonstrate volunteer control

Treatments

	Treatment
1	Untreated
2	Callisto 200ml IBS
3	Voraxor 200ml IBS
4	Callisto 200ml IBS fb Condor 1000ml GS14
5	Callisto 200ml IBS fb Quadrant 800ml GS14
6	Mateno Complete 1000ml GS14
7	Callisto 200ml IBS fb Boxer Gold 2500ml + Quadrant 1000ml GS14
8	Mateno Complete 1000ml GS22
9	Callisto 200ml IBS fb Boxer Gold 2500ml + Quadrant 1000ml GS22
10	Boxer Gold 2500ml GS14
11	Boxer Gold 3000ml GS14
12	SYN EVO 3000ml GS14
13	Callisto 200ml IBS fb SYN EVO 3000ml GS14

Results

Unfortunately, due to a large amount of variation and inconsistency with the introduced broadleaf pressure to the site, there was no usable data extracted for broadleaf weed control.

There were however some interesting observations when it came to ryegrass control from the various treatments. Figure 1 below shows both the annual ryegrass control in the bars and the panicle counts in the line at the site. The annual ryegrass counts were completed 114 days after the pre-emergents were applied, and 78 days after the post-emergent treatments. The panicle counts were completed at the same time. The post-em treatments of Boxer Gold, Mateno Complete and SYN EVO (prosulfocarb plus diflufenican) provided statistically better ryegrass control than standalone pre-emergent treatments. There was also a trend towards better panicle control, reducing overall weed burden. This is another example of the value delayed post-emergent herbicides can add when conditions are conducive to their performance. Even the lower cost options per ha (such as Boxer Gold at $25/ha) when applied in good conditions on optimal weed size can provide an excellent ROI compared to more premium products.

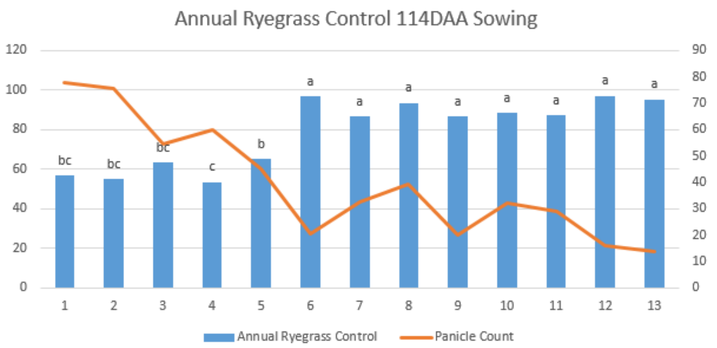

Figure 1. Annual Ryegrass Control and Panicle Counts. Treflan 2.5L treatment (1) had 18 plants/m^2 .

Acknowledgements

Living Farm for sowing and managing the trial
The Reynolds Family for use of their property to conduct the trial
Liebe Group and their members for the opportunity to participate in their 2022 program

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Efficacy and Safety of Nufarm Newly Developed Herbicide Unity + Maya Tank Mix and Galaxy on Controlling Broadleaf Weeds in Cereals

Rex Cao, Field Development Officer, Nufarm

Key Messages
- Galaxy demonstrated an equivalent crop safety and efficacy on volunteer canola comparing to Velocity.
- Galaxy demonstrated a good flexibility, allowing growers to tailor their own mix partner ratio.
- Maya resulted in less crop phytotoxicity than Brom EC when mixed with Unity (carfentrazone).
- Unity + Maya resulted in robust weed control, providing an alternative option for early spray.

Aim
Demonstrate the safety and efficacy of Nufarm newly developed herbicide Galaxy (75 g/L pyrasulfotole) and Maya (400 g/L bromoxynil).

Background
Nufarm has developed two new herbicide solutions to address resistant broadleaf weeds to group 2, 4 and 12 herbicides. Galaxy is a standalone pyrasulfotole formulation (75 g/L pyrasulfotole) that offers outstanding weed control; gives growers the flexibility to customize and tailor their own tank mix ratios, allowing them to create a mix that suits their specific needs. Unity + Maya is a new combination (Group 14 + 6) that targets hard-to-kill radish, including phenoxy-resistant populations. Unity is an emulsifiable water formulation containing carfentrazone. It is a Group 14 herbicide which has no known resistance in Australia and is a robust molecule for resistance management. However, it is very harsh on cereals, so it has rarely been used in tank mixes with EC formulations like Bromicide 200 (Group 6) in the past. To address this crop safety issue, Nufarm introduced a novel bromoxynil SC formulation called Maya, which contains 400 g/L bromoxynil. When used in a tank mix with Unity, Maya delivers equivalent efficacy and significantly improves crop safety compared to traditional bromoxynil EC formulations.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	9m x 3m x 4 replications
Soil type	Sandy Loam
Paddock rotation	2021 canola, 2022 wheat
Sowing date	30/05/2022
Sowing rate	85 kg/ha Vixen wheat
Fertiliser	80 kg/ha K-till + 40 L/ha Flexi N
Herbicides, Insecticides & Fungicides	118 g/Ha Sakura and 1.5 L/ha Treflan at IBS
Harvest date	N/A

Treatments

	Treatment
1	Untreated control
2	Velocity 1000 mL/ha + CanDo adjuvant 0.5 % v/v
3	Galaxy 670 mL/ha + Bromicide 1050 mL/ha + CanDo adjuvant 0.5 % v/v
4	Galaxy 670 mL/ha + Bromicide 1250 mL/ha + CanDo adjuvant 0.5 % v/v
5	Flight 720 mL/ha
6	Galaxy 670 mL/ha + Bromicide MA 1250 mL/ha + CanDo adjuvant 0.5 % v/v
7	Galaxy 1340 mL/ha + Bromicide MA 2500 mL/ha + CanDo adjuvant 0.5 % v/v
8	Unity 100 mL/ha + Bromicide 1000 mL/ha
9	Unity 100 mL/ha + Maya 500 mL/ha
10	Velocity 670 mL/ha + CanDo adjuvant 0.5 % v/v
11	Unity 100 mL/ha + Agritone 330 mL/ha
12	Unity 100 mL/ha + Maya 500 mL/ha + Agritone 330 mL/ha

Table 1. Details of products uesd in this trial to assess efficacy and safety on broadleaf weeds in cererals.

No.	Product	Active ingredient	Concentration g/L
1	Bromicide 200	Bromoxynil	200
2	Maya	Bromoxynil	400
3	NUL3605	Pyrasulfotole	150
4	Unity	Cafentrazone	240
5	Velocity	Bromoxynil & Pyrasulfotole	210 & 37.5
6	CanDo	Ethylated seed oil	500
7	Agritone	MCPA amine	750
8	Flight	Picolinafen, bromoxynil and MCPA ester	35, 150 and 350

Results

Table 2. Crop safety assessment.

Treatment	Crop Biomass			Phytotoxicity		
	1 WAA	2 WAA	8 WAA	1 WAA	2 WAA	8 WAA
1	100^{a}	100^{a}	100	0^{e}	0^{d}	0
2	100^{a}	100^{a}	100	0^{e}	0^{d}	0
3	100^{a}	100^{a}	100	0^{e}	0^{d}	0
4	100^{a}	100^{a}	100	0^{e}	0^{d}	0
5	100^{a}	100^{a}	100	8^{c}	6^{b}	0
6	100^{a}	100^{a}	100	0^{e}	0^{d}	0
7	100^{a}	100^{a}	100	0^{e}	0^{d}	0
8	90^{b}	95^{b}	100	20^{a}	17^{a}	0
9	100^{a}	100^{a}	100	10^{b}	5^{b}	0
10	100^{a}	100^{a}	100	0^{e}	0^{d}	0
11	100^{a}	100^{a}	100	5^{d}	3^{c}	0
12	100^{a}	100^{a}	100	10^{b}	5^{b}	0

Table 3. Efficacy on volunteer canola.

Treatment	Visual Control		Survivors/plot
	1 WAA	2 WAA	8 WAA
1	0	0	7
2	95^{abc}	100^{a}	0
3	97^{ab}	100^{a}	0
4	94^{abc}	100^{a}	0
5	89^{bc}	98^{ab}	0
6	89^{bc}	100^{a}	0
7	99^{a}	100^{a}	0
8	100^{a}	100^{a}	0
9	97^{ab}	94^{b}	0
10	82^{c}	96^{b}	0
11	56^{d}	91^{c}	1
12	95^{ab}	97^{b}	0

Comments

The main fit of these products is resistant wild radish in WA. However, as there was no wild radish in the main site, the target broadleaf weed in this trial was volunteer canola instead. All treatments resulted in complete control at 8 weeks after application (WAA), except for treatment 11 (Carfentrazone + MCPA amine, Table 3). This was expected that because MCPA amine is not as strong as bromoxynil on broadleaf weeds. This mix is often used due to crop safety concern of carfentrazone in post-em. This treatment in this trial indeed showed a good safety profile. However, from the efficacy angle, this mix was not very robust. Volunteer canola is known to be easy to kill, but treatment 11 could not achieve 100 % control. By contrast, treatment 8, a combination of Unity and Bromicide 200 killed all canola but resulted in significant crop damage and reduced vigour (Table 2).

The solvent in Bromicide 200 also caused additional stress to the crops and resulted in unacceptable crop damage of 20% at 1 WAA. The winter season had favourable rainfall, which helped the crops recover over the next eight weeks. Unity + Bromicide 200 did not show significant biomass reduction compared to the untreated control at the final assessment (Table 2). However, if the cropping season is not ideal, such as during a drought or frost event, this crop damage could result in a permanent yield loss. When we replaced the new SC formulation Maya with Bromicide 200 (Treatment 9), the crop bleaching was significantly reduced to 10% (Table 2). Additionally, there was no noticeable reduction in biomass compared to the untreated control at all assessments.

The addition of Agritone (treatment 12) also demonstrated a good safety profile and did not cause additional crop damage (Table 2). This shows that Maya is safer to mix with Unity when applied to wheat at the same active constituent amount. Both Unity + Maya and Unity + Brom EC effectively and quickly browned out and controlled the target weed, volunteer canola, which is resistant to glyphosate and imidazolinone herbicides (Table 3). Both treatments resulted in 100% control at the final assessment. As the Unity + Maya mix was very effective.

The tank mixes containing the herbicide Galaxy demonstrated similar safety and efficacy against Velocity at both the 1X and 2X recommended rates (Table 2). In terms of safety, Galaxy performed similarly to Velocity, and was slightly safer than Flight at early timings due to the presence of picolinafen in Flight, which can cause leaf bleaching. One key differentiation between Galaxy and other pyrasulfotole products is flexibility. With Galaxy, growers have the flexibility to adjust the ratio and rates of pyrasulfotole, MCPA, and bromoxynil to suit specific situations. The recommended rate range for Galaxy is between 250 to 670 mL/ha (18.75 to 50 g pyrasulfotole).

Acknowledgements

Many thanks for Liebe Group and Sam Reynolds to help on site selection.

Peer review

Tristan Clarke, Elders Dalwallinu.

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Nufarm

The Opportunity Cost of Herbicide Residue Effects Across Crop Types (IMI Residue Trial)

Chris O'Callaghan, Liebe Group

Key Messages

- After two seasons this research has been discontinued.
- There has been no conclusive data generated from this trial work that can reliably inform grower decision making on this topic.
- Further investigation is required.

Aim

To compare the potential yield penalty incurred due to herbicide residues in comparison to the yield penalty inherent in growing a herbicide-resistant variety.

Background

Herbicides that have long carry over residues can often limit cropping options, investigating the potential yield lost is important for growers to understand when planning crop rotations for the long term. This trial has been developed by the Liebe Group R&D Committee and internally funded by the Liebe Group.

Ten herbicides were applied in the previous year (2021) immediately following harvest on the 13th December. In 2022 seven different strips of various crops including canola, wheat, barley and lupins were sown over the herbicide residues, including both standard and IMIdazolinones (IMI) tolerant varieties.

Results may differ significantly at sites with different soil profiles, as residual herbicides are broken down through a number mechanisms in the soil and, as such different soil profiles will influence how each residue is broken down.

IMI chemistry such as Intercept, Sentry and Claw are all broken down primarily through microbial activity and as such higher rainfall years where the soil has greater microbial activity will result in shorter residual activity and vice versa in dry years. Sulfonurea (SU) chemistry such as Associate and Monza are broken down through hydrolysis (chemical reaction of the interaction of chemical with water) and as such higher pH soils will result in prolonged residual activity.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling			
Plot size & replication	2.5m x 5m x 3 replications			
Soil type	Sandy loam			
Paddock rotation	2020: Wheat	2021: Wheat		
Sowing date	19/05/2021			
	Wheat	Barley	Lupins	Canola
Sowing rate	70	80	100	3.5 kg/ha
Fertiliser	100 kg/ha Urea 130 kg/ha MacroPro Extra	100 kg/ha Urea 130 kg/ha MacroPro Extra	130 kg/ha MacroPro Extra	100 kg/ha Urea 130 kg/ha MacroPro Extra

Treatments

Herbicides

T#	Product	Active	Rate (g or ml)/ha
1	Untreated		
2	Intercept	Imazamox + Imazapyr	375
3	Intercept		750
4	Sentry	Imazapic + Imazapyr	20
5	Sentry		40
6	Claw	Imazamox	45
7	Associate	Metsulfuron	5
8	Monza	Sulfosulfuron	30
9	Brodal	Diflufenican	200
10	Saracen	Florasulam	100
11	Callisto	Mesotrione	200
12	Voraxor	Saflufenacil + Trifludimoxazin	200

Crop and Variety

Crops Sown 19th May 2022:

Crop	Variety	Rate (kg/ha)
Wheat 1	Hammer	70
Wheat 2	Scepter	70
Barley 1	Maximus	80
Barley 2	Buff	80
Lupin	Jurien	100
Canola 1	Hyola Garrison XC	3.5
Canola 2	Pioneer 43Y29 RR	3.5

Comments

In 2022, after a visual assessment of this trial and no apparent yield penalties associated with the different treatments, the committee decided not to take the trial through to yield. There is insufficient data to fully understand the reasons around why we have not seen a yield penalty. Discussions at the spring field day, led to a couple of theories relating to the timing of the spray. The trial was sprayed in December after harvest, onto a high stubble load. This timing does not exactly replicate a paddock situation and may have led to increased herbicide tie-up on the stubble, and/or increased exposure to sunlight over the summer period. Any further research should aim to replicate paddock-use scenarios to get a better understanding of residual effects.

Acknowledgements

This trial is led and funded by the Liebe Group under guidance of the Liebe Group R&D Committee and has been implemented on the Reynolds family properties at Miling. Thanks to Tristan Clarke of Elders Dalwallinu and Shannon Meyer of Elders Coorow, for their assistance planning and spraying the trial.

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DISEASE & PEST RESEARCH RESULTS

2022 Survey of the Summer/Autumn Brassica Refuges for Diamondback Moth to Predict Early Season Risk of Infestation

Christiaan Valentine, Research Scientist, Department of Primary Industries & Regional Development

Key Messages

- This is the third year of a four-year research project looking at the influence of a late summer, early autumn green bridge at predicting growing season diamondback moth (DBM) numbers.
- It is important to monitor DBM populations by sweep netting as numbers can quickly increase above thresholds.
- Similarly, it is important to monitor DBM populations to avoid unnecessary spray applications.

Aim

- To assess the role of Brassica green bridge on DBM presence and impact on winter / spring populations.
- To monitor DBM populations through the season and determine if there is a correlation between moths caught in traps and caterpillars detected in the field.

Background

The project has two outputs:

1. A March/April green bridge survey mapping brassicas and DBM populations. We conducted the March and April survey to measure the Diamondback moth populations in the green bridge and any potential impact this may have for the growing season. Traps were placed at sites we found actively growing brassicas, figure 1.
2. Monitoring of 53 focus canola crop sites which from June to Harvest figure 2. We placed traps in target canola paddocks and monitored fortnightly for Diamondback moth. Paddocks are sweep-netted to determine caterpillars in relation to moth numbers during the season.

The results of the green bridge surveillance provide a foundation to assess the role of Brassica green bridge in pre-season DBM presence regionally and direction into the design of the next phase of surveillance which aims to relate pre-season DBM presence with canola crop colonisation timing and potential for populations to increase above threshold levels.

Widespread summer rainfall for 2022 was generally low compared to 2020 and 2021. Consequently, green bridge sites found during the March survey were located in areas that received isolated showers between January and March. Only 3 of the 545 sites surveyed in March contained DBM larvae. This compared to 26 locations with larvae in March 2020 and 11 in 2021. We placed 94 pheromone moth traps at where we detected brassicas and collected 4 weeks later in April. 24 of these traps contained DBM moths, (marked as diamonds in figure 1).

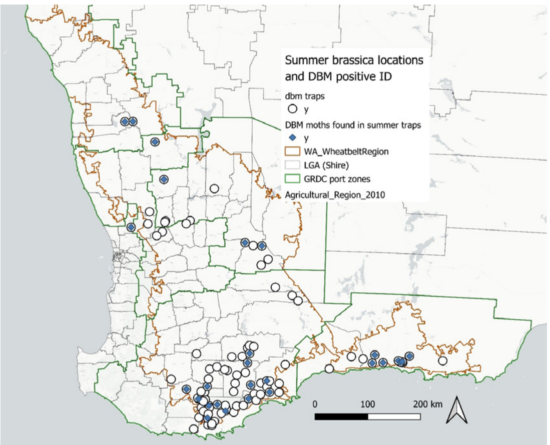

Figure 1: March Brassica and trap locations (White dots), and positive diamondback moth identified in traps when picked up in April (Diamonds).

Following on from the March-April green bridge surveillance for Brassicas and DBM moth and caterpillar presence in the green bridge, focus crops were chosen both near and far from DBM positive sites to investigate whether pre-season Brassicas harbouring DBM contribute to early crop colonisation and/or higher populations of caterpillars in spring. Strategic surveillance was conducted as soon as canola crops in the regions had established. Figure 2 shows a map of the canola focus sites and the growing season moth and caterpillar numbers.

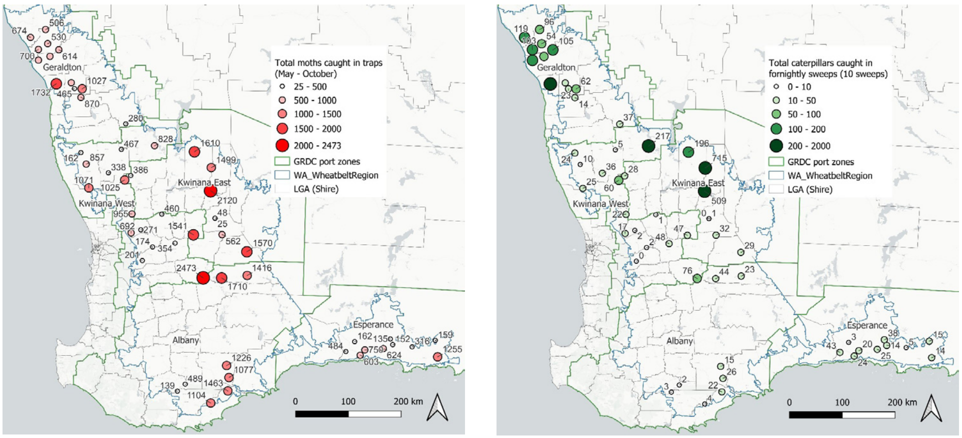

Figure 2: Map of DBM focus crop sites in each port zone of the WA Grainbelt in 2022. Left is the total moths caught during the growing season; right is the total caterpillars caught in fortnightly sweeps.

