2022

HART TRIAL RESULTS

Sponsors

The board of the Hart Field-Site Group Inc would like to acknowledge the significant financial contribution of our committed sponsors, supporters, collaborators and partners.

Principal Sponsor

Sponsors

Research supporters

We also receive project funding support provided by the Australian Government

Collaborators

Hart 2023 calendar

HART FIELD DAY

September 19

Our main Field Day attracts over 600 visitors from all over South Australia and interstate.

Every half hour a block of eight sessions are run simultaneously with highly regarded specialists speaking at each trial. A comprehensive take-home Field Day Book is included in the entry fee.

This is Hart's main event of the year.

Hart AGM

October 2023

Getting The Crop In

March 8

8am – 12:30pm

At this annual seminar, industry guest speakers from across the county cover a wide range of topics, all relevant to broadacre cropping.

Winter Walk

July 18

9am – 12pm

An informal guided walk around the trial site; the first opportunity to inspect the site post seeding, with guest speakers presenting their observations on current trials.

They are on hand to answer questions and will also share their knowledge on all the latest cropping systems and agronomic updates.

Spring Twilight Walk

October 17

5pm followed by BBQ

Another informal opportunity to inspect the trial site, this time just prior to harvest, again with industry researchers & representatives presenting in the field.

This event is followed by drinks and a BBQ in the shed - a great opportunity to network.

Acknowledgements

The success of our research program could not be achieved without the contribution of a large number of people and organisations.

Supporters

We thank the numerous growers and consultants who provide various contributions, from knowledge and experience through to land and equipment for conducting trials.

Peter Baker
Andy Barr
Andrew Cootes
Rob & Dennis Dall
Matt Dare
Trevor Day
Colin Edmondson
Marg Evans
Simon Honner
Damien Hooper
Michael Jaeschke
Simon Jaeschke
Paul Jarret
Roger Kimber
Allan Mayfield
Peter McEwin
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Anthony Pfitzner
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Kevin Pratt
Chris Preston
Shane Reinke
Adam Rowley
Andre Sabeeney
Stuart Sherriff
Kelvin Tiller
James Venning
Rob & Glenn Wandel
Scott Weckert
Rob Wheeler
Glen Wilkinson
Matt Williams
Justin, Bradley & Dennis Wundke

We would also like to thank various organisations for the provision of seed and/or products that were trialed in the 2022 research program.

ADAMA
Advanta Seeds
Agriculture Victoria – field pea breeding program
Agriculture Victoria – lentil breeding program
Agspec
Australian Grain Technologies
Barenbrug
BASF
Bayer Crop Science
Corteva Agriscience
CSIRO
FMC
Global Grain Genetics
Imtrade
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Nufarm
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PGG Wrightson Seeds Australia
Pioneer Seeds
Plant Science Consulting
Pulse Breeding Australia
S & W Seeds
SARDI Clare
SARDI Vetch Breeding Program
SARDI Agronomy & Crop Sciences
Seednet
Seed Force
Sumitomo
Syngenta
University of Adelaide
University of Adelaide – bean breeding program
UPL

Thank you also to the following people who volunteer on Hart's Research Committee.

Rob Dall
Matt Dare
Ash Hentschke
Simon Honner
Simon McCormack
Sarah Noack
Rob Price
Stuart Sherriff
Scott Weckert
Glen Wilkinson

And finally, thank you to those who have volunteered their time to support Hart's 'BEEN FARMING LONG?' workshop series for early career farmers.

Jim & Katherine Maitland
Andrew Mitchell
Rob Pratt
Deb Purvis
Scott & Jeff Weckert
Ben Wundersitz
Ben Marshman
Alec Bowyer
Damien Sommerville
Nufarm
Viterra

Our guiding principles

OUR PURPOSE

To deliver value to growers and make agriculture better

(in productivity, sustainability & community)

OUR VISION

To be Australia's premier cropping field site, providing independent information and enhancing the skills of the agricultural industry

OUR VAULES

Independence

in order to provide unbiased results

Relevance

to issues facing farmers

Integrity

in all dealings

Credibility

through providing reliable, quality information

Professionalism

in the management of the site and presentation of trials

Value for money

low cost of information to farmers

Hart management

Hart Field-Site Group board

Andre Sabeeney (Clare) .... Chairman
Glen Wilkinson (Snowtown) .... Vice-chairman, sponsorship
Sandy Kimber (Clare) .... Executive officer
Deb Purvis (Wallaroo) .... Finance officer
Matt Dare (Marola) .... Commercial crop manager, sponsorship
Ryan Wood (Clare) .... Sponsorship
Scott Weckert (Blyth) .... Sponsorship, community engagement
Simon Honner (Blyth) .... Board member
Rob Dall (Kybunga) .... Board member
Stuart Sherriff (Clare) .... Board member
Josh Reichstein (Blackwood) .... Board member
James Venning (Barunga Gap) .... Board member

Rebekah Allen .... Research & extension manager
Declan Anderson .... Regional intern
Gabrielle Hall .... Media

Site Management

SARDI, Agronomy Clare:
Patrick Thomas, John Nairn, Sarah Day, Dili Mao, Navneet Aggarwal, Penny Roberts, Dylan Bruce, Greg Walkley, Amber Spronk and Jacob Nickolai

Hart Field-Site Group:
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Or find out more about us…

Hart Field Day

September 19, 2023

www.hartfieldsite.org.au

The Hart site

The Hart field site (40 ha owned by the group) is managed as four quarters that are rotated each year. In 2022, Quarter 4 hosted our trials.

Quarter 1 was sown with Mulgara oats and was cut for hay to tidy the site in preparation for 2023 trials.

Quarters 2 and 3 were sown with wheat as our commercial crop.