Notable 'outbreaks' (i.e., above threshold levels of larvae) occurred in the Kwinana East zone and it was earlier than anticipated (August). Some localised outbreaks then occurred in the Geraldton zone during September. Growers were supported with field surveillance results and management information through media such as the PestFacts WA newsletter and direct communication with agronomists. Agronomists from the Kwinana East zone noted that localised outbreak sites that occurred in the region (not focus sites) experienced some moisture stress during July and August which likely increased DBM reproduction rates. Also, earliest germinated canola crops seemed to have had the highest numbers likely from earlier colonisation and larger reproductive time window.

As with 2021 data, there appears to be a correlation between early moth numbers and subsequent increase in larvae number. There were two sites in June with >100 moths (found in traps on average per fortnight) and 21-100 larvae (per 10 sweeps) found in crops which then eventuated into high larvae numbers in August. This indicates that significant (>100) moth numbers found on traps per fortnight in June could be a predictor for high larvae in August or September.

Comments

DBM colonisation of moths in June occurred regardless of whether sites were situated close or far from pre-season green bridge sites which harboured DBM. This likely indicates that other factors, in addition to DBM in the green bridge, are influencing DBM migration and population change. However, there was not much Brassica green bridge across the WA grainbelt in March-April 2022 so initial sources of DBM were likely very low and isolated.

Moths caught in traps appeared to be a good predictor of caterpillar populations. It looked as if large moth detections correlated with increased caterpillars caught approximately 4 weeks later, particularly in the Kwinana East and Geraldton regions. Interestingly, Large trap catches in the Corrigin Shire and South Stirlings did not translate to high caterpillar numbers. Consistent wet crops in the Albany region made monitoring of caterpillars difficult.

Several cold fronts at the end of September and the beginning of October brought heavy rain and wind which would likely have reduced DBM caterpillar numbers.

Acknowledgements

This research was a co-investment by DPIRD and GRDC, project DAW1905-010RTX, Survey of the Summer/Autumn Brassica Refuges for Diamondback Moth in the Western Region to Predict Early Season Risk of Infestation. Technical and survey support from DPIRD staff, The Liebe Group, West Midlands Group, Mingenew Irwin Group and South East Agronomy Services.

Peer review

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Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

Spraying for Redlegged Earth Mite May Become a Thing of the Past

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Alan Lord, Entomologist, Department of Primary Industries & Regional Development

Key Messages
- Redlegged earth mites (RLEM) that have developed resistance to organophosphates and synthetic pyrethroids are becoming more common in broadacre farming in WA. As a consequence the industry will need to look at alternatives to spraying insecticides to control RLEM.

Aim
To determine the extent of RLEM insecticide resistance in the Western Australia grain belt.

Background
In 2014, RLEM with combined omethoate (Group 1B) and synthetic pyrethroid (SP) (Group 2A) resistance were found indicating that the current insecticides may have limited use for control in the future.
The following year we reported finding RLEM in a single location that were resistant to the organophosphate (OP) chlorpyrifos. However further testing revealed these mites were not resistant to either omethoate or bifenthrin.

However, in 2017 RLEM were found to be resistant to OP's (Group 1B) and SP's (Group 2A), indicating insecticides in these groups cannot be relied on to effectively control RLEM long term.

The Department of Primary Industries and Regional Development has conducted resistance testing in WA as part of a Grains Research and Development Corporation (GRDC) investment being led Cesar Australia in collaboration with the University of Melbourne. Insecticides used in this study, were selected by the national team and used for resistance testing throughout broad-acre growing regions of Australia. The findings for 2022 are presented in this paper.

Method
Mite collection
- Paddocks that were suspected of having a chemical failure or farms with high levels of pesticide usage were selected.
- At least 2000 RLEM's were collected using a suction sampler and placed into air tight containers with moistened paper towel and plant material and refrigerated.

Method for bioassays
The inside of 5 mL vials were coated with either:
- Bifenthrin at 0.1 g a.i./L (equivalent to field rate) (Group 2A)
- Omethoate at 0.0058 g a.i./L (approximately equivalent to 1/5 of label rate) (Group 1B)
- Chlorpyrifos at 0.021 g.a.i/L (equivalent to LD90) (Group 1B)
- Control (water)

Mites from a known susceptible source were also used to compare results with the survey populations.

Testing for resistance
- Vials were coated with the required insecticide concentration then left overnight upside down at room temperature until all inner surfaces were completely dry. Once dry, a vetch leaf was placed at the bottom of each vial.
- Then for each collection site, 8 healthy RLEM were placed in the vial. For each treatment there were 6 replicates.
- After 24 hours mites were counted as either dead or alive.

Results

Mites were collected from the high to medium rainfall areas of WA, from Geraldton to Esperance and as far west as Cowaramup. Mites were bioassayed from a total of 57 sites and over half of these sites (38 sites) had mites surviving exposure to SP's and/or OP's (Figure 1).

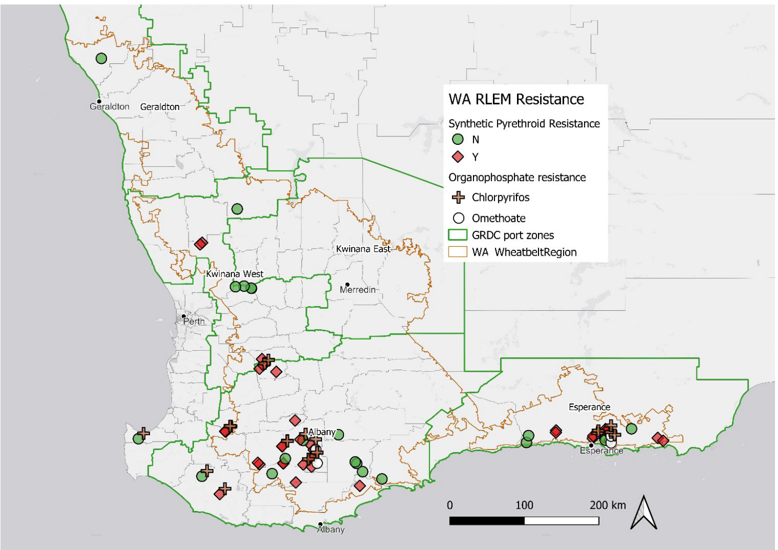

Figure 1: Results from RLEM resistance testing 2022.

Of the 38 sites which had survivors, about half of these sites (20 sites) had RLEM surviving exposure to a single insecticide.

- About 40% of sites (17 sites) had RLEM surviving exposure to bifenthrin only. Previous trials have shown that mites surviving rates of bifenthrin are resistant to all SP insecticides (Group 2A) but OP's are still efficacious against them.
- About 10% of sites had RLEM that only survived OP's indicating that SP's are still effective in controlling mites at these sites.

At 18 sites RLEM survived exposure to more than one insecticide group.

- At 56% of these sites (10 sites) there was cross resistance to SP's and chlorpyrifos. At these sites, omethoate still had efficacy;
- Whereas at 22% (4 sites) there was cross resistance to SP's and omethoate. At these sites, chlorpyrifos still had efficacy.
- Of concern is that about 22% (4 sites) had RLEM that survived exposure to all insecticides. At these sites SP's have little efficacy in controlling RLEM. Also the OP's omethoate, chlorpyrifos as well as other insecticides in the OP group are unlikely to provide on-going control.

Comments

Organophosphate (e.g. omethoate; Group 1B) and synthetic pyrethroid (e.g. bifenthrin; Group 2A) insecticides cannot be relied on to effectively control RLEM long term. Alternative control measures need to be considered such as:

- Use crop rotations that fit with the farming system to suppress RLEM. For example, grow crops susceptible to RLEM mite damage, such as canola, after crops that do not support large RLEM populations, such as a cereals.
- Heavy grazing of pasture paddocks to a residual of 2 t DM/ha for 4 weeks in spring around the Timerite® date in spring prior to sowing crops susceptible to RLEM such as canola.
- Control weeds. Weeds provide habitat for mites. A weed free crop will have few mites and over-summering eggs to carry through to the following season.
- Use insecticidal seed dressings.
- Avoid spraying OP's or SP's throughout the season if targeting other pests (RLEM are active in the cool, wet part of the year, typically from April to November). If there is a need to control other pests use a different chemical group (e.g pirimicarb to control aphids).
- Use alternative pesticide groups such as Diafenthiuron, Group 12A registered for use on canola to control RLEM.

Acknowledgments
The research undertaken as part of this project is made possible by the significant contributions of growers, agronomists and grower groups. The authors would like to thank them for their continued support.

References
For further information refer to the Resistance Management Strategy for RLEM at:
grdc.com.au/FS-RLEM-Resistance-strategy

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Soilborne Pathogen Identification and Management Strategies for Winter Cereals

Chris O'Callaghan and Juniper Kiss, Liebe Group

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

Background
Soilborne diseases remain an important constraint to grain crop production in Australia, estimated to cost grain growers over $370 million each year. Common diseases in the Western region include rhizoctonia bare patch, crown rot, root lesion nematode, cereal cyst nematode, and take-all. Irrespective of the disease, any pathogen that affects the roots, ultimately limits the uptake of water and nutrients and is, therefore, an important contributor to the yield gap.

Despite the significance of the issue, diagnosing plant diseases and particularly those caused by soilborne pathogens can be difficult. Growers mostly rely on above-ground symptoms, which is problematic as diseases are hard to distinguish from each other, other crop issues, and the change in farming practice to early sowing has minimised in-season expression.

The three treatments for this trial were implemented in 2021 including T1: brown manured field peas, T2: Uniform fungicide in-furrow, T3: pre-seeding deep ripping, and T4 was an untreated control plot. The 2021 wheat (Mace) yields were: 3 t/ha (T2), 2.3 t/ha (T3), and 2.8 t/ha (control).

In 2022, the site was sown with Scepter wheat, with the aim of gaining a better understanding of the impacts of these treatments in the second year following their application.

Trial Details

Trial location	Hyde property, Dalwallinu		
Plot size & replication	36 m x 100 m, not replicated		
Soil type	Red loam		
Paddock rotation	2017: Field peas	2019: Barley	2021: Treatments
	2018: Wheat	2020: Fallow	2022: Wheat (Scepter)
Sowing date	01/06/2022		
Sowing rate	65 kg/ha Scepter wheat		
Fertiliser	01/06/2022 - Flexi 40 L/ha, Map Zn 60 kg/ha 16/06/2022 - Urea: 60 kg/ha		
Herbicides, Insecticides & Fungicides	13/05/2022: 2 L/ha Treflan, 2.5 L/ha Boxer Gold 27/05/2022: Trident 1 L/ha 01/06/2022: 400 mL/ha Flutriafol		
Harvest date	10/01/2023		

Treatments implemented in 2021

T1: Pea (Twilight) – Brown manured field pea crop

T2: Wheat (Mace) – Fungicide (Uniform) applied in-furrow

T3: Wheat (Mace) – Pre-seeding deep ripping

T4: Wheat (Mace) – Control

2021 Soil composition

Depth (cm)	pH ($CaCl_2$)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	Col P (mg/kg)	Col K (mg/kg)	KCl S (mg/kg)	EC (ds/m)	OC (%)	PBI
0-10	8.2	9	2	31	359	3.7	0.186	0.79	98.3
10-20	9.2	6	< 1	8	175	5.6	0.230	0.57	154.8
20-30	9.2	2	2	13	246	14.0	0.294	0.68	137.7
30-40	9.5	1	2	12	246	30.9	0.414	0.49	139.5

Results

Plant establishment was reduced in Treatment 1 where wheat was sown into brown manured field pea stubble (Fig 1).

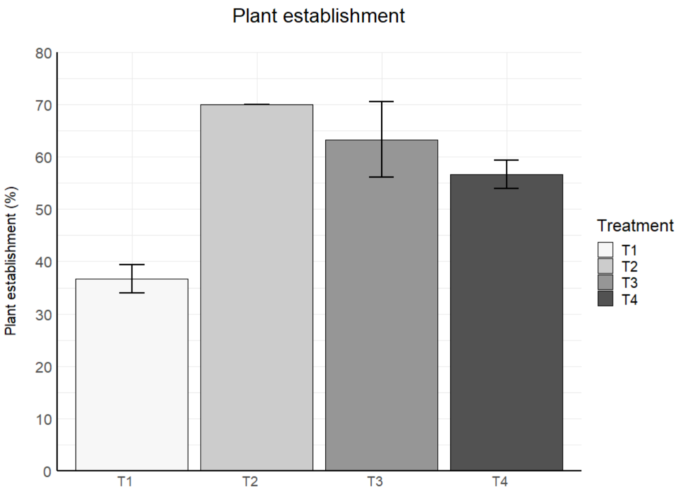

Figure 1. Plant establishment for each of the four treatments 6 weeks after sowing at the soil pathogen trial at the Hyde property, Dalwallinu.

Table 1. PREDICTA B results from treatments at the end of the 2021. Soil was sampled after crop harvest on 2nd December 2021.

Treatments		Pathogens detected from PREDICTA B tests		
		Rhizoctonia solani DNA	Fusarium pseudograminearum DNA	Pratylenchus neglectus nematodes/ g soil
1	Field peas	10	14	13
2	Uniform in-furrow	4	71	24
3	Deep ripping	0	3536	5
4	Control (untreated)	55	1436	17

At the end of 2021, Rhizoctonia solani was present in all wheat plots and its density was highest in the control plot (55 pgDNA/g sample). Fusarium pseudograminearum was present in all plots and T3 had the highest density (3536 pgDNA/g sample). Root lesion nematode (Pratylenchus neglectus) numbers posed a medium risk to the crop and was highest in T2 (24.33 nematodes/g soil). Yellow leaf spot was present across all wheat plots, being highest in T2. (As Yellow leaf spot is a stubble borne disease and not a root borne pathogen this was not covered as part of the project). Macrophomina phaseolina was present in the field pea treatment with minimal levels on all other treatments (Table 1).

Table 2. Results of live plant sampling in August 2022. Samples were processed through DDLS.

Treatments		Rhizoctonia solani	Root lesion nematode (Pratylenchus neglectus/g of root)
1	Field peas	Not detected	3,935
2	Uniform in furrow	Detected	1,374
3	Deep Ripping	Detected	3,037
4	Control	Detected	3,188

Live plant sampling in August 2022, detected *Rhizoctonia Solani* was present in all plots except the field pea treatment and root lesion nematode present in all plots (Table 2). The number of root lesion nematodes is considered moderate and may cause an economic loss in yield of the crop. Treatment 2 had a low number of root lesion nematodes.

Table 3. PREDICTA B results from treatments at the end of the 2022. Soil was sampled on 20th December 2022 after wheat crop harvest.

Treatments	Pathogen levels detected and risk level for the following season from PREDICTA B tests		
	Rhizoctonia solani DNA	F. pseudograminearum DNA	Pratylenchus neglectus nematodes/ g soil
1. Field peas	12 (low)	8 (low)	**84 (high)**
2. Uniform in furrow	0 (below detection)	0 (below detection)	68 (high)
3. Deep Ripping	2 (below detection)	**34 (medium)**	21 (medium)
4. Control (untreated)	**42 (medium)**	2 (low)	53 (high)

PREDICTA B sample taken at the end of 2022 showed that as was the case last year, *R. solani* was highest in the control plot (42 pgDNA/g soil), with minimal presence in the deep ripped plot (T3) and in-furrow fungicide plot (T2). Some *R. solani* was detected in the field pea treatment (T1), despite not being detected in the live plant sampling earlier in the year.

There was less presence of *F. pseudograminearum* than last year, whilst nematode (*Pratylenchus neglectus*) numbers were higher than last year, particularly in the Field Pea stubble (T1) and in-furrow fungicide plot (T2).

Table 4. Grain yield and quality of wheat.

Treatment	2021 yield t/ha	2022 Yield t/ha	2022 Protein %	2022 Screenings %
1. Field Pea crop (2021)	-	2.3	7.1	1.16
2. Uniform In-Furrow Fungicide (2021)	3.0	2.1	7	1.48
3. Pre-Seeding Deep Ripping (2021)	2.3	2.3	7.1	1.31
4. Untreated Control	2.8	2.9	7.4	1.38

All treatments yielded above 2 t/ha, with T2, uniform in-furrow being the lowest yielding and T4, the untreated control being the highest yielding.

Pathologists' comments

It is important to note that PREDICTA B sampling detect the amount of pathogen and nematode present in the soil sample provided. This does not always translate to disease being expressed on the host plant. Predicta B is used as a guide.

Root lesion nematode management tools for broadacre cropping include variety choice in susceptible crops and rotations of resistant crops to reduce levels. Wheat variety Scepter is susceptible to root lesion nematode (RLN) species *P. neglectus* so the nematodes increased across all treatments in 2023 (WA 2023 Crop sowing Guide) and were detected during live plant root assessments conducted early in the season (Table 1). Utilizing field pea as a rotation option is a recommended management tool to reduce *P. neglectus*. Its unfortunate that the paddock was untrafficable for an extended period in the 2021 season which allowed weeds to proliferate. Many grass and broadleaf weed species are also susceptible to RLN which is the likely cause of the continued increase in levels over the 2021 and 2022 seasons. The *P. neglectus* levels recorded in all treatments would cause yield loss in a conducive season.

Fungicide Uniform is an established treatment to reduce *Rhizoctonia* root rot, particularly early in the season when plants are establishing (Huberli *et al*. 2015). Presence of the pathogen in roots in the season following fungicide treatment can be expected as Uniform does not eliminate the fungus.

Deep ripping is a tool to loosen compacted soil horizons to allow better water, nutrient and root penetration through the soil profile. DPIRD research suggests that this style of deep soil tillage is not effective for *Rhizoctonia* root rot or root lesion nematode management in infested paddocks (Muenda *et al.* 2020; Collins *et al*. 2021).

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Acknowledgements

This trial is part of a GRDC-invested project 'Soilborne pathogens of winter cereals: Extension of identification and management strategies', led by the Grower Group Alliance, with this trial being overseen by the Liebe Group. Thanks to the Hyde family for their assistance, hosting, implementing, and managing the trial.