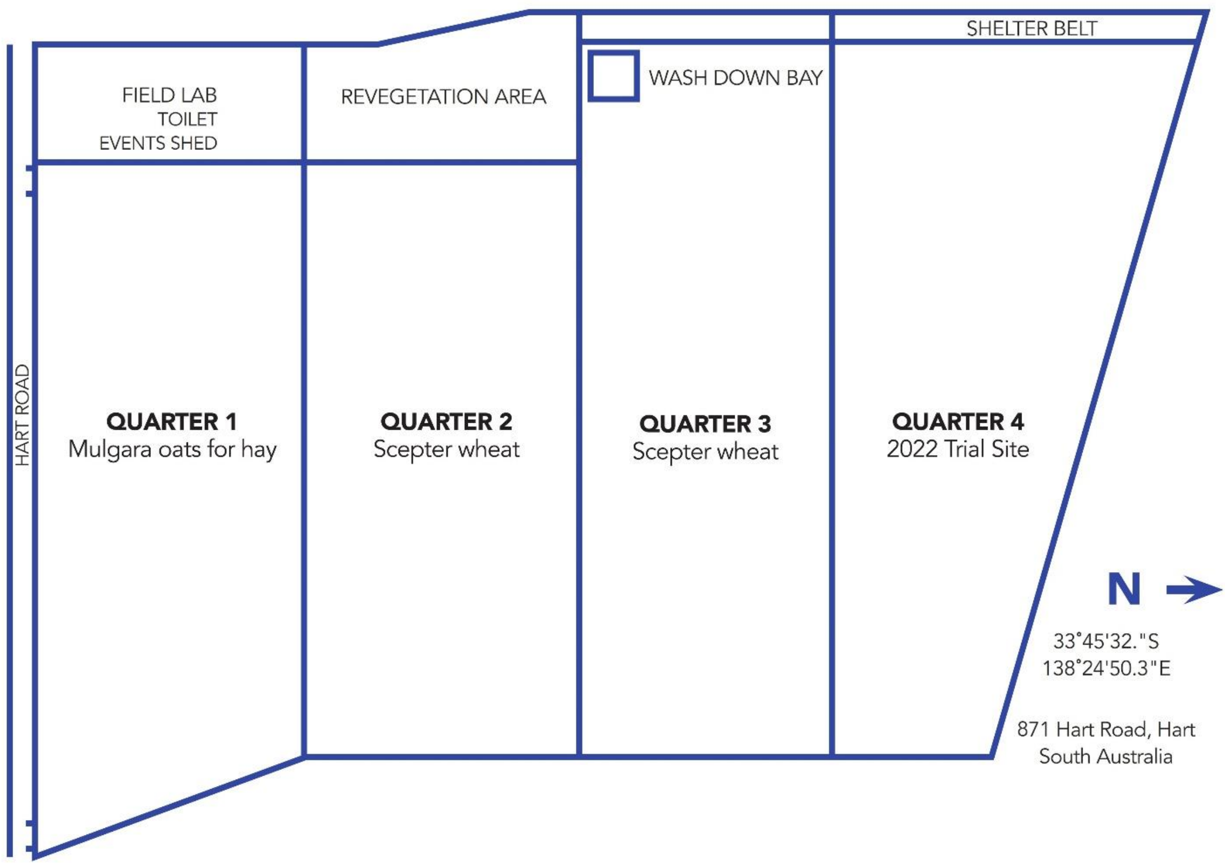


Photo. Hart site visit by Lucerne Australia's 2022 study tour.

Hart commercial crop report

Matt Dare; Hart Field-Site Group

The 2022 Hart commercial crop was sown in Quarters 2 & 3 (16.5 hectares) to Scepter wheat at 100 kg/ha on May 29.

There was marginal moisture at sowing from a 6 mm rain event a few days earlier.

Sakura was applied at recommended label rates (118 g/ha) prior to sowing Quarters 2 & 3 on May 28. A knockdown herbicide was not applied prior to sowing as there had not been enough rain to germinate any weeds.

Mulgara oats for hay was sown (~80-100 kg/ha) in Quarter 1 in preparation for 2023 trials. Fertiliser was applied; 75kg/ha DAP (18:20:0:0), with all seed.

Seeding was completed prior to the site receiving 38 mm rain on May 31. It was somewhat nostalgic sowing straight through the old cropping systems trial that had been in the same location on the site since 2000.

Thanks to Glen Wilkinson for providing Scepter seed and getting it to the site on Sunday so the commercial crop could be sown before the seasons break.

On July 10, 100 kg/ha of urea was spread on the commercial wheat crop. We received 2.6 mm of rainfall on July 12, but only 15 mm for the month in total.

Both the commercial wheat crop and oats were sprayed for broadleaf weeds on August 9; 25 g Paradigm, 400 ml MCPA LVE570, 70 ml Dicamba750, 100 ml Dimethoate and 0.5% Uptake oil per hectare was applied.

In addition, the wheat had 500 ml/ha of epoxiconazole applied.

A follow up application of 90 kg /ha of urea was applied by Peter McEwin on September 13 – thank you Peter.

A further fungicide application (500 ml/ha of epoxiconazole) was applied for stripe rust on September 23.

The commercial crop was harvested on the 5th January and yielded 4.54 t/ha (75 tonnes) of H2 quality wheat. Thanks to Matt Williams for harvesting and Peter Agnew for delivering the grain to Snowtown.

Thanks also to Rob Wandel who cut the oats in Quarter 1 in preparation for 2023 trial site.

The 2022 season at Hart; rainfall, temperature and soil analysis

Rebekah Allen and Declan Anderson

Hart Field-Site Group

The Mid-North region had a dry start leading into the 2022 growing season, with a lack of rainfall across summer months until the season break arrived late May. This meant there was very little stored soil moisture (Figure 1 & 2) at seeding. Some sowing windows across the region were either pushed back, or late crop emergence was noted. The season break occurred on May 30 at Hart, with 26 mm of rainfall received (Table 1).

Seeding at the Hart field site commenced on April 22, with early sown winter wheat and vetch trials. Most of Hart's pulse and cereal program was sown by late May, however no significant rain had occurred during this time. All remaining trials were sown by June 17 directly into soil moisture. By this time, Hart had noted 88 mm growing season rainfall (GSR) with majority of this rainfall received between May 30 and June 11.

Starting soil nitrogen (N) at Hart was 74.2 kg/ha at depth (0-105 cm), after an oaten hay crop in 2021 (Table 2).

Trials at Hart began emerging on June 8. The site experienced drier conditions through July (15 mm), with rainfall becoming more consistent mid-late August. Crop growth was very slow during winter months due to cold conditions (Figure 3), also resulting in minimal water use (Figure 2). Monthly rainfall was well above average from September to November (Figure 1).

Hart received 519 mm of annual rainfall in 2022, placing it at a decile 10 rainfall year (average annual rainfall 400 mm). Growing season rainfall (April – October) of 355 mm was 55 mm above Hart's 100-year average growing season rainfall (300 mm), equivalent to a decile 8 season.

Daily minimum and maximum temperature data at Hart in 2022 is provided in Figure 3.

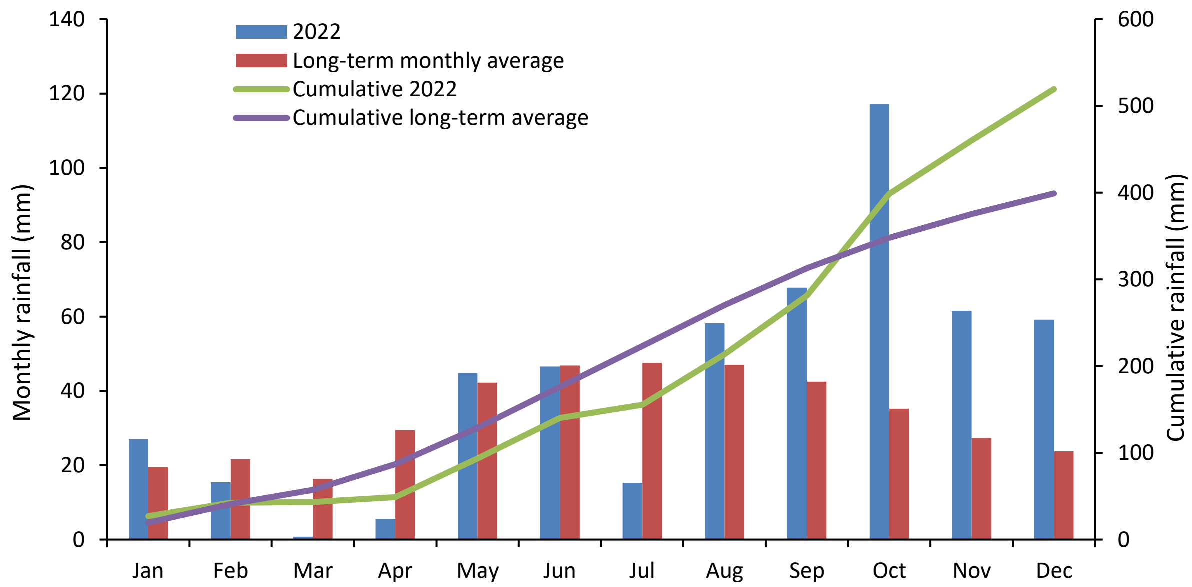


Figure 1. Hart rainfall graph for the 2022 season and long-term average. Lines are displayed to present cumulative rainfall for long-term average (purple) and 2022 (green).

Table 1. Hart rainfall chart for 2022 (Source: Mesonet)

	January	February	March	April	May	June	July	August	September	October	November	December
1	0	0.2	0	0	0	1	0.2	6.2	0.2	0.2	28.4	0
2	0	0	0	0	0	0	0	0	0	0	1.8	0
3	0	0	0	0	0	0	0	4.6	0	0	1.6	0
4	0	0	0	0	0.4	3.4	0	0	0.2	5.8	0	0
5	0	0	0	0	0	0.4	0	0.8	0	11.8	0	0
6	5.2	0	0	0.8	0.8	11.8	0.2	0.4	0	0	0	0
7	3.6	0	0	0	0.8	11.4	0.4	3	0.2	4	0	0
8	0.6	0	0	0	0	0.2	2.6	0.4	25.4	0.2	0	0
9	0	1.6	0	0	0	0	1	0	12.2	0	0	0.2
10	0	0	0	0	0	0.4	0.2	0.2	6.2	0	1.4	0.2
11	0	0	0	0	0	4.6	0	5	0	0	0	0
12	0	0	0	0	0	0	1.8	6	0.4	0.2	9.8	0
13	0	0	0	0	0	0	0.8	5.4	0	16.6	3.6	0
14	0	0	0	0	0	0	0.2	3.4	3.6	3.8	3.6	0
15	0	0	0	0.8	0	0	0	3	1.8	0.2	0.2	0
16	0	0	0	0.2	0	4.6	0	1.4	4.4	0	0	0
17	0	7.2	0	0	0	0	2	0	3	0	0	0
18	0	0	0	0.8	0	0	1.6	0.8	0.6	3.4	0	0
19	0	0	0	0.4	0	0	0.2	6.6	0.2	0	4.6	0
20	0	0	0	0	0	2.2	0	0.4	0	0	2.4	0
21	0	1	0	1.4	0	1.4	0	2	3.6	0	1.8	4.2
22	1.2	0	0	0	0	0.6	0	0	0.2	0	0.4	28.8
23	12.2	0	0.8	0	0	0	0	6	0.2	23.4	0	0
24	4.2	0	0	0	0	0	0	0.2	1.6	11.4	0	0
25	0	0	0	0	1.2	1.8	3.6	0.6	0	4	0	0
26	0	0	0	0	4.4	0.2	0.2	0.2	1.8	0	0	0
27	0	0	0	0	0	1.4	0	0	0.6	0	2	18.8
28	0	5.4	0	0	0	0	0	0	1	0	0	7
29	0		0	0	0	0	0	0	0.2	0.6	0	0
30	0		0	1.2	26.2	1.2	0	1.4	0.2	0	0	0
31	0		0		11		0.2	0.2		31.6		0
Montly total	**27.0**	**15.4**	**0.8**	**5.6**	**44.8**	**46.6**	**15.2**	**58.2**	**67.8**	**117.2**	**61.6**	**59.2**
GSR rainfall				5.6	50.4	97.0	112.2	170.4	238.2	355.4		
Total rainfall	27.0	42.4	43.2	48.8	93.6	140.2	155.4	213.6	281.4	398.6	460.2	519.4