Peer review

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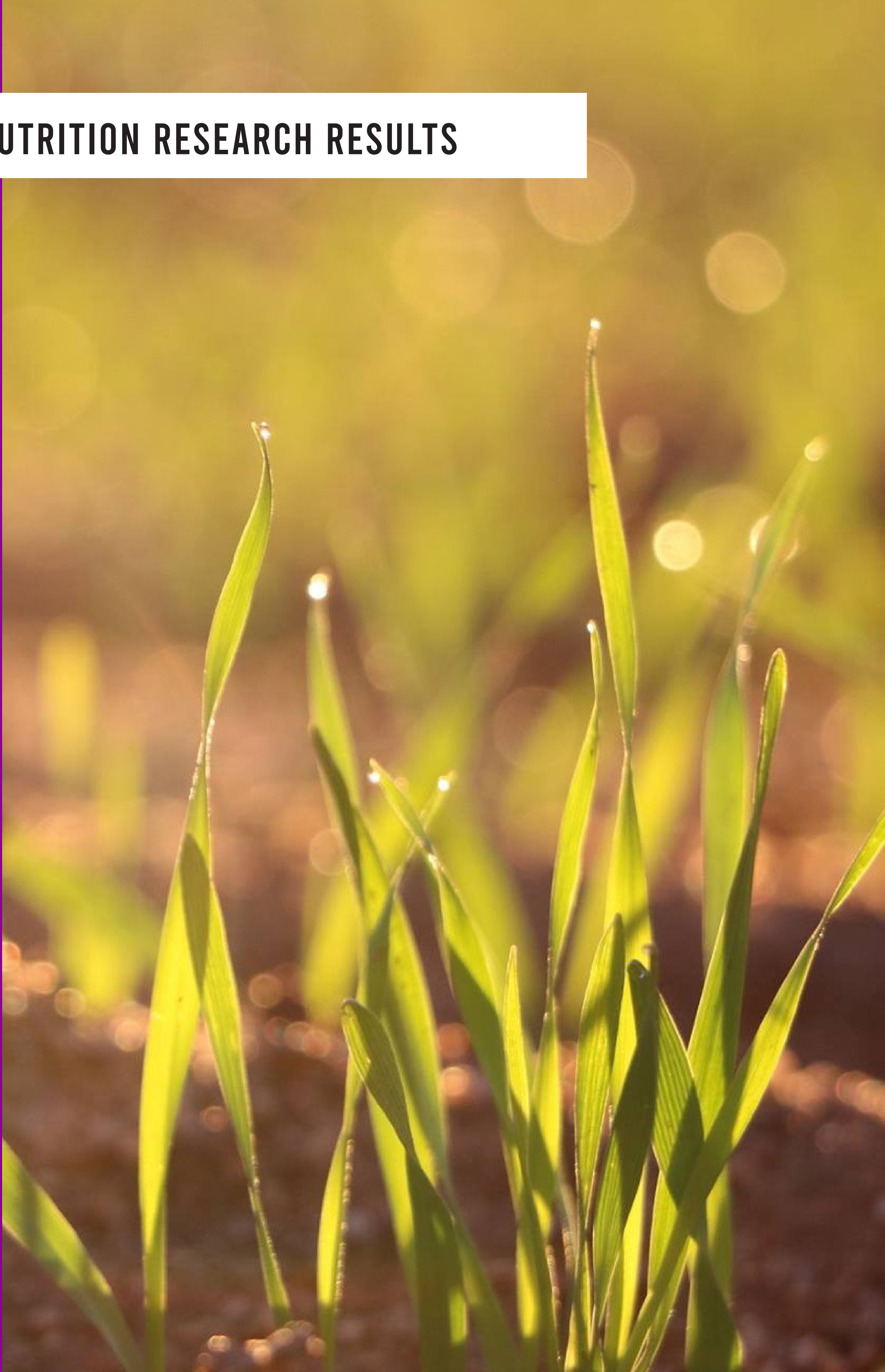
NUTRITION RESEARCH RESULTS



Use of Inert Stone Mulch to Improve Yield on Sodic, Alkaline Soil

Wayne Parker, Research Scientist, Chad Reynolds, Research Scientist &
Jo Walker, Research Scientist, Department of Primary Industries & Regional Development

Key Messages
- Stone mulch on the surface of a sodic alkaline soil reduces surface evaporation to increase crop yield.
- Given the finish of the 2022 season full stubble retention did not improve crop yield over nil stubble retention.

Aim
This trial aims to determine the benefit or detriment of stone mulch applied to a soil surface in comparison to full height stripper stubble retention.

Background
Clay soil has the capacity to store more moisture than loam and sand but more of it is unavailable to the plant. While the plant available water is greatest in clay the water retained by the soil is also the greatest. In low rainfall years the amount of plant available water by percent of rain is lower than in sand and loam. The greatest fluctuations in yield occur in clay soil with both very high yields possible with high rainfall and next to no yield with low rainfall. In an environment strongly conducive to evaporation gains are to be made by preventing moisture leaving from the surface without first going through a crop.

Surface mulch prevents moisture evaporation from the soil. In current farming systems most surface mulch takes the form of stubble. The type of stubble, height, percentage cover, volume all influence the rate of evaporation. Increased volume, percentage cover and height all reduce the levels of evaporation. The stripper header removes only the grain and husk from the head of the cereal plant leaving the stubble in its entirety. This is maximum height and volume possible for any stubble mulch. Current harvest practice sees the stubble cut, chopped and spread which decreases the height of stubble, creates smaller particles sooner broken down by weathering and digestion.

Other forms of mulch do already exist in broadacre agriculture. They include water repellent sand and stone. Mulches work through increasing pore size on the surface and breaking capillary rise as well as reducing surface temperature. Inert stone mulch has been used to positive effect when applied to the surface of sodic, alkaline clay soil (Hall *et al* 2022). This trial seeks to determine the yield benefit of stone mulch and stripper stubble when compared to bare soil.

Trial Details

Trial location	Prowaka Spring, Carnamah
Plot size & replication	20m x 4m x 4 replications
Soil type	Sodic, alkaline clay
Paddock rotation	2021 barley 2022 canola
Sowing date	10/05/2022
Sowing rate	2 kg/ha Battalion Canola
Fertiliser	Sowing 65 kg/ha Agflow extra Post 120 kg/ha Urea
Herbicides, Insecticides & Fungicides	Pre Treflan Post Roundup early, 6 leaf and late. Mouse off, Affirm for DBM
Harvest date	01/11/2022

Treatments

	Treatment
Gravel mulch	14mm blue metal stone applied to surface to depth of 3-4 cm. Same stone as is applied to bituminised road surfaces
Full stripper stubble	Stubble harvested with stripper front
½ height stripper stubble	Stripper stubble cut to half height with whipper snipper to simulate cut and spread of current header front operation
Bare soil	Stripper stubble and trash burnt prior to seeding leaving bare soil

Soil Composition

Depth (cm)	pH (H_2O)	Col P (mg/kg)	Col K (mg/kg)	S (mg/kg)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	EC (ds/m)	OC (%)	ESP (%)
0-10	7.38	23.75	730	7.2	1.87	6.70	0.24	4.9	3
10-20	8.37	6	621	3.5	1.25	2.95	0.15	2.6	6
20-30	8.85	5	456	4	0	1.63	0.22	2.2	12
30-40	9.17	<5	405	8.7	0	1.80	0.36	1.5	20
40-50	9.31	<5	388	21	0	1.63	0.55	1.2	27
50-60	9.38	<5	419	47	1.20	1.55	0.75	1.0	33

Results

Table 1: Establishment numbers and harvest quality parameters from the trial

Treatment	Plants/m^2	Yield (t/ha)	Oil (%)	Protein (%)	1000 grain weight (g)
Bare	54b	1.70a	43.6	19.0	2.93a
Stone mulch	46a	1.81b	44.2	18.4	3.28b
Stripper stubble	56bc	1.66a	43.8	18.8	3.03a
Half stubble	62c	1.71a	44	18.6	3.04a
LSD (p<0.05)	4	0.07	NS	NS	0.13

The stone mulch provided an additional 100 kg/ha over the next best treatment, though no differences in oil or protein were achieved. Stone mulch treatment also provided the largest grain size.

Soil moisture profile was measured at one time only, 30th of August, and was not altered by either treatment, data not presented. Variability was large enough to cancel any trends.

Table 2: Leaf tissue test results

	Boron	Chloride	Copper	Manganese	Potassium	Sodium	Sulfur
Bare	29.4a	3.39b	7.51b	96a	5.79a	0.56b	0.595b
Stone Mulch	35.6b	3.42b	8.407c	122b	6.68b	0.5825b	0.575ab
Half Stubble	28.2a	2.85a	7.147ab	80a	5.4a	0.365a	0.548a
Stripper Stubble	28.9a	2.96ab	A	84a	5.91ab	0.405a	0.54a
LSD (p<0.05)	2.9	0.48	0.38	22	0.84	0.133	0.04

Comments

Yield difference is reflective of the long, wet, cool finish to the season. There is a statistically significant improvement in canola yield from gravel surface treatments. This increase of 100 kg/ha is not as large an increase as anticipated, only 6% over that of the remaining treatments. The seed weight of the stone mulch treatments accounts for this difference at 8% greater than the half stubble treatments.

The two - three weeks following pollination is the time pod number and seed within pod survival is determined (Mendham and Robertson, 2004). In this period water was not limiting and all treatments set, retained and filled an equivalent number of pods. During the season canola in the stone mulch treatments had larger biomass and were taller plants. It is probable that the increased biomass of these plants provided the additional substrates to fill seed at the end of the season as seen in the larger seed weight. Currently gravel mulching is cost prohibitive and logistically challenging. Each plot was covered with approximately 5.2 ton of stone to give a depth of 3cm which equates to 650 t/ha. Such rates may be possible with modified clay spreaders though no other agricultural equipment exist today.

In a cereal season there is potential for full length stubble to reduce evaporation during the summer months, keep the surface cooler and retain more moisture for the beginning of the season. Unfortunately this trial is unable to answer these questions as season 2023 sees a carryover of canola stubble, harvested conventionally.

Acknowledgments
Thanks to Scott Bowman for sowing and managing this trial throughout the year, also for his generosity in hosting the many field walks during the season.

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Peer review
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GOVERNMENT OF WESTERN AUSTRALIA

Nitrogen, Potassium and Seeding Rates for Wheat

James Easton, Senior Agronomist, CSBP

Key Messages

- No response to potassium (K) fertiliser.
- Nitrogen (N) fertiliser was very profitable.
- Grain yields were unaffected by seeding rate.

Aim

To determine in wheat (1) the requirement for K fertiliser on a site with marginal Colwell K levels (55 mg/kg at 0-10cm, 20-30 mg/kg between 10 and 30cm), (2) the profitability of N fertiliser and (3) the effects of varying seeding rate.

Background

In intensive cropping systems, K levels are declining, most notably in the sub soil. Adequate K is critical for maximising N and water use efficiency. Without legumes in the rotation, soil N levels are also in decline.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	15m x 1.83m x 3 replicates
Soil type	Sand over clay/gravel at 60-80cm
Paddock rotation	2019 canola, 2020 wheat, 2021 canola
Sowing date	09/05/2022
Sowing rate	Vixen wheat base rate 60 kg/ha
Fertiliser	20/4/2022: MOP top-dressed (49.5K) 09/05/2022: Refer to treatments below of seeding fertiliser and Flexi-N banded 06/07/2022: Flexi-N (w/v 42.2N) 25/07/2022: Flexi-N (w/v 42.2N)
Herbicides, Insecticides & Fungicides	09/05/2022: 1.8 L/ha Ultra, 300 ml/ha Lorsban, 118 g/ha Sakura, 1.7 L/ha TriflurX. 22/06/2022: 150 ml/ha Axial and 500 ml/ha Jaguar. 25/07/2022: 500 ml/ha Aviator and 50 ml/ha Trojan.
Harvest date	07/11/2022

Soil Analysis 20/04/2022

Depth (cm)	pH ($CaCl_2$)	Col P (mg/kg)	Col K (mg/kg)	S (mg/kg)	Nit N (mg/kg)	Amm N (mg/kg)	EC (ds/m)	OC (%)
0-10	6.2	20	55	14	18	<1	0.09	0.6
10-20	5.4	15	23	18	11	<1	0.06	0.6
20-30	4.4	28	29	8	5	<1	0.03	0.2

Treatments

Trt	Seed Rate (kg/ha)	TD IBS (kg/ha)	Banded (L/ha)	Banded (kg/ha)	Z24 (L/ha)	Z51 (L/ha)	N	K
1	60	-	-	68 Big Phos	-	-	2	0
2	60	-	60 Flexi-N	65 Agstar	-	-	34	0
3	60	-	60 Flexi-N	90 K-Till Extra Plus	-	-	34	12
4	60	40 MoP	60 Flexi-N	90 K-Till Extra Plus	-	-	34	31
5	60	80 MoP	60 Flexi-N	90 K-Till Extra Plus	-	-	34	51
6	60	-	60 Flexi-N	90 K-Till Extra Plus	120 Flexi-N	-	85	12
7	60	40 MoP	60 Flexi-N	90 K-Till Extra Plus	120 Flexi-N	-	85	31
8	60	80 MoP	60 Flexi-N	90 K-Till Extra Plus	120 Flexi-N	-	85	51
9	40	80 MoP	60 Flexi-N	90 K-Till Extra Plus	120 Flexi-N	-	85	51
10	80	80 MoP	60 Flexi-N	90 K-Till Extra Plus	120 Flexi-N	-	85	51
11	60	80 MoP	60 Flexi-N	90 K-Till Extra Plus	180 Flexi-N	60 Flexi-N	135	51
12	40	80 MoP	60 Flexi-N	90 K-Till Extra Plus	180 Flexi-N	60 Flexi-N	135	51
13	80	80 MoP	60 Flexi-N	90 K-Till Extra Plus	180 Flexi-N	60 Flexi-N	135	51

Results

Plant Counts

Trt	Seed rate (kg/ha)	Target (kg/ha)	Plant Counts (per m^2)	Above Target (per m^2)	Germination (%)
9	40	100	115	15	92
11	60	150	158	8	84
10	80	200	216	16	86

Harvest

Trt	N	K	Yield (%)		Protein (%)		HL Wt (kg/hL)	
1	2	0	3.5	f	10.0	g	76	e
2	34	0	4.4	e	10.5	fg	79	cd
3	34	12	4.5	de	11.0	ef	78	d
4	34	31	4.8	c	10.9	ef	79	cd
5	34	51	4.7	cd	11.1	ef	79	bcd
6	85	12	5.4	b	11.4	de	80	a
7	85	31	5.4	b	12.0	bcd	80	ab
8	85	51	5.4	b	11.6	cde	80	a
9	85	51	5.4	b	11.6	cde	80	a
10	85	51	5.4	b	12.3	abc	80	a
11	135	51	5.5	ab	12.7	ab	80	a
12	135	51	5.8	a	12.3	abc	80	ab
13	135	51	5.5	ab	12.9	a	80	abc
		Prob(F)	<0.0001		<0.0001		<0.0001	
		LSD	0.3		0.8		1.0	

Screenings were 2-3% with no significant differences between treatments.

Nitrogen economics, nitrogen use efficiency (NUE) and water use efficiency (WUE)

N	Yield (t/ha)	Protein (%)	Revenue ($/ha)	Cost ($/ha)	Returns ($/ha)	NUE (%)	WUE (kg/mm)
2	3.53	10.0	-	-	-	-	15
34	4.62	10.9	498	116	383	110	19
85	5.41	11.8	891	289	602	80	22
135	5.60	12.6	1075	459	616	62	23

Assumptions
- Economics: AH2 $380/t, APW1 $360/t, APW2 $330/t; N $3.40/kg (on-farm prices).
- NUE based on 75% recovery of the N taken up is translocated to grain.
- WUE based on 1/3 of Jan to Mar rainfall plus April to October rainfall.

Comments
Despite marginal soil K levels, plant testing in late June showed that K levels in the crop were adequate (4 – 5%) - without application of K fertiliser. Follow up soil testing to 50cm in May also showed higher Colwell K levels (average 70 mg/kg from 0 to 50cm) than initially measured.

There was no yield response to K, and K applications had no effect on crop response to N.

There was a very strong and profitable response to 85 kg N/ha, with returns of about $3 for every $1 spent on nitrogen use efficiency was exceptional.

This trial showed that even at high prices, N fertiliser can be very profitable applied to responsive crops. Increasing N rates from 85 to 135 kg/ha increased grain protein from 11.8 to 12.6%, which would have also added additional returns in protein value through quality optimisation.

While there was no response to K, banding some K at seeding provides some insurance against deficiencies. High yielding crops remove a lot of K. In this trial, up to 25 kg K/ha was removed in the grain. In the paddock, much higher 'removal' rates occur when stubble is baled or crop residues are not evenly re-distributed.

K fertiliser requirements are best monitored by taking soil samples to at least 30cm and plant samples during the growing season.

Acknowledgements
Thanks to the Reynolds family for hosting the trial and to the CSBP Field Research team.

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Optimising Nitrogen and Phosphorus Rates in a High Input Cost Environment

Brett Beard and Saritha Marais, Area Managers, Summit Fertilisers

Key Messages

- There was a significant yield response to increasing P rates, with yields ranging from 4.6 t/ha when no P was applied up to 5.4 t/ha when 24kg P/ha was applied.
- There was also a significant yield response to increasing N rates, with yields ranging from 3.2 t/ha when no N was applied up to an average of 4.9 t/ha when 120kg N/ha was applied.
- Yield differences between N strategies were minor and not statistically significant, however it was the split application that performed the best and the seeding application that performed the worst. There was over a 0.5 t/ha difference between the two at 120kg N/ha, indicating that there was no penalty for delaying N applications.
- Despite high input costs in 2022, applying 24kg P/ha and 120kg N/ha improved indicative gross margin returns by nearly 50% compared to when no P and no N was applied.

Aim

To provide yield and returns data for demonstrated options to optimise nitrogen and phosphorus use when budget is a considerable determining factor in a wheat cropping budget. The study includes an investigation into impacts of delaying nitrogen applications intended to decrease upfront risk while still allowing a crop to reach its maximum potential yield later in the season.

Background

There is an emerging train of thought that traditional approaches to Nitrogen (N) management are leaving crops short – evidenced by disappointing grain protein levels in recent seasons. Growers may be forgoing profit by playing the season late and not addressing crop demand early when yield potential is critically set. Early N applications do have the potential to present some risk, particularly when input costs are high, as rates cannot be cut back in seasons which might not be so favourable. There has also been a recent survey showing that soil P is accumulating across the region with 70% of soils having sufficient soil P levels. Despite this, trials done by Summit Fertilizers are still showing response to increasing P rates.

These two trials done side-by-side will add value to the region by interrogating the traditional ideas of ‘sufficient’ nutrition by pushing N and P rates to determine the profitability at the end of the season, with hopes to repeat similar trials in future years. Both trial protocols have been done by Summit Field research previously, this enables us to compare 2022 results with those of previous years in similar rainfall and soil types.

Trial Details

Trial location	Main Trial Site, Reynolds Property, north Miling
Plot size & replication	10m x 2.2m x 4 replications
Soil type	Loamy Sand
Paddock rotation	2021 canola, 2020 wheat
Sowing date	03/05/2022
Sowing rate	83 kg/ha Havoc wheat
Herbicides, Insecticides & Fungicides	03/05/2022: 0.12 kg/ha Pyroxasulfone, 0.2 L/ha Mesotrione, 2 L/ha Trifluralin, 0.5 L/ha Chlorpyrifos, 0.15 L/ha Alpha-Cypermethrin, 2 L/ha Glyphosate 14/06/2022: 2.5 L/ha Prosulfocarb 23/06/2022: 0.67 L/ha Bromoxynil & Pyrasulfotole
Harvest date	08/12/2022

Soil Composition

Depth (cm)	pH ($CaCl_2$)	Col P (mg/kg)	PBI	Col K (mg/kg)	S (mg/kg)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	EC (ds/m)	OC (%)
0-10	6.4	17	3	35	7	9	3	0.07	0.6
10-20	5.9	20	11	31	6	6	1	0.04	0.5
20-30	4.6	28	17	31	5	2	1	0.03	0.3
30-40	4.5	22	13	44	7	2	1	0.02	0.2
40-50	5.4	10	19	37	8	1	2	0.02	0.2

Treatments

	Treatment	Establishment Fertiliser Banded (kg/ha)	Seeding* 3-May (kg N/ha)	3 Leaf GS* 31-May (kg N/ha)	Late Tillering GS* 12-Jul (kg N/ha)
1	P0	60 SOP, 90 Urea	40	40	40
2	P4	18 MAP, 60 SOP, 85 Urea	40	40	40
3	P8	36 MAP, 60 SOP, 80 Urea	40	40	40
4	P12	54 MAP, 60 SOP, 75 Urea	40	40	40
5	P16	72 MAP, 60 SOP, 70 Urea	40	40	40
6	P20	88 MAP, 60 SOP, 65 Urea	40	40	40
7	P24	105 MAP, 60 SOP, 65 Urea	40	40	40
1	N0	75 TSP, 60 SOP	-	-	-
2	N40 Seeding	65 MAP, 60 SOP	40	-	-
3	N40 Split	65 MAP, 60 SOP	20	-	20
4	N40 Early Post	65 MAP, 60 SOP	10	30	-
5	N40 Split Post	65 MAP, 60 SOP	10	15	15
6	N80 Seeding	65 MAP, 60 SOP	80	-	-
7	N80 Split	65 MAP, 60 SOP	40	-	40
8	N80 Early Post	65 MAP, 60 SOP	10	70	-
9	N80 Split Post	65 MAP, 60 SOP	10	35	35
10	N120 Seeding	65 MAP, 60 SOP	120	-	-
11	N120 Split	65 MAP, 60 SOP	60	-	60
12	N120 Early Post	65 MAP, 60 SOP	10	110	-
13	N120 Split Post	65 MAP, 60 SOP	10	55	55

*In-season N applied as UAN

In-Season Results

An in-season biomass assessment was conducted at mid-to-late tillering on the 12/07/2021 by measuring Normalised Difference Vegetation Index (NDVI) using a handheld Greenseeker® (Figure 2). There was a significant trend of increasing plant biomass with increasing rates of applied P up to 8kg P/ha at the time of assessment ($p<0.01$). As rates of P increased above 8 kg/ha biomass remained consistent until a sharp rise in plant growth was observed with the application of 24kg P/ha. Plant growth also demonstrated significant increases with increasing N rates ($p<0.001$). A large growth response was observed from nil N to 40kg N/ha and biomass continued to increase up to 80kg N/ha applied at seeding and 120kg N/ha when applied early post emergence. Aside from a minor differentiation at 120kg N/ha, no differences in plant growth responses were observed between seeding and early post-emergent N strategies ($p=0.61$). Split and split post strategies had not received their total N applications at the time of these readings.

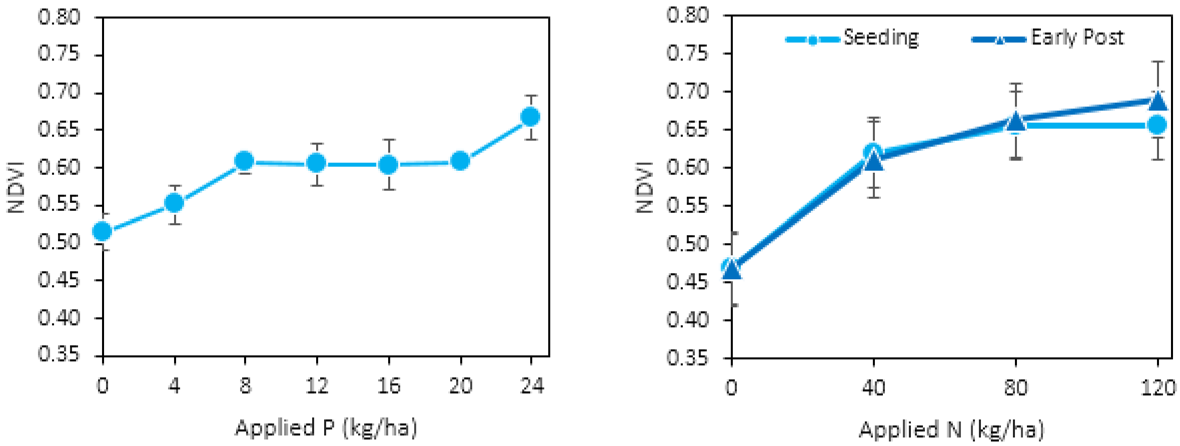

Figure 2. Greenseeker® NDVI readings recorded on the 12/07/22 at mid-to-late tillering (Z23-Z30).

Harvest Results

Above-average growing season rainfall resulted in good yields across the two trials, with a combined average of 4.6 t/ha. In the P trial, yields ranged from 4.3 t/ha where no P was applied, up to a high of 5.4 t/ha where 24kg P/ha was applied (Figure 3a). There was a significant trend of increasing yields with increasing rates of P ($p<0.01$). The yield response curve suggests yield increases to P were beginning to plateau around 16kg P/ha, but a large increase in yield from 20 to 24kg P/ha results an almost linear response generated (Figure 3b).

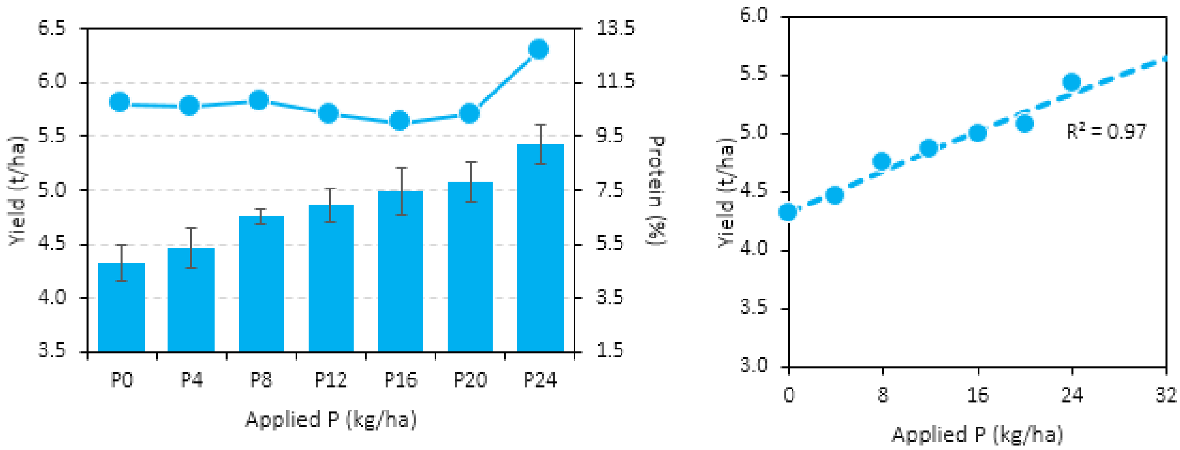

Figure 3. a) Harvest yield (bars) and grain protein (points) with increasing rates of P. b) Yield responses to increasing rates of P. Mitscherlich function fitted.

In the N trial, the lowest yield was 3.2 t/ha when no N was applied, while the highest was 5.1 t/ha when 120kg N/ha was applied in a split application (Figure 4a). There was a clear, significant trend demonstrating that higher N rates resulted in higher yields ($p<0.001$), but differences between strategies were relatively minor and not statistically significant ($p=0.09$). The split strategy resulted in the highest yields when 80 and 120 kg N/ha was applied. The worst performing strategy was the seeding N strategy, which was particularly evident at 120 kg N/ha where the yield was just over half a tonne per hectare less than the split strategy.

This trend suggests N applied at seeding may have potentially leached away to some extent, and that there was no yield penalty for delaying N applications. Delaying N applications can potentially reduce risk because N applications can be adjusted to suit growing conditions. Conditions were favourable in 2022, so higher applications resulted in significant yield increases. Response curves show good increases in yield up to 120 kg N/ha across all strategies, with the response curves beginning to plateau at this rate (Figure 4b).

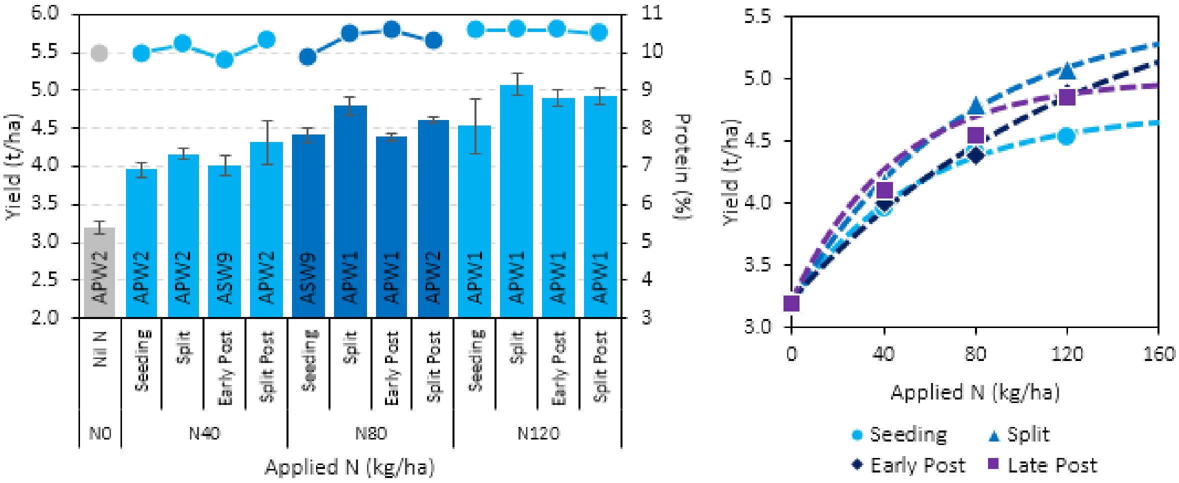

Figure 4. a) Harvest yield (bars) and grain protein (points) to the different N rates and strategies. b) Yield responses to increasing rates of N. Mitscherlich function is fitted to all datasets.

Grain protein was relatively consistent across both trials and did not appear to be significantly influenced by P or N rates (Figures 3a, 4a). Grain protein ranged from 9.8% and 10.8%, except for where 24kg P/ha was applied which had a protein content of 12.7%. There was a slight trend of increasing protein with increasing N rates, however from nil N to 120kg N/ha the average protein increase was just 0.5%.

Hectolitre weights were high and screenings were low across the trials, meaning protein was the determining factor of receival grades. A high protein content of 12.7% where 24kg P/ha was applied meant it had a receival grade of H2, which combined with a considerably higher yield than other treatments meant it was easily the most profitable treatment under 2022 growing conditions, with an indicative gross margin of $1960, which exceeded that of the P0 control by $625/t, or nearly 50% (Figure 5a).

As grain protein generally increased with increasing N rates, most treatments that received at least 80kg N/ha were receivable as APW1, while nil and 40kg N/ha applications were mostly APW2, with a few exceptions (Figure 4a). N rates generally remained profitable up to 120kg N/ha, with yield increases great enough to compensate for additional input costs. However, it was 80kg N/ha applied with a split application that was the most profitable strategy, with an indicative gross margin of $1630/ha, which was $580/ha or 56% greater than profits from the nil N treatment (Figure 5b).

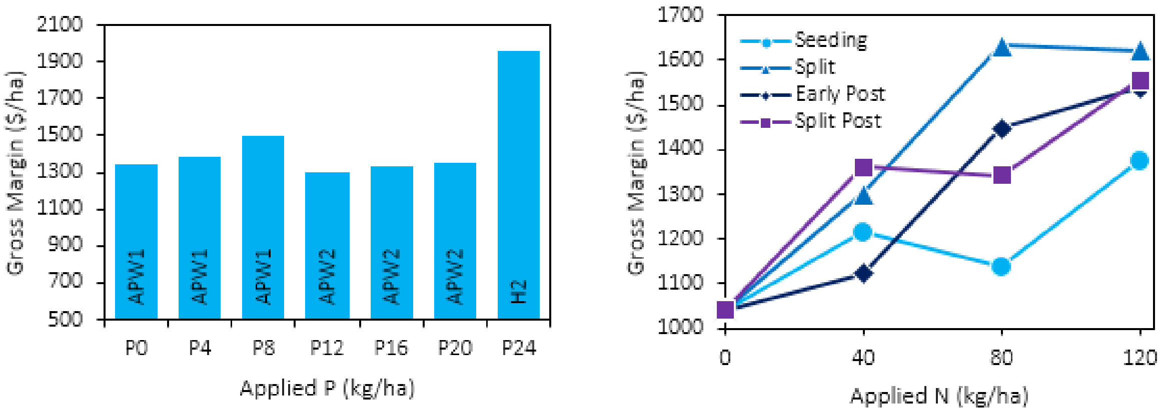

Figure 5. a) Indicative gross margins with increasing rates of P. b) Indicative gross margins with increasing rates of N.

These trials demonstrate the importance of sufficient P and N nutrition, even when input costs are high and in years with good yield potential. Despite reasonable yields of 4.3 t/ha (P0) and 3.2 t/ha (N0) in the control treatments, both trials exhibited significant yield responses to increasing rates of P & N fertiliser that equated into increasing returns up to high rates of both nutrients. These results demonstrate that despite high input costs observed in 2022, grain prices were high enough and there was enough of a yield response at this site under 2022 conditions that it was still profitable to apply high rates of both P & N fertiliser, meaning nutrient responsiveness and yield were still the main drivers of profitability.

No	Treatment	Fert. Cost ($/ha)	Yield (t/ha)	Protein (%)	Hectolitre Weight (kg/hL)	Screenings <2mm (%)	Grade	Grain Value ($/ha)	Gross Margin ($/ha)
1	P0	630	4.33	10.7	77.5	1.4	APW1	1970	1340
2	P4	650	4.47	10.6	77.5	1.3	APW1	2030	1380
3	P8	670	4.76	10.8	75.8	1.3	APW1	2165	1495
4	P12	690	4.87	10.3	76.6	1.7	APW2	1995	1305
5	P16	710	4.99	10	76.4	1.8	APW2	2050	1335
6	P20	730	5.07	10.3	78.5	1.3	APW2	2080	1350
7	P24	755	5.43	12.7	77.4	1.3	H2	2715	1960
1	N0	270	3.20	10	77.9	1.5	APW2	1310	1040
2	N40 Seeding	410	3.96	10	78.0	1.3	APW2	1625	1215
3	N40 Split	410	4.17	10.2	76.1	1.3	APW2	1710	1300
4	N40 Early Post	410	4.01	9.8	77.7	1.3	ASW9	1530	1125
5	N40 Split Post	410	4.32	10.3	75.7	1.4	APW2	1770	1360
6	N80 Seeding	550	4.42	9.9	78.3	1.0	ASW9	1685	1135
7	N80 Split	550	4.80	10.5	80.1	1.2	APW1	2180	1630
8	N80 Early Post	550	4.39	10.6	98.5	0.6	APW1	1995	1445
9	N80 Split Post	550	4.61	10.3	78.3	1.3	APW2	1890	1340
10	N120 Seeding	690	4.54	10.6	79.6	1.0	APW1	2065	1375
11	N120 Split	690	5.08	10.6	78.1	1.0	APW1	2310	1620
12	N120 Early Post	690	4.89	10.6	78.6	0.9	APW1	2225	1540

Table 1: Gross margin is a simple representation of grain value minus cost of fertiliser input. Fertiliser cost based on Summit Fertilizers April 2022 retail list pricing ex Kwinana. Grain value based on delivery grade grain prices from CBH for the 08/12/2022 at Kwinana.

Acknowledgements
Thank you to Sam Reynolds for generously providing the trial site, the Liebe Group for giving us the opportunity to participate in this site and to Living Farm for harvest and grain quality analysis.

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SOIL HEALTH RESEARCH RESULTS

Redefining Dryland Salinity Management for New-Generation Land Custodians - A Summary

Extracts from a Catchment Management Review prepared for the Liebe Group by Greg O'Reilly from Contour Environmental and Agricultural Consulting

Key Messages

- This pilot project has consisted of a literature review and four case studies in 2022.
- The Liebe Group will be holding a salinity masterclass workshop and implementing field trials in 2023.

Aim

To explore dryland salinity issues and potential land management interventions.

Background

Dryland salinity is a major cause of land degradation in the southwest of WA, with more than one million hectares being classified as severely salt-affected and a further 2.8 to 4.5 million hectares at risk (DPIRD, 2022). Focusing on the eastern fringe of the Moore River Catchment (Figure 1), this project will investigate the resurgence of dryland salinity and the opportunity for a new generation of landholders to employ management options on-farm. A landscape-scale review was completed in 2022 by Contour Environmental and Agricultural Consulting.

Catchment review summary extract

Salinity has been a major land degradation issue in the WA wheatbelt ever since widespread clearing of native vegetation began in earnest around the mid-20th century. Rising groundwater and subsequent salinisation of soils and waterways in lower lying areas of the landscape continues to cost the economy significantly in lost production and has severely affected the often-unique biodiversity assets of now fragmented wetland systems.

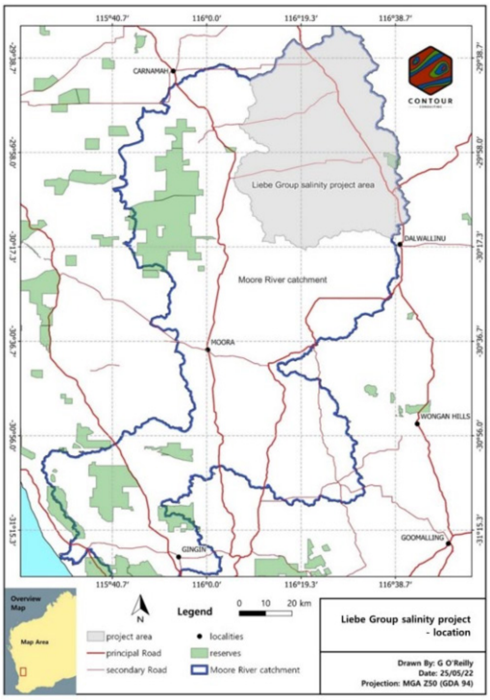

Figure 1: Liebe Group project focus area, in relation to the Moore River Catchment.

Considerable knowledge and investment in understanding and managing salinity has occurred, particularly in the period following the implementation of the State Salinity Strategy in 2000, which coincided with a particularly wet year (1999) across many regions including the current project catchment in the northeast agricultural region.

The wet year of 1999 led to a spike of groundwater rise and an increase in waterlogged and saline land and generated significant interest in understanding and mitigating the salinity threat.

There had been highly regarded research into salinity in WA stretching back decades, so the mechanisms were already well understood, but certainly the decade until around 2010 saw considerable research and monitoring effort, on-ground works, funding for projects, and extension of knowledge to land managers and stakeholder groups and was a key focus for natural resources management (NRM) in WA at that time.

With changing priorities for government funding, and coinciding with a long period of declining rainfall in the broader southwest of WA, groundwater levels in some areas tended to stabilise or became variable (rising and falling depending on sites and location). There was also perhaps a realisation that mitigating salinity was a very costly and often complex task, requiring good cooperation between community sectors, government, and industry, and with multiple approaches and strategies working best in unison and across tenures and property boundaries.

In the project catchment in particular, rainfall declined significantly in the 21st century and relatively few years between 2004 and 2019 were above the long-term median rainfall. There was a notable drop-off in break-of-season autumn rainfall and a slight increase in scattered and erratic summer storm events. It is not surprising that salinity has not been a pressing issue for ongoing generational change on farms and conservation lands. A younger generation of farmers and land managers is now taking over the reins, having cut their teeth in the dry years 2010-2020, and they have different perspectives and priorities than those managing land in the 1990s and early 2000s.

Cropping has become the predominant activity in the project catchment with far less mixed farming, and some of the animal-based solutions to salinity such as perennial fodder plantations may no longer seem elevant or may even be a hindrance to a cropping program. Similarly, some soil conservation earthworks, alley and corridor plantings linking remnant native vegetation, may need reconfiguring to better suit current and future farming systems.

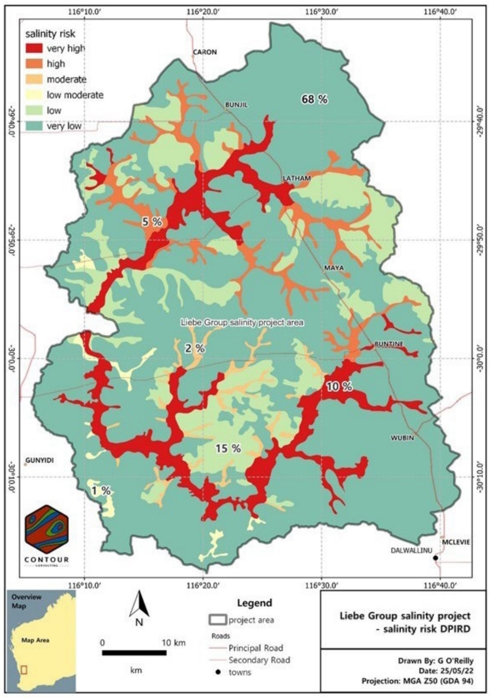

Figure 1: Salinity Risk areas within the project area. Source: DPIRD.

This review has confirmed there has been limited monitoring of salinity in the project catchment for over a decade and that the extensive groundwater monitoring bore network constructed by government in the early 2000s is poorly managed. Data, even on the location of monitoring bores, is uncoordinated between three government departments and the potential ongoing value of this investment in understanding future salinity trends is at risk.

The review has found that there are well-developed sound recommendations to manage salinity in the project catchment based on large investments in research and development in the past. Renewed interest in tackling salinity issues, particularly in direct response to infrequent wet seasons, requires ongoing clear and concise messaging of existing knowledge and, hopefully can lead to ongoing investment in mitigating the threat, as well as encouraging monitoring and further research into the salinity issue.

Focus Properties Summary

Four case study properties were a focus of this project and were located near Latham, Maya, Buntine, and Wubin. A summary of some general observations are made below.

Natural Vegetation

The health of natural vegetation on uncropped land on all farms visited was exceptional. The salt affected areas, road verges, tree patches, embankments, any areas that can't be cropped, were all growing a diversity of perennial plants – chenopods and other shrubs and sub-shrubs, with annual and perennial grasses. Natural regeneration of trees was noted. The health and vigour of non-cropped areas on all farms may be having a positive impact on alleviating salinity.

Drains

The existing drain network in some areas needs repair and maintenance due to silting, particularly where surface inflows into drains also occur. Where these drainage networks cross through multiple farms, the issue of governance and cost-sharing may need to be addressed. Most farmers believe the deep drain networks established over past decades have been effective and all had plans for refurbishment or creating further spurs or branches into problem areas.

Trees & Revegetation

All farmers are open to planting trees and revegetation to target salinity, and all had successful past projects and have learnt lessons, especially on species selection. The emergence of a potential carbon farming income stream in recent years is seen as a bonus helping to recoup costs associated with the establishment. Some basic estimates of potential carbon storage through revegetation in the Dalwallinu area were undertaken using the FullCAM model (Figure 3).

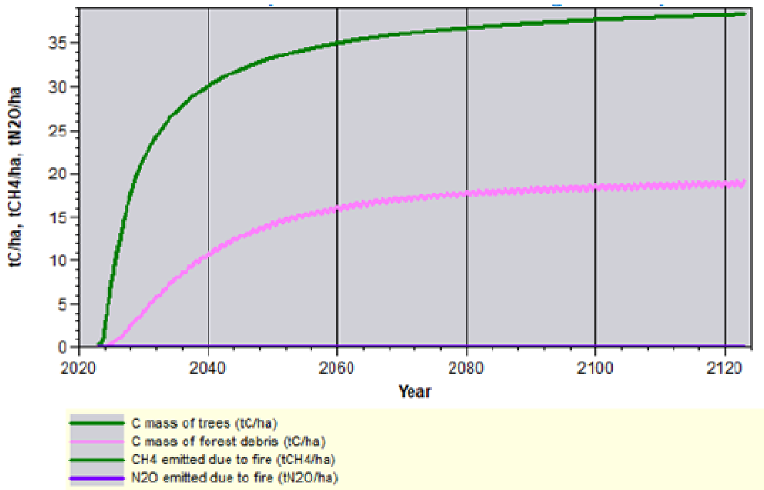

Figure 3: Output from FullCAM modelling for an environmental planting at one of the focus sites.

The net result is about 553 tonnes carbon/hectare sequestered after 25 years according to FullCAM modelling. The current price of an Australian Carbon Credit Unit (ACCU) is around $30 per tonne of carbon but was higher than $50 earlier in 2022. Assuming a constant $30 per ACCU over the 25-year life of the carbon farming project, an income of around $660 per hectare per year could be expected. For a typical 10-hectare revegetation project, this equates to total revenue of around $166,000 after 25 years.

Another possibility is a farm forestry project which would generate carbon income over a 25-year project and then could be harvested for wood products. For this method, species do not have to be native and one WA species that has potential in saline winter wet areas to produce timber is Casuarina obesa (Swamp She-oak).

Comments

Considerable knowledge and investment in drainage have occurred in the project area. Lessons have been learnt about revegetation and species selection. The changes to a cropping-only system have likely had some impact on salinity though it is not quantified. The various aspects of drainage; regulatory, geophysical, governance of drain networks, and the importance of surface water management to complement groundwater drainage are all still important issues.

The full salinity catchment review can be viewed on the Liebe Group website.

Acknowledgments

Thank you to the Dodd, Pearse, McAlpine and Barnes families for taking the time to be involved in this catchment review.

This project is supported by the Western Australian Government's State NRM Program.

Peer review

The full catchment management review document was reviewed by Richard Marver.

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Understanding the Why, When and Where of Best Practice Soil Testing for Sustainable Soil Health in the Northern Wheatbelt

Chris O'Callaghan, Liebe Group

Aim
In the Northern Agricultural Region of Western Australia, many farmers have adopted soil testing on an annual basis to guide their liming programs and fertiliser decisions. However, there has been limited uptake of more in depth testing to understand soil parameters such as microbial biomass, soil moisture, soil carbon, and soil strength and how these indicators can contribute to the overall health and economic potential of their soils. Soil testing to depth, >30cm, is also rarely employed due to the cost and ease of completing.

This project will focus on supporting farmers in the Liebe Group region to optimise their soil testing investment and understand the situations where more in depth testing could provide greater return on investment and support their decision making in managing soil constraints. Through the engagement of an agricultural professional, growers will be supported in implementing on-farm demonstrations that aim to improve the health of the soil including management of aluminium toxicity, increasing soil biological activity, removal of subsoil constraints and building soil carbon levels.

The activities will take a 'grass-roots' approach and focus on empowering young, innovative farmers to better understand when, where and why to use in depth soil testing to guide their soil management practices on their farm. Local farmers will be engaged in the project by attending capacity building opportunities such as an annual bus tour to visit demonstration sites with soil-specific guest speakers.

Four focus sites have been located around the Liebe Group region and have been sampled to measure baseline soil properties.

Site 1: Kalannie. Soil Acidity remediation site
Site 2: Buntine. Salinity Reclamation site
Site 3. Buntine. Soil Carbon monitoring site
Site 4. Marchagee. Salinity and water repellence remediation site

In August 2022, a workshop called "Making Sense and Cents of Soil Testing", was held in Dalwallinu giving growers the opportunity to learn more about soil testing and how to improve returns from soil testing results.

Work will continue on this project in 2023.

Acknowledgements
This project is funded through the Commonwealth Government's National Landcare Programs Smart Farms Small Grants: Soil Extension Activities.

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Demonstrating the Benefits of Soil Amelioration ("Ripper Gauge")

Juniper Kiss, Liebe Group, and Dylan Hirsch, Hirsch Farms

Key Messages

- Deep ripping can provide a significant yield benefit which can last for several years.
- Deep ripping does not always provide statistical or economic yield benefit immediately.
- Subsoil nutrient recovery and redistribution following deep ripping can be significant and should be considered when planning fertiliser applications.
- Controlled traffic can prolong the effect of deep ripping on subsoil strength (compaction).

Aim

To evaluate and demonstrate the benefit of soil amelioration and controlled traffic farming. To evaluate differences in deep ripping timing over subsequent years.

Background

Previous GRDC research trials have found that shallow ripping (30-40 cm), deeper ripping (>50 cm), and deep ripping with topsoil slotting increased wheat yields by 8%, 35%, and 53% (Davies et al., 2017).

This trial was established in 2021, when the paddock was in a canola phase. Ripping was conducted at 1 week, 3 weeks and 6 weeks after sowing, with an unripped strip kept as a control. The Hirsch's have always seen canola and deep ripping as a package, because of canolas' ability to use subsoil moisture and produce a reliable yield response, and the tillage effect of stimulating weeds where they can be controlled with glyphosate or selective herbicides. However, it can be risky, with plant establishment sometimes reduced by inconsistent depth control in softer sands when seeding after ripping. Reduced plant establishment can undo the yield response of canola in this system.

Deep ripping post seeding, when there is adequate subsoil moisture available is considered an option to alleviate potential reduction in plant establishment however this comes with significant logistical issues (e.g., machinery and labor availability, risk of seedling mortality). After seeing the effects of Early Post Emergent deep ripping trial strips on previous canola crops, Dylan implemented this trial to better assess the effects of different timings of post-emergent deep ripping. The soil was previously deep ripped in 2017 and is a yellow sandy loam, which is considered easy to rip when there is moisture in the soil.

In 2022, the site was sown to wheat to continue to measure the effects of the deep ripping.

Trial Details

Trial location	Hirsch Property, Latham
Plot size & replication	12.2m x 400m x 2 replications
Soil type	Sandy Loam
Paddock rotation	2018: Canola 2019: Wheat 2020: Wheat 2021: Canola 2022: Wheat
Sowing date	19/05/2022
Sowing rate	60 kg/ha Vixen Wheat
Fertiliser	85 kg/ha MacroPro, 40 L/ha UAN banded
Herbicides, Insecticides & Fungicides	2.5 L/ha Boxer Gold, 240 mL/ha Voraxor IBS 1 L/ha Jaguar, 300 mL/ha MCPA @ 3 leaf
Harvest date	08/12/2022

Treatments

T1	Unripped (Control)
T2	Ripped @ 2-3 leaf canola stage 20th May 2021. Moist but not saturated profile
T3	Ripped @4-6 leaf canola stage 31st May 2021. Dry topsoil with moist subsoil
T4	Ripping @ 8 leaf canola stage 16th June 2021. Moist but not saturated profile

Soil composition

Table 1. Soil nutrient analysis and moisture % taken on the 22nd of April, 2022 at Latham.

Treatment & Depth	NH3 (mg/kg)	N03 (mg/kg)	P Colwell (mg/kg)	K Colwell (mg/kg)	S (mg/kg)	Zn (mg/kg)	OC (%)	EC dS/m	pH (CaCl2)	Soil Moisture (%)
T1 0-10	2	3	28	106	11.8	0.28	0.71	0.069	6.2	0.9
T1 10-30	2	3	10	73	16.2	-	0.35	0.044	4.9	0.8
T2 0-10	2	10	31	127	8.3	0.45	0.56	0.063	6.3	0.9
T2 10-30	2	9	11	79	14.3	-	0.33	0.048	4.6	1.9
T3 0-10	2	8	33	130	10.3	0.21	0.65	0.067	6.2	0.7
T3 10-30	1	4	12	62	18.3	-	0.35	0.054	4.8	1.4
T4 0-10	2	8	35	129	14	0.19	0.5	0.062	6.1	1.1
T4 10-30	2	3	9	71	16.2	-	0.34	0.047	4.7	0.1

Results

2022 wheat plant establishment (figure 1) and NDVI (figure 2) did not vary between the treatments. The soil strength (compaction) statistically significantly differed between T1-T2, T1-T3, T1-T4, and T3-T4 (F_3=17.51, P<0.001) (Figure 2). Soil compaction below 50 cm was lower in the deep ripped plots. The soil was not water-repellent across the trial. The average yield varied between 3.15-3.95 t/ha (Figure 4) and T2 (ripping 1-week post-seeding) had the highest yield overall.

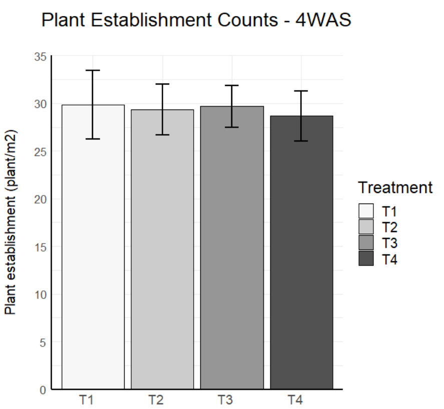

Figure 1. Wheat crop establishment at 4 weeks after sowing (4WAS) did not statistically differ between the different ripper treatments at the Ripper Gauge trial at Latham in 2022. Error bars are ± SEM.

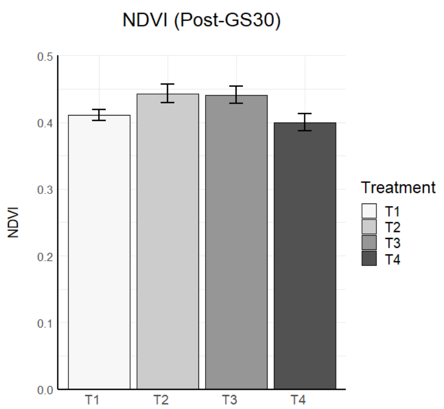

Figure 2. Whilst the NDVI appeared to be lower in the control plots, NDVI overall did not statistically differ between the treatments (P > 0.05). Error bars are ± SEM

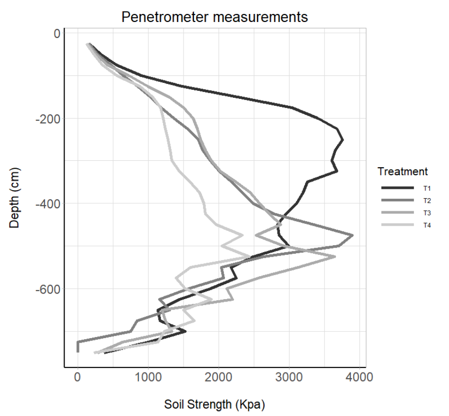

Figure 3. The soil strength (compaction) statistically significantly differed T1 (control) and all the other treatments in August 2022.

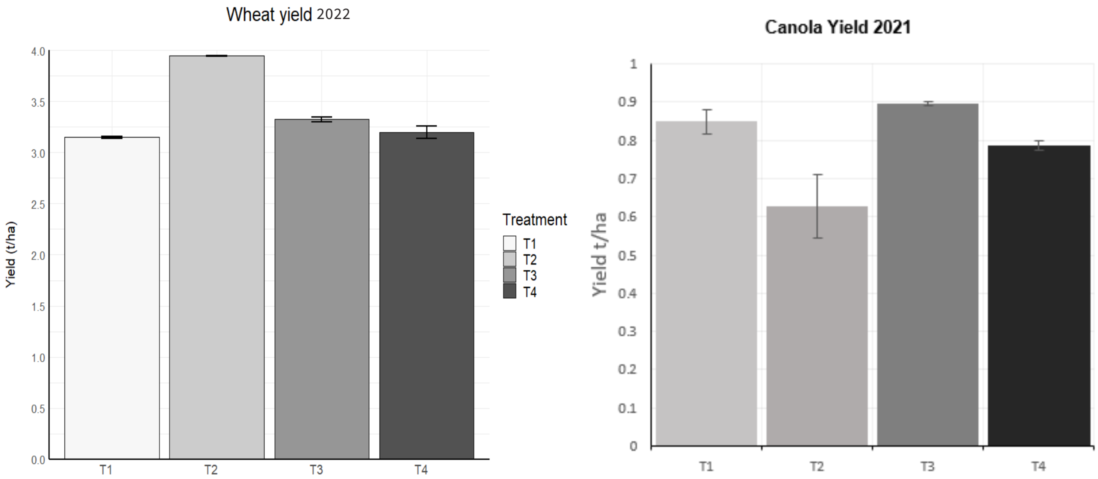

Figure 4. Yields of wheat in 2022 (left) and yield of canola in 2021 at Latham (right).

Comments

In 2022, there was an even establishment of wheat accoss the trial (figure 1). There did appear to be a lower amount of biomass indicated by NDVI readings in the control treatment (T1) (figure 2), however this was not statistically significant. Penetrometer readings taken in August 2022 (figure 3), highlighted the continuing effect of the deep ripping on soil compaction, with the control (T1) being significantly more compacted than all of the ripping treatments. This however did not translate into a significant yield benefit across all ripping treatments at harvest time (figure 4.) The data indicated a higher yield in treatment 2, which was the lowest yielding treatment in the 2021 canola crop. In 2021, treatment 2 was lower yielding due to higher plant mortality as a result of the ripping one week after sowing. This may have left a higher level of moisture and nutrition in the soil for the 2022 wheat crop to utilise. This is only marginally supported by the soil composition results, which show treatment 2 to have slightly higher levels of Nitrate N and Potassium in the top 30cm, as well as slightly higher subsoil moisture reading (table 1) than the other treatments. All ripped treatments had higher nitrogen N, phosphorous P and potassium K levels than the control, suggesting that the previous canola crop may have redistributed subsoil nutrients to the topsoil in ripped plots. There was also a slightly elevated amount of Zn in the top 10cm compared to the other treatments. It must be noted that these soil measurements are unreplicated and are providing a guide only.

Although the treatments have not produced a significant economic return on deep ripping, the trial will continue to be harvested in 2023 and 2024 to measure yield differences across treatments.

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Peer review

Chris O'Callaghan, Liebe Group.

Acknowledgements

This project (WMG1803-002SAX) is a GRDC investment that is led by the West Midlands Group and this site is managed by the Liebe Group. This site is one of four trial sites across the Wheatbelt that has investigated the use of early post-emergent (EPE) deep ripping on grain yield. Thank you to the Hirsch family for hosting the trial site.

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Using Living Plant Systems and Modern Farming Methods to Sequester Soil Organic Carbon, Reduce Greenhouse Gas Emmissions and Improve Soil Fertility

Chris O'Callaghan, Liebe Group

Aim

This project aims to trial, measure and demonstrate crop sequencing and new technologies that can sequester organic carbon (C), mitigate greenhouse gas emissions and improve soil fertility in crop production systems that have traditionally struggled to accumulate C.

Background

Farmers have considerable interest in new practices that can improve the supply / recycling of nutrients from organic sources, minimise losses and increases their soil C stocks whether for productivity reasons or being able to participate in carbon trading schemes. Plant residues are utilised by soil biota including microorganisms and insects, with carbon dioxide (CO_2) being released into the atmosphere and nutrients being mineralised for plant use. Currently it is considered that only a small proportion of the C enters the soil and stays there. Building stable C such as humus takes time, especially under dry conditions in soils with low buffering capacity. Hence, at the present time, there are no methodologies for Australian Carbon Credit Units (ACCU's) for cropping and pasture in low rainfall zones of the wheatbelt.

This project will use a farming systems approach to investigate methodologies for C sequestration and nitrous oxide mitigation using crop sequencing (including summer crops, cover crops and pastures), soil C amendments and soil amelioration. These will be trialled in small to medium size plots in fully randomised designed experiments.

Three trial locations spread through the wheat belt (South, Central and central North) targeting a range of climatic and soil type differences will be managed by WANTFA and Murdoch University through the Cooperative Research Centre for High Performance Soils (the Soil CRC) in collaboration with five farming system groups: Liebe Group, West Midlands Group, Facey Group, Corrigin Farm Improvement Group and WANTFA. The selected treatments also have the potential to increase productivity on farm and have soil health benefits.

The Liebe Group site is located west of Coorow, on a poor sandplain paddock. The site has not got a cropping history and is currently out of production, only covered by a tussocky weed. This was deemed an ideal site for this project, as soil carbon levels and fertility is low and the farmer is wanting to improve the paddock and bring it back into production. In 2022, 80 t/ha of bentonite clay was applied, with the rest of the treatments to be implemented in 2023.

Treatments

1	80 t/ha Bentonite Clay + Plough
2	80 t/ha Bentonite Clay + Manure + Plough
3	80 t/ha Bentonite Clay + Extra Nutrients + Plough
4	Plough Only
5	Chicken Manure + Plough
6	Extra Nutrients + Plough

Figure 1. Bentonite clay being spread on a sandplain site in Coorow in June 2022.

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FARMING SYSTEMS RESEARCH RESULTS

The Impact of Stubble Height on Cropping Systems in the Western Region - Maya

Jessica Cole & Chris O'Callaghan, Liebe Group

Key Messages
- Weed densities appear lower in a strip and disc system early on.
- Pre -seeding spray efficiency was greater in the low cut draper front plots although this did not impact overall weed control.
- Stubble crunching slightly reduced soil moisture at seeding.
- The taller stripper front, with a stubble crunch and disc sown yielded slightly higher in this season.

Aim
To give growers the knowledge and understanding of how differing stubble architectures contribute value to their farming system, understand the differing costs involved, acknowledge the risk/reward profile and use this new knowledge to make profitable adoption decisions.

Background
There is a lot of interest in the 'Strip and Disc' system (high residue system) in the WA Wheatbelt, and growers are looking to understand the benefits in water use efficiencies, reduced wind erosion, and increased yields to determine the fit for their system.

With GRDC investment, the Liebe Group is leading a four-year project in partnership with three grower groups (Stirlings to Coast Farmers, Facey Group, and Corrigin Farm Improvement Group), Farmanco, CSIRO and DPIRD.

There are four large-scale demonstration sites located throughout the state that were implemented by host growers during harvest in 2021. Each site is designed with various treatments including the stripper front & disc seeder and draper front and tyne seeder combinations, as well as an additional treatment determined to be a locally relevant priority around stubble management.

The investment aims to compare the various stubble residues, with the following aspects being explored of high stubble systems:
- Soil moisture - increased water infiltration and decreased evaporation
- Lower weed germination due to less disturbance
- Improved soil structure
- Disease carryover
- Herbicide tie-up in stubble
- Harvest weed seed control options
- Lack of cultivation below the seed, if moving to disc seeding
- Increased fire risk over the summer
- Pre-emergent herbicide efficacy
- Nitrogen inefficiency when top spreading into the straw
- Frost risk

This report focuses on the Liebe Group site at Maya, with results from the other sites in Western Australia being released later in the year. The stubble height treatments for this trial were implemented at harvest 2021.

Trial Details

Trial location	Brendon McAlpine, Elserae Agriculture, Maya
Plot size & replication	39.4m x 900 m (1 strip) x 4 replications
Soil type	Tamar Tussock Sandplain, with ironstone gravel ridges
Paddock rotation	2020 lupins, 2021 wheat, 2022 canola
Sowing date	21/04/2022- 25/04/2022
Sowing rate	1.8 kg/ha Emu Canola
Fertiliser	03/05/2022: 45 kg/ha MAP, 50 kg/ha Urea 07/06/2022: 88 kg/ha Urea, 20 kg/ha MOP
Herbicides, Insecticides & Fungicides	10/03/2022: 1 kg/ha Mouseoff Zinc Phosphide 23/03/2022: 1 t/ha Limesand, 0.5 t/ha Gypsum 12/04/2022: 1.45 L/ha Paraquat 250 01/07/2022: 200 mL/ha Targa 01/09/2022: 1 kg/ha Mouseoff Zinc Phosphide 15/09/2022: 0.3 L/ha Chlorpyrifos, 0.15 L/ha Affirm, 0.02 L/ha Trojan
Harvest date	21/11/2022

Treatments

1	Draper Front + Tyne Seeder
2	Stripper Front + Disc Seeder
3	Stripper Front + Disc Seeder + Stubble Crunched

Soil test values 2022 Pre-Seeding

Depth (cm)	pH ($CaCl_2$)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	Col P (mg/kg)	Col K (mg/kg)	KCl S (mg/kg)	EC (ds/m)	OC (%)
0-10	5.7-6.2	10-16	2-3	36-57	18-97	4.5-11.9	0.067-0.106	0.69-1.23
10-30	4.5-5.4	1-3	<1-1	12-27	<15-49	5.6-25.2	0.022-0.042	0.20-0.52
30-50	4.4-5.8	<1-4	<1-1	<2-10	<15-49	6.9-33.9	0.012-0.042	0.12-0.30
50-70	5.2-5.6	<1-2	<1-1	3-7	<15-106	6.3-35.8	0.020-0.340	0.07-0.16
70-100	5.4-5.7	<1-2	<1	<2-7	<15-37	26.2-42.2	0.025-0.420	0.07-0.12

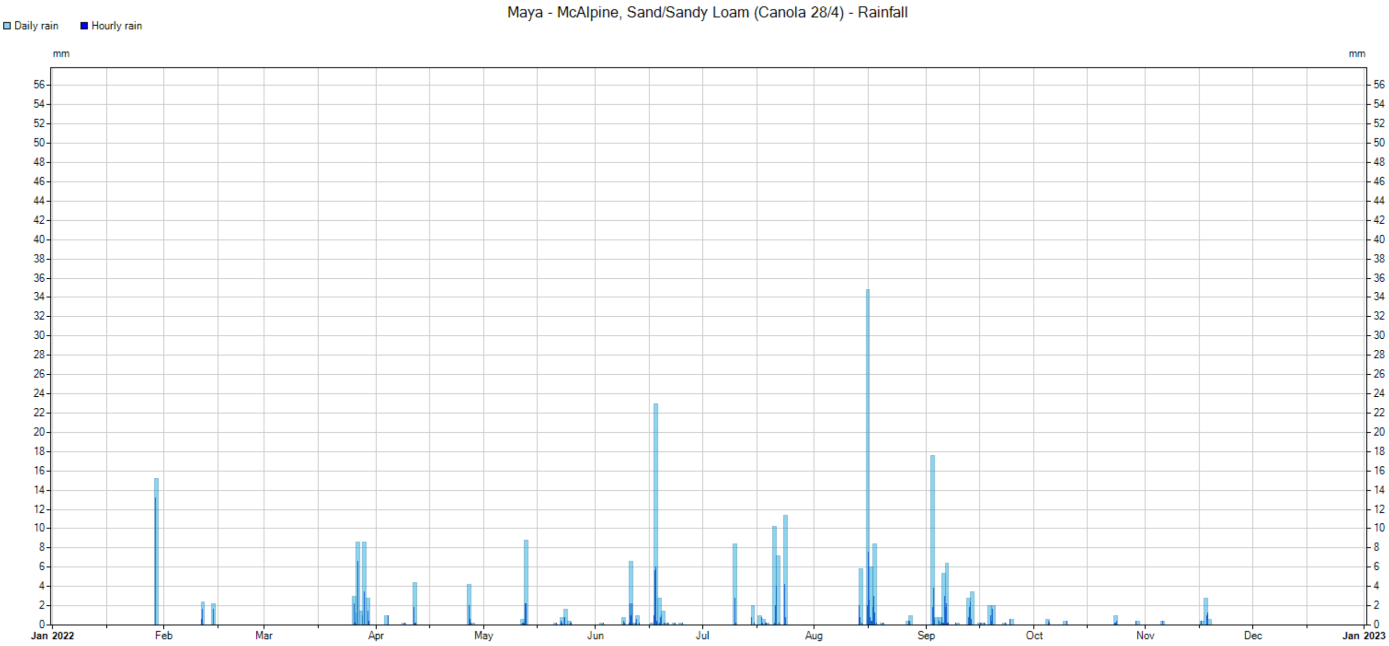
Soil test critical (90% relative yield) values for canola measured in the 0–10 cm soil layer.

Soil test measurement	Critical value (mg kg^{-1})	Critical range[A] (mg kg^{-1})
Col P	19	17–25
Col K	44	42–45
KCl S	6.8	60–7.5

[A]95 per cent chance that this range covers the critical soil test value.

The soil test values are indicating adequate P status, but site where K is below 44 mg K kg^{-1} would be limiting canola growth. Where KCl S is below 6.8, sulphur would be limiting canola production.

2022 Daily Rainfall



Maya monthly rainfall

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2022	15.2	4.6	24.4	9.8	12.2	35	41	56.6	42.6	2.4	3.4	0	247.2

Results

Harvest Losses 2021

Harvest loss measures were not taken in 2022 as there was no stripper front used, however in 2021 numerous drop tray tests of losses coming from the different harvesting setups where completed in a nearby paddock in a wheat crop. Both front and machine (back) losses were measured. Whilst not conducted in an experimental manner, the results give an insight into the difference between the machines. Front losses from the draper front were 0, whereas, from the stripper front, the losses ranged from 62-77 kg/ha, mainly coming from heads of wheat that had dropped off the front. The machine losses when using the draper front setup were within an acceptable limit, around 50 kg/ha. Initial machine losses coming from the stripper front setup were higher than acceptable, with less material going through the machine and faster ground speeds sending around 260 kg/ha out the back. Lowering the fan speed and reducing ground speed slightly, these losses were able to be reduced to around 30 kg/ha.

Moisture Conservation & Crop Establishment 2022

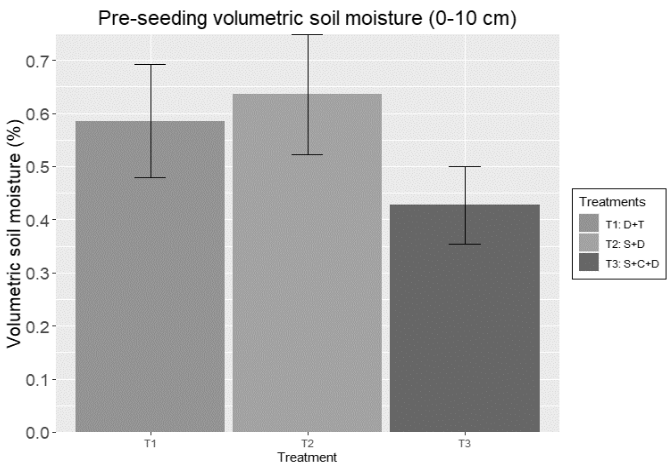


Figure 1. Pre-seeding volumetric soil moisture readings measured on 20/4/2022.

Soil water content was above crop lower limit due to rainfall event of 23mm on 26–31 March. Canola germination occurred due to rainfall event of 4mm on 27 April followed by 9mm on 13 May.

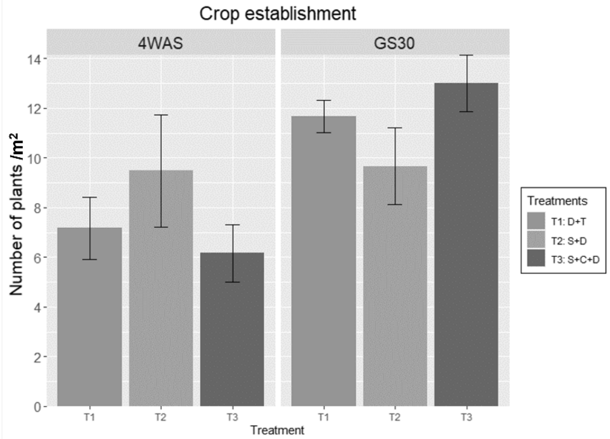


Figure 2. Crop establishment at 4WAS (24/5/22) and GS30 (10/8/22).

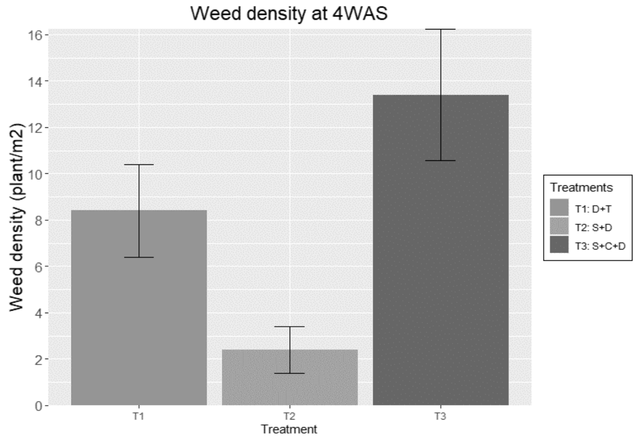


Figure 3. The weed density recorded at 4WAS (24/05/22).

Soil moisture at seeding as measured using a volumetric probe in the top 10cm showed little difference between the low cut draper front and tall stripper stubble recorded in this season (Figure 1). At 4WAS, canola establishment was poor, with relatively low plant counts across all the treatments. The strip & disc treatment had a slightly high establishment at this time than the other treatments, although by August plant numbers in these treatments had caught up.

In 2023, additional soil moisture readings will be taken to get a more complete picture of soil moisture changes between treatments at seeding.

Spraying Efficacy & Weed Density 2022

Table 1. Pre-seeding spraying efficacy recorded using the SnapCard spray app. Measurements taken on 08/04/2022. (Please note this data was reported incorrectly in the Liebe Group November newsletter).

	Spray cover (top)	Spray cover (bottom)	% Loss
Draper Cut (low cut)	17.33	16.78	3.22
Stripper front	17.30	9.84	43.15

Pre-seeding spray efficacy was more efficient in the low cut draper front treatment, with only 3% of the spray not penetrating the low cut stubble to reach the ground. In stripper front treatments, this increased to 43% (Table 1). It is worth noting the spraying was completed in marginal conditions due to wind, with the higher stubble likely catching the spray before it hit the ground. *Please note the spray efficacy figures were reported incorrectly in the Liebe Group November Newsletter.*

T1 and T3 had higher numbers of weeds at 4 weeks after sowing than T2 (Figure 3) likely due to the increased soil disturbance caused by the tynes in T1 and stubble crunch in T3. By the second weed assessment timing in August, 5 weeks after a glyphosate application, no weeds were present across all treatments (data not shown).

Yield 2022

Yield data from 2022 showed canola yields were statistically significantly, ($P<0.05$), higher for T3 compared to T1 and T2 (Figure 4) albeit only marginally (2.44 t/ha – 2.58 t/ha).

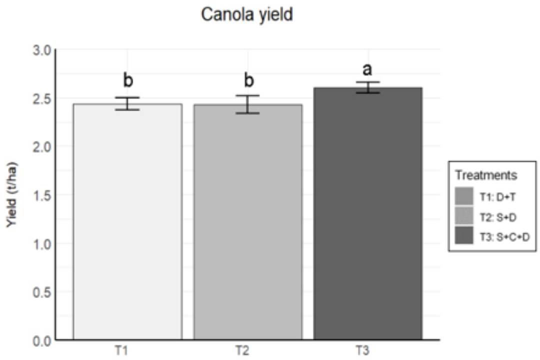


Figure 4. The canola yield in 2022. Error bars are ± SEM. The [ab] represents statistical difference (P<0.05) according to the one-way ANOVA test.

General Comments

Conditions at this site at the start of the season were relatively dry and this had an impact on crop establishment overall. A favourable finish to the season led to good yields across all treatment.

Stubble heights for the low cut draper (Macdon D145) treatment averaged 20cm, whereas the stripper front (Shellbourne) treatments were around 65cm. In 2021, the wheat crop experienced areas of frost that affected the standing stubble integrity. This gave rise to some seeding issues that had to be rectified on the go this season. The site was sown with canola (Nuseed Emu) over the ANZAC day long weekend 2022. Seeding machines used for the different treatments were a C2 Morris Bar on 12-inch spacing and Borgoult 3720-40 bar on 7.5-inch spacing. The 2022 harvest was completed with a Macdon D145 draper front only.

The original trial design had to be adjusted to incorporate a stubble crunching element on treatment 3 (originally stripper + tyne) as the tynes were unable to get through the residue without hair pinning and bulldozing. This changed the treatment to be stripper + disc + stubble crunch. Stubble crunching is an added cost to the budget including expenses of hire, fuel and labour. It was noted by the host grower that stubble crunching caused issues for the disc seeding bar as well, with loose stubble meaning regular lifting was required. There may have been a cultivation effect with this treatment as well, particularly in relation to the soil moisture availability in the period immediately after seeding however this was not measured this season. Additional moisture measurements will be taken in 2023.

There is interest to see if stubble breakdown is quicker in this treatment and if it resulted in changes to plant available nitrogen. Cereal stubble especially has a high carbon-to-nitrogen (C:N) ratio that can tie up soil N leading to N deficiency in the crop (Kirkegaard et al., 2018). In 2023, plant tissue testing will be included in the protocol which could provide new insights into N-cycling in higher stubble loads.

Due to machinery logistics and availability the trial will be moved to Bunjil in 2023 with a new host grower, Dylan Hirsch.

Acknowledgments

This project is an investment by the Grains Research & Development Corporation. Thank you to the McAlpine family for hosting, seeding and harvesting the trial for the past two seasons.

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Peer Review

Geoff Anderson, Department of Primary Industries and Regional Development.

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MACHINERY AND TECHNOLOGY

Agtech Decoded: Growers Critically Analysing the Role of New Technology in On-Farm Decision Making - What Are the Possibilities?

Chris O'Callaghan and Juniper Kiss, Liebe Group

Key Messages

- 19 paddocks with soil moisture probes have been the focus of using digital tools and modelling to improve yield predictions.

Aim

To critically assess the ability of modern data analytics to address farming system challenges. The project involves monitoring 19 paddocks that have been set up with soil moisture and weather stations.

Background

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 way farmers make decisions in their farming business.

Often, growers lack the time, tools, or skills to process, visualise and use different sources of data efficiently, but through this project and in partnership with CSIRO will enable growers to better understand the opportunities presented by the latest digital technologies and how they can use them for decision-making purposes. Precision2Decision report states that a minimum 2% productivity increase (livestock is higher) is possible from yield forecasting. Digital platforms have the power to address agronomic problems quickly and cheaply and they could reduce the gap between the yields growers achieve in a paddock and the water-limited potential of the paddock (the yield gap).

The Liebe Group has a long history of working with CSIRO to introduce and validate tools and systems research with farmers with numerous project leaving a legacy of better characterised soils and improved understanding of yield prediction tools. Digital agriculture is moving rapidly and this project will continue that legacy and provide the opportunity for adoption and validation of new tools with local farmers.

This project also collaborates with Stirlings to Coast Farmers, which provides a diversity of farming systems to the project.

Project progress

CSIRO collaborators are using the next-generation Agricultural Production Systems Simulator (APSIM) model and other tools, to estimate the potential yield of 19 paddocks. The Liebe Group paddocks are shown in figure 1. The modelling is investigating whether there was a yield gap present between potential yield and actual yield. This analysis will be presented to participating growers in a workshop to be held on the 22nd March in Dalwallinu.

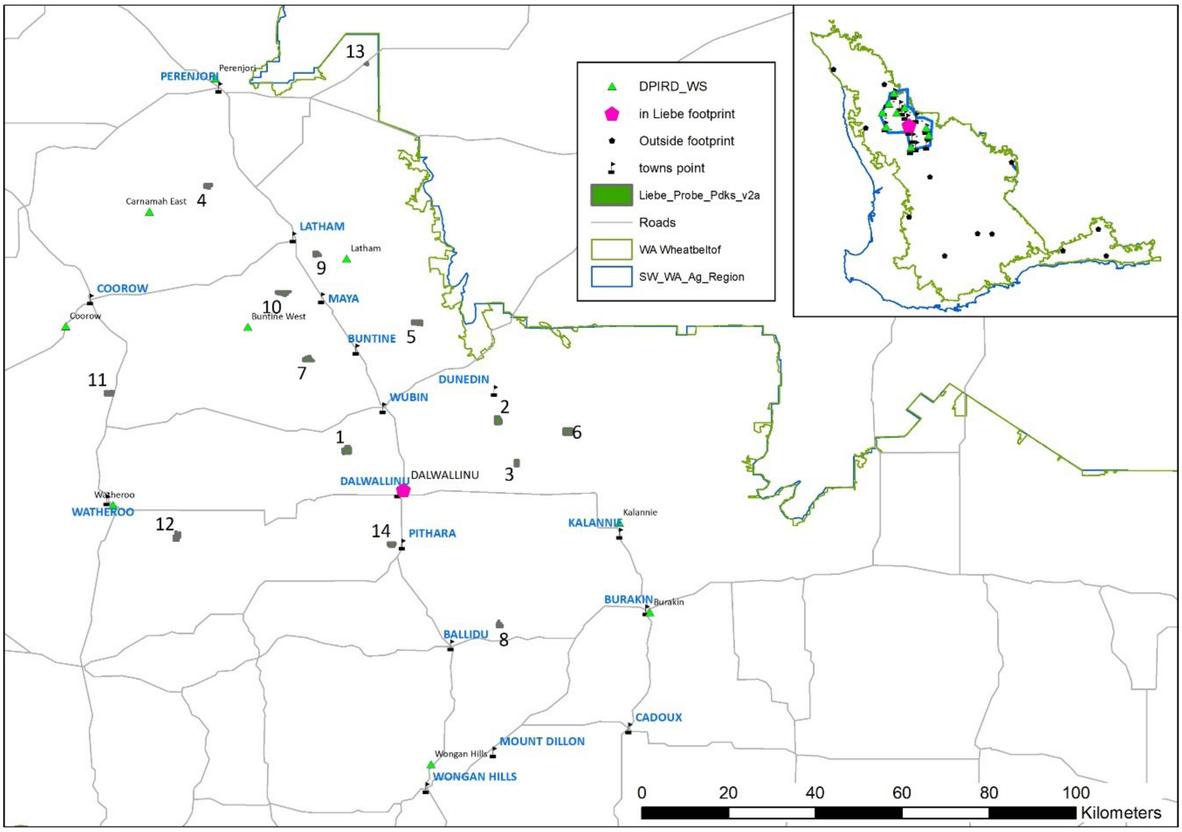

Figure 1. Distribution of soil moisture probes and weather stations (numbered) in the Liebe group area.

Comments

Recent changes in technology have enabled this type of analysis to be more effective and efficient. For example, CSIRO has developed satellite-driven crop assessments such as Agriyieldz and has access to publicly available datasets such as the Soil Landscape Grid of Australia that would complement farmer data to create a valuable data asset and tool. The Agricultural Production systems simulator is a CSIRO tool that can be utilised to assess the potential yield of a paddock, considering soil type and seasonal conditions.

Acknowledgments

The Agricultural Innovation Hubs Program received funding from the Australian Governments Future Drought Fund.

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Measuring Harvest Losses in Western Australia

Chris O'Callaghan and Tyler McIlroy, Liebe Group

Key Messages

- A total of 72 tests of harvest grain losses were completed by the Liebe Group in 2022.
- In 2021 an estimated $300m of value across WA was lost through Harvest Losses.
- Front losses in legume crops were high in 2021 and again in 2022.
- 2022 data analysis is on going and will be made available later in the year.

Aim

Grain growers in the Western Region will understand the current level of grain losses (tonnes and $) during harvest for all of the major grain crops in Western Australia and understand where these losses occur. Growers will be able to calculate acceptable losses irrespective of varying yield levels.

Background

In the 2021 season, a total of 200 harvest loss drop tray tests were conducted across Western Australia. An analysis of these results that was extrapolated across the total tonnages of the 2021 harvest resulted in an estimated $300m of value across WA being lost through Harvest Losses. Lupins, Lentils and chickpeas were particularly susceptible with Lupins losing around 11% at harvest, Lentils 8% and Chickpeas 7% (figure 1), with front losses being particularly high.

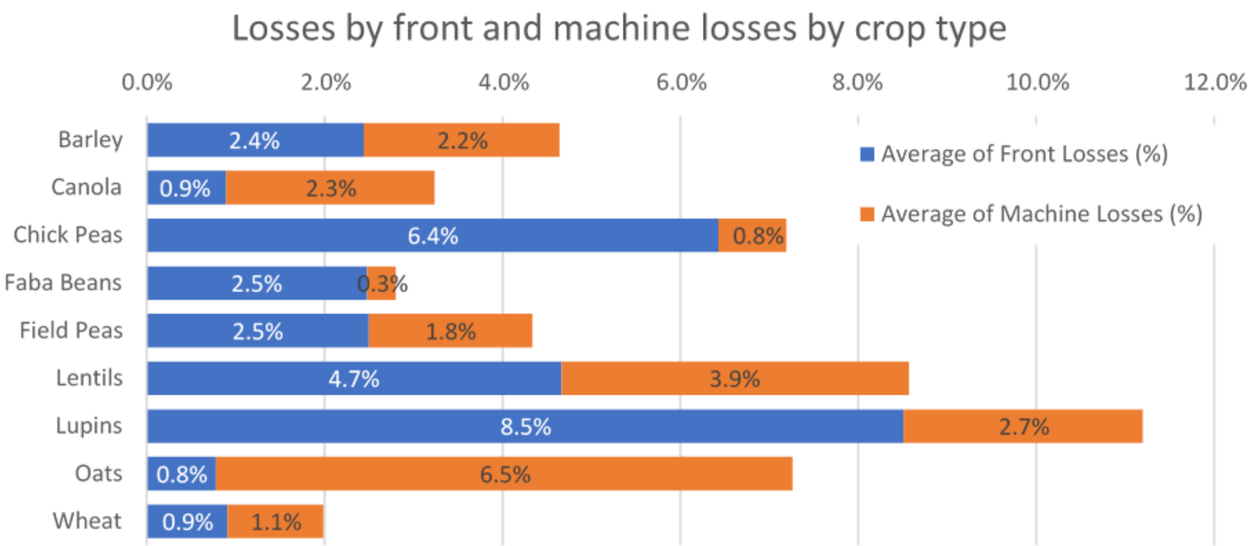

Figure 1. 2021 results of harvest loss percentages from 200 tests from across WA.

There are acceptable losses and different thresholds for each grain crop, which represent the optimum balance between grain loss and harvest efficiency (speed, logistics etc.). Optimising this balance will ensure growers can minimise losses while maximising profit.

This investment by the GRDC aims to quantify the losses in each of the major grains crops in the Western Region and create a benchmark for losses, rather than relying on anecdotal evidence or farmer-collected data in investment analysis. The data captured will focus on the front and back losses, with an analysis to summarise the findings and help guide further investment in minimising harvest loss.

Results

The Liebe Group team conducted harvest loss sampling activities at 72 sites throughout the Kwinana East and Geraldton Port Zones. Visiting individual farms during their harvesting period, drop pans were utilised to measure front and machine losses.

Full results from 2022 are currently being collated and analysed by the project team however a few initial observations have been made from the sites completed by Liebe staff:

- Front losses were again high in Lupins as well as chickpea crops, with the highest recorded front loss in lupins being nearly 900 kg/ha.
- Canola front losses averaged around 24 kg/ha or 1.15%.
- Canola machine losses averaged 32 kg/ha or 1.4%.
- The majority of losses in wheat and barley crops were under 1%.
- Many growers were interested in finding the balance between optimising harvester capacity and increasing losses. In some cases harvesters could handle the extra throughout associated with higher ground speeds, however this can also result in increased machine losses if setting were incorrect.

Comments

To read the full 2021 report, please visit https://www.liebegroup.org.au/harvestlosses

Acknowledgements

This is a GRDC invested project, led by the Grower Group Alliance. The Liebe Group acknowledges the contributions participating growers have provided to the project activities. Thank you also to Ben White, Primary Sales Australia, and Glen Riethmuller (DPIRD) for their support.

Contact

The Liebe Group
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08 9661 1907

GENERAL INFORMATION

Benchmarking with Aglytica

Aglytica is a specialist benchmarking company providing farm financial and production analysis to hundreds of businesses across Australia. Aglytica's annual publication, Farm Profit Series™, is designed to help producers compare results to other businesses and has been produced (as the Farmanco Profit Series) for nearly 25 years.

Benchmarking is a process that uses key performance indicators to better understand how the management activities of a farming business impacts its profitability. It is a tool used to compare your business externally to similar businesses or to make comparisons within the business itself. This comparison can then be used to identify business strengths and areas for improvement to help make decisions to achieve the desired outcomes.

Benchmarking can be used to improve the understanding of the physical and financial performance of your business, increase motivation to improve your efficiency, identify trends, create best practice, improve the business bottom line, improve awareness, and allow farm owners and managers to better align their performance with their business objectives.

The following data has been extracted from the 2021/2022 Farm Profit Series and is based on the shires covered by the Liebe Group. For further information or if you are interested in having your farm business benchmarked, please contact Hilary Bunny on 0439 448 159 or hilary@aglytica.com.au. You can also find more about our benchmarking products on the Aglytica website - www.aglytica.com.

Table 1: Business Performance Measures for 2021.

Liebe Group 2021 Overview			
	Lower 25%	**Average**	**Top 25%**
Effective area	3394	5429	7968
Land Value $/Eff Ha	$4,878	$3,172	$1,885
Labour	5.17	5.72	6.32
Crop %	83%	89%	93%
Machinery Value $/ha	$457	$452	$401
Net Equity %	93%	90%	92%
Growing Season Rain	366	336	332
Income $/100mm Effective Rain	**$285**	**$313**	**$323**
Cashflow Measures			
Farm Income	**$974**	**$1,006**	**$1,056**
Wages $/ha	$28	$21	$23
Fertiliser $/ha	$123	$119	$124
Pesticides $/ha	$83	$92	$94
Fuel and Oil $/ha	$25	$26	$26
Repairs and Maintenance $/ha	$53	$40	$31
Total Variable Costs $/ha	**$508**	**$481**	**$485**
Overheads $/ha	$58	$45	33
Drawings/Management $/ha	$50	$40	$37
Machinery Capital $/ha	$72	$65	$81
Farm Infrastructure Expenditure $/ha	$7	$7	$7
Total Fixed Costs $/ha	**$185**	**$156**	**$157**
Operating Surplus $/ha	**$282**	**$368**	**$415**
Profit Measures			
Operating Profit $/ha	**$319**	**$409**	**$480**
Return on Assets Managed % (ROAM)	**7.73%**	**16032%**	**26.07%**

Whole Farm
2021 was an excellent year for the farm businesses in the zone covered by the Liebe Group. The results have been heavily influenced by the well above average yields in the low rainfall zone, however the Top 25% is based on the 5-year average ROAM not just the 2021 ROAM.

The group average operating profit ($/ha) was nearly 3 times the five-year average (figures 1 and 2). Strong commodity markets were met with above average growing season rainfalls to provide management with a leg up. If historical reports are correct and farmers make 100% of their profits in three out of ten years, this was one of those years.

Profitability measures were historically very high in the 2021 period. The top 25% generated a return on assets managed (ROAM) average of 26.07%. ROAM is a profitability measure determining how efficiently a business uses its resources. It is one of the best benchmark measures to assess the ability of a business to expand and grow its profits into the future.

ROAM is calculated by dividing the business earnings before interest and tax by the value of the total asset base (including infrastructure and lease values). It is important to note that ROAM generally has a much stronger correlation with profit than with land values. However, ROAM figures will be influenced by extreme movements in land valuations, which will be coming through in the 2021 and 2022 years. So, whilst ROAM is an important measure to track, it should be coupled with other key performance indicators to get a robust view of the benchmarked year.

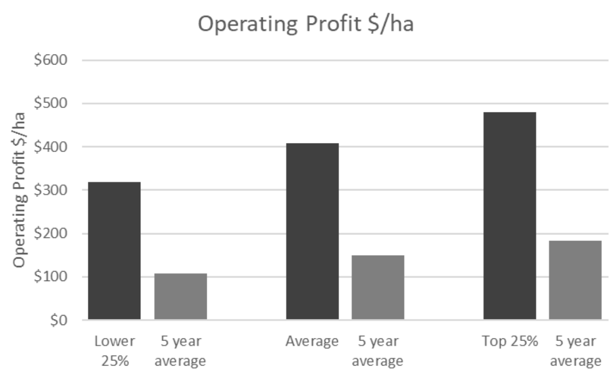


Figure 1: 2021 Operating Profit compared to the five-year average.

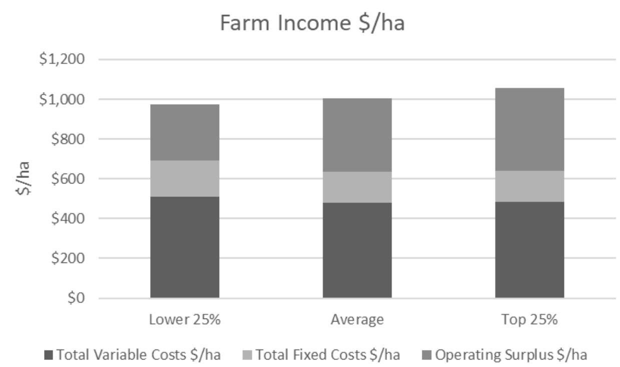
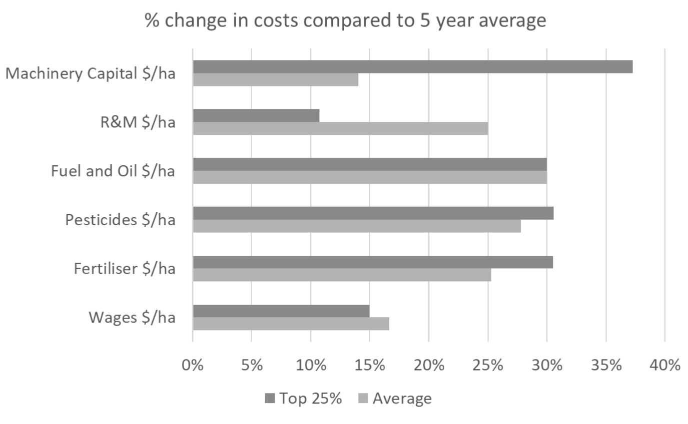


Figure 2: 2021 Breakdown of Farm Income.

If 2021 was a year to generate historically high profits, what did the top 25% do differently?

Comparing the Top 25% and the Lower 25% result for 2021 shows that you can generate over three times the ROAM by generating 8% more income off lower value land, while spending 5% less on variable costs and 15% less on fixed costs. If we ignore land values, they were able to increase operating profit per hectare by 47% or $133/ha, with $82/ha of that extra profit coming from the higher income and $52/ha coming from cost savings.



Graph 3: 2021 breakdown of key costs

The top 25% spent significantly less on machinery repairs and maintenance in 2021 than the rest of the cohort (figure 3). It is likely that the top 25% opted to turn over machinery with favourable interest rates rather than repair and maintain older machinery. This is also evident in the cropping plant valuations between opening and closing where the average increased cropping plant by $180,000 compared to the top 25% who increased by $350,000. Being in the top 25% cohort consistently, requires a level of management that knows where the best return on investment is and how to achieve it in the most efficient manner.

Cropping

Across the major crops yields were up around 0.5 t/ha on the five-year average, which can be attributed to better seasonal conditions. On inspection, the water use efficiency measures (WUE) were down on wheat and barley, lupins were on the average, and canola was above average. While you can expect a 0.5 t/ha increase in yield as a direct result of better seasonal conditions, the insignificant difference between the top 25% and average in yields shows the impact of the severe frost on all the wheat and barley crops in the area. The better potential from well managed crops was brought back to average.

Fortunately, the canola crops were not as badly affected by the frosts and were able to compensate with later pods because of the soft finish. The medium rainfall, top 25% cohort, managed to yield 0.82t/ha greater than the 5-year average, while the bottom 25% yielded 0.47t/ha than the 5-year average. They also managed this with a total operating cost of $107/ha less than the average. A testament to getting the agronomy and the timing right.

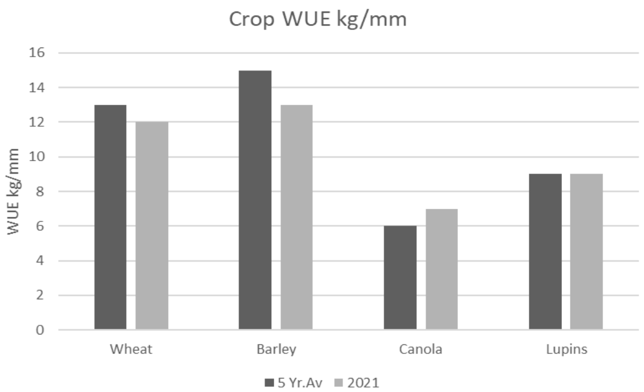


Figure 4: 2021 Crop WUE compared to the five-year average.

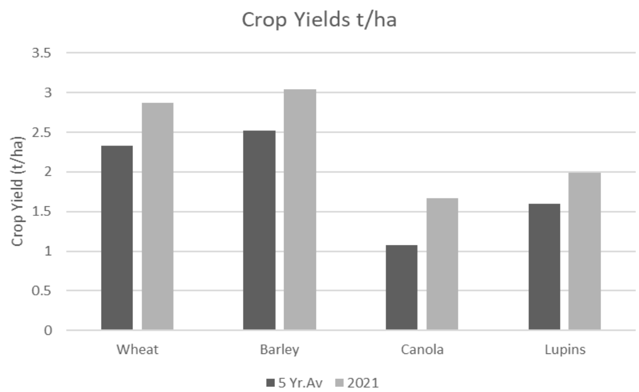


Figure 5: 2021 Yields compared to the five-year average.

Livestock

An increase in production on both per hectare and per head performance was evident in 2021. The group average increased stocking rate and resulting per hectare indicators such as wool and lamb production as well as individual animal performance such as increased weaning percentage.

Significantly higher variable and fixed costs seemingly ate into profits in 2021. On a $/DSE basis, variable costs jumped 45% on the 5-year average and the fixed costs jumped 50%. The group average operating profit was $22/DSE which was certainly up on the 5-year average, but only 16% of the gross income was retained as profit which is relatively low. It is important to understand the whole enterprise return when adjusting inputs to drive livestock production. Cost of production per unit of output is extremely important and drives the success of any enterprise.

Table 2: The 2021 Sheep enterprise analysis compared to the five-year average.

		5 Yr Average	2021
Income	$/dse	$86	$140
Variable Costs	$/dse	$40	$58
Fixed Costs	$/dse	$41	$62
Operating Profit	$/dse	$12	$22
		5 Yr Average	**2021**
Stocking Rate	wg dse/wg ha	4.26	4.96
Weaning Percentage	%	95%	100%
Lambs Weaned per ha	hd/ha	1.62	2.08
Clean Wool Cut	kg/wgha	8.6	12.4
Clean Wool Water Use Efficiency	kg/ha/100mm	3.94	4.3

Machinery

Considerably greater crop income has lowered the crop plant, machinery and labour measure (CPML) across the group compared to 2020 and the five-year average. However, the 4% gap that exists between the average and the top 25% was still evident. CPML is the ratio that indicates the efficiency of owning and operating machinery at an enterprise level. Four percent may not seem like much but over income revenues of $5,000,000 that is a difference of $200,000 per annum.

Scale is a big driver of this difference and top 25% performance is not always attainable for smaller operations however, managers should be monitoring this indicator within businesses across years and always be aiming to lower it.

Table 3: 2021 Total Machinery Costs which include Capital, Running Costs, Management and Contract.

2021 Total Machinery Costs $/ha			
	Lower 25%	Average	Top 25%
Machinery Replacement Allowance	$63	$55	$51
Management Allowance	$59	$40	$26
Wages, F&O, R&M, Contract	$148	$120	$110
CPML (Total Cost of Machinery)	$270	$215	$187
CPML as a % of Income	26%	21%	17%
Crop Income ($/ha)	$1,092	$1,068	$1,084
Crop Area (ha)	2886	4932	7440

Carbon Benchmarking

A new addition to the profit series in 2021 was the benchmarking of farm greenhouse gas emissions. Emissions of carbon dioxide (CO_2), methane (NH_4) and nitrous oxide (N_2O) are benchmarked as tonnes of CO_2 equivalent (CO_2e). Emissions are categorized into scopes to capture all emissions on farm. These are classified as scope 1, 2 and 3 emissions.

- Scope 1: All emissions on-farm from agricultural activity.
- Scope 2: Emissions from the production of purchased electricity.
- Scope 3: All emissions associated with producing inputs such as fertilisers, herbicides etc.

The figure below demonstrates the scope 1 emissions in CO_2 emissions per tonne, from the crops benchmarked by the Liebe Group. Emissions per tonne of Canola are generally higher because the yields per hectare tend to be around half the cereal yields, and the Oaten Hay are lower because the yields are often close to double the cereal yields.

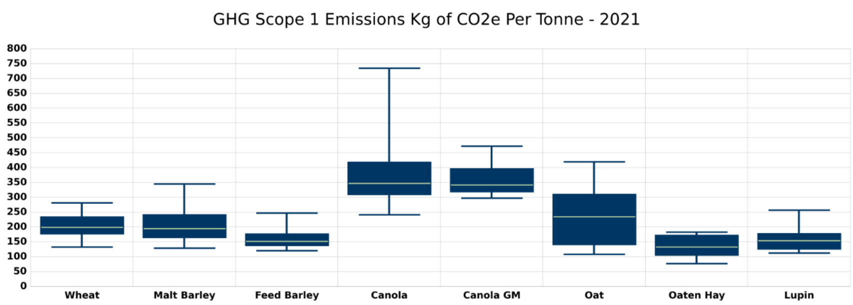


Figure 6: 2021 Scope 1 emissions for each crop enterprise.

Conducting an emissions audit for your business allows you to benchmark your results against the largest database of its kind in Australia. Like all aspects of farming, in order to make the best decisions, you need to understand where you currently stand.

2022 RAINFALL REPORT

	Dalwallinu	Kalannie	Coorow	Carnamah	Latham	Perenjori	Wongan Hills	Goodlands	Watheroo	Main Trial Site (north Miling)
Jan	12.8	-	-	2.8	7.4	11	1	4.2	0.6	-**
Feb	5.8	4.2	9.4	6	25.2	14	44.6	16.6	67.8	25**
Mar	25.8	92.2	60.4	45	43	63.6	45	81.8	54	75**
Apr	21.4	22.4	14.3	25.2	37	19.5	18	22.8	22	11.6
May	14.6	22.2	25.9	19.1	17.6	30	41.4	16.2	49.6	17
Jun	34	59.6	27.4	20.6	32	32.4	33.6	38	33.3	39.4
Jul	45.8	40.2	48.6	48.8	49.2	47.5	60	46.8	91	50.6
Aug	94.2	89.8	64.4	97.7	99.4	96.1	105.6	81.2	-	73
Sep	34.2	36	36.5	38.1	36.2	45.6	29.6	33.2	-	22.4
Oct	3.6	7.2	7.6	3.7	4.4	-	8.2	17.8	38.5	10.8
Nov	13.4	-	6.1	8.9	6	2.2	72	4.6	41	3.8
Dec	-	-	2.8	-	-	-	2.2	-	-*	-
GSR (Apr - Oct)	247.8	277.4	224.7	253.2	275.8	271.1	296.4	256	234.4*	224.8
Total	305.6	373.8	303.4	315.9	357.4	361.9	461.2	363.2	397.8	328.6

*Note: Rainfall data not available for some months.
** Note: January data not availabe, February and March are grower provided figures.

Information gathered from the Bureau of Meteorology at www.bom.gov.au and through Liebe Group rain gauges.

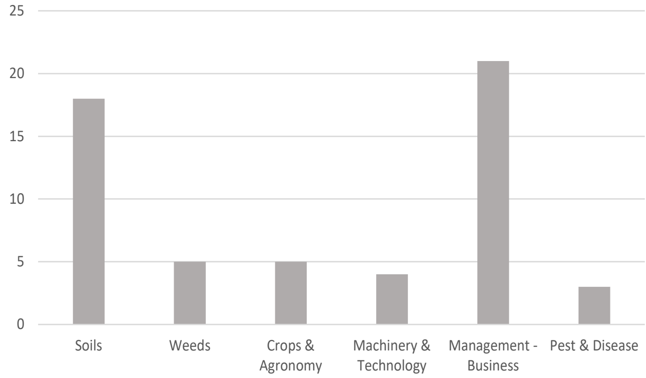
Contact the Bureau of Meteorology by phone (08) 9263 2222, by fax on (08) 9263 2233 or by email at climate.wa@bom.gov.au

The Liebe Group have taken all due care but cannot provide any warranty nor accept any liability for this information.

2022 LIEBE GROUP R&D SURVEY RESULTS

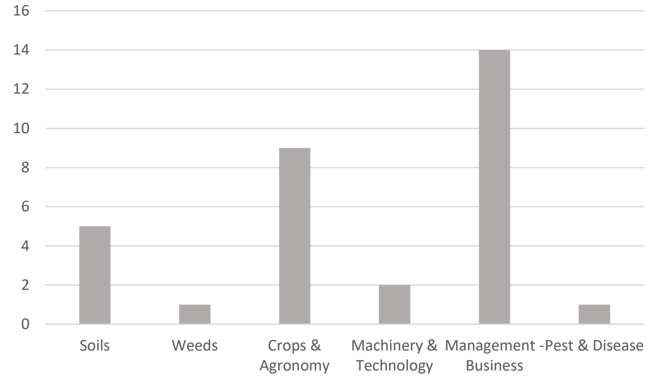
Conducted September 2022 at the Liebe Group Spring Field Day.

What are the key challenges affecting your farm business that could be addressed by the Liebe Group?



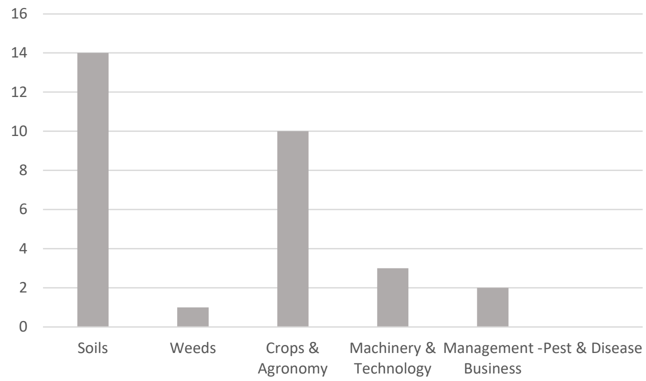
What are the key areas in relation to Business Management?
- Rising costs risk
- Staffing
- Input costs vs profits
- Farm planning and succession

What are the key areas of knowledge or skills you wish to build on through training and workshops?



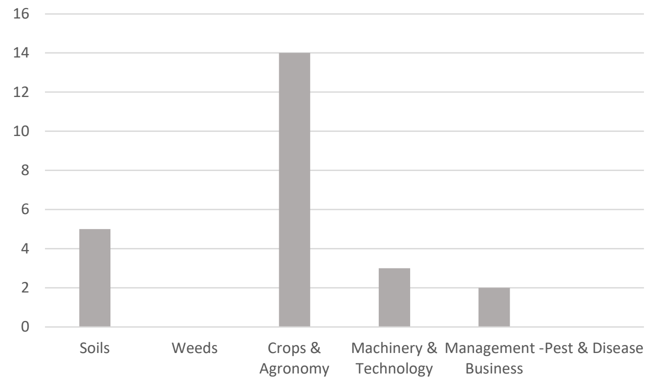
What are the key areas in relation to Business Management?
- Grain marketing
- WH&S and on-farm safety
- Time management
- Efficient use of fertilisers and budgeting

What farming system concepts or practices would you like to see demonstrated at a local level by Liebe Group?



What are the key areas in relation to Soils?
- Wetting agents on non-wetting soils
- Deep soil amelioration techniques
- Soil biology to improve input efficiency
- Adding microbes to build soil carbon

What long term research would you like to see the Liebe Group invest in?



What are the key areas in relation to Crops and Agronomy?
- Long term rotational trials
- Rotational cropping with break crops
- Salt resistant crops

LIEBE GROUP STRATEGIC PLAN 2022 - 2026

PURPOSE
Collective local knowledge that advances, unites and reduces risks for our members

VISION
Vibrance and Innovation for Rural Prosperity

MISSION
To facilitate grower prioritised research, development and extension to support our members to be profitable and sustainable.

COMMITMENT TO MEMBERS
- We are a welcoming, inclusive and forward thinking grower group
- We are focused on supporting members and providing an enjoyable member experience
- Research, development, extension and adoption will have local significance and relevance to members
- We collaborate for mutually beneficial outcomes
- We will protect the integrity and professionalism of our research, development and extension
- We will deliver value and return on our investments (people, resources, projects)
- We will support our staff to help us deliver upon our purpose, mission and vision
- We will have a professional and capable Board

STRATEGIC OBJECTIVES	STRATEGIES
Membership 1.1 Members are engaged and active in the Liebe Group	• Communication Strategy developed and implemented • Diverse engagement opportunities are offered • Members have timely access to R,D,E and A as well as other services that will benefit their farm business
Research, Development, Extension and Adoption 2.1 Skilled, professional and capable team that can deliver R,D,E and A 2.2 Our R,D,E and A is leveraged for member benefit	• Organisational structure reflects member and industry priorities in R,D,E and A • Liebe Group team is up-skilled and exposed to new experiences and learnings to be able to deliver locally significant R,D,E and A • R&D Sub Committee prioritise and present ideas and concepts to the Board to consider • Work towards a Liebe Group collaborative R and D hub
Partnerships 3.1 Our partners deliver value to our members	• Partnership Strategy is developed and implemented • Identify and approach new partners that help us deliver upon our purpose and vision
Governance 4.1 We demonstrate best practice not for profit governance	• Investment into the capacity and capabilities of the Liebe Board • Active succession planning by the Board and Executive Officer • Sub Committees are active and communicate strategic and operational challenges and opportunities to the Board • Highly skilled finance sub committee to oversee finances

BACKGROUND

The Liebe Group Board endorsed the 2022-2026 Strategic Plan in October 2021, following several months of comprehensive consultation with members, partners and the wider agricultural industry. With assistance from experienced consultant Caroline Robinson, this new plan marks the sixth strategic planning exercise that the Liebe Group has conducted.

Taking on a more concise format, the 2022-2026 plan highlights future opportunities for the group which will be guided by four main strategic objectives. The plan will assist the group in achieving its vision of farming communities and family businesses that are vibrant, innovative and prosperous. Our strategy will be reinforced by continual improvement and evaluation of impact and success, and will continue to provide the guidance to staff in operations and planning.

ROLE OF THE LIEBE GROUP

The Liebe Group is a dynamic, grower-driven, not for profit organisation that operates within the Dalwallinu, Coorow, Perenjori and Wongan-Ballidu Shires in the West Australian Wheatbelt. As a leading 'grass roots' group, the Liebe Group provides its members with access to innovative, timely and relevant research along with grower and industry network opportunities from all over Australia. The group ensures regular consultation with members and industry to guarantee the group remains relevant. Liebe is governed by a central Board which is informed by a range of operational sub-committees that are comprised of local growers and industry partners.

The group conducts valuable research, development and extension through trials, demonstrations and workshops, and provides information to over 100 farming businesses in the local region, encompassing a land area of over 1,000,000ha.

OUR VALUES

The following are a set of evolving philosophies and values that the group maintains for members and employees. By accepting these values it enables us to build trust in order to make effective and efficient decisions and reach our potential.

Member Driven
Primarily, the Liebe Group is here to create value for its members through R&D, technology and capacity building extension. It is local and relevant, and prioritized by the membership.

Innovation and Progression
The group is innovative and progressive and this is encouraged and valued. An ethos of constant review is adhered to, to ensure we are on track and achieving best practice.

Professionalism
The group is professional which is encouraged and nurtured in the membership. The group is driven by the decision-making capacity of the Board and its supporting sub-committees which use accountable and transparent processes. We expect staff to be confidential in their dealings within the group.

Apolitical
The group is apolitical, which means collectively we won't represent the members without following a process to ensure we are representing all their ideas or opinions.

Respect
The group values and respects its members and partners, and their resources and experience. We expect people to be open and honest, and build processes that reflect the transparency of the administration and processes used in the group.

Independence
The group is independent and acts under direction from the 'grass roots.' The group is objective in its views and stance.

Inclusivity
The group is inclusive which means we involve, encourage and support staff, members and the community to take part, have a voice and maintain their ideas and views as individuals.

Collaborative
Effective networking and links to beneficial partnerships is encouraged to add value and opportunities. The group works collaboratively within the agricultural industry to value add. The group maintains an ethos of team work and cooperation within the group and values peer to peer learning.

Empowerment
Empowerment and capacity building is encouraged of members and staff to ensure everyone reaches their potential and supports their personal development.

Enjoyment
There is a social and fun philosophy within the group.

ACKNOWLEDGEMENTS

The Liebe Group would like to thank those who contributed to this Strategic Plan, and for continuing to support the group with passion and enthusiasm. We look forward to continuing this journey with you all.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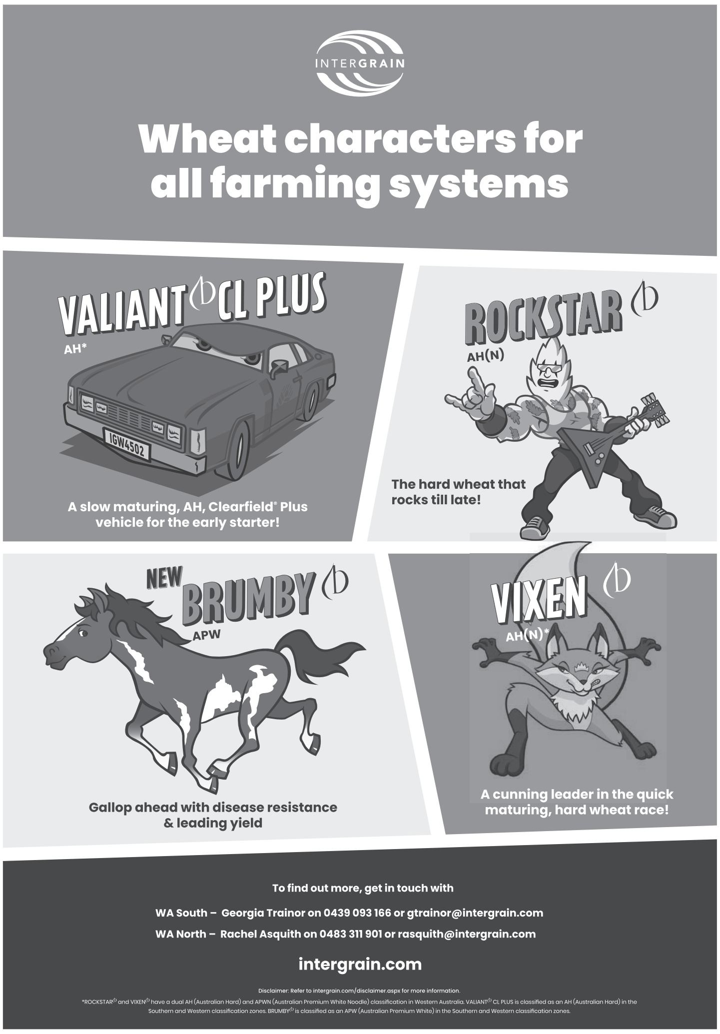
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