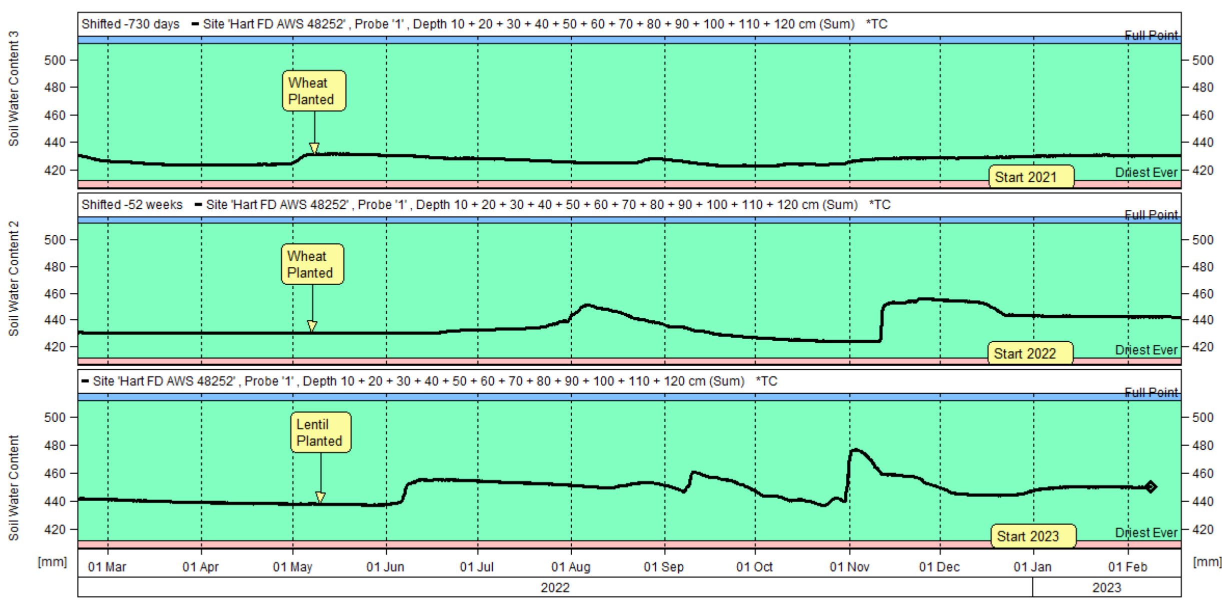


Figure 2. Soil moisture probe summed comparison (80cm) for 2020 (top), 2021 (middle) and 2022 (bottom) at the Hart field site.

Hart soil moisture data is free to view thanks to Agbyte and can be viewed here:
https://www.hartfieldsite.org.au/pages/live-weather/soil-moisture-probe.php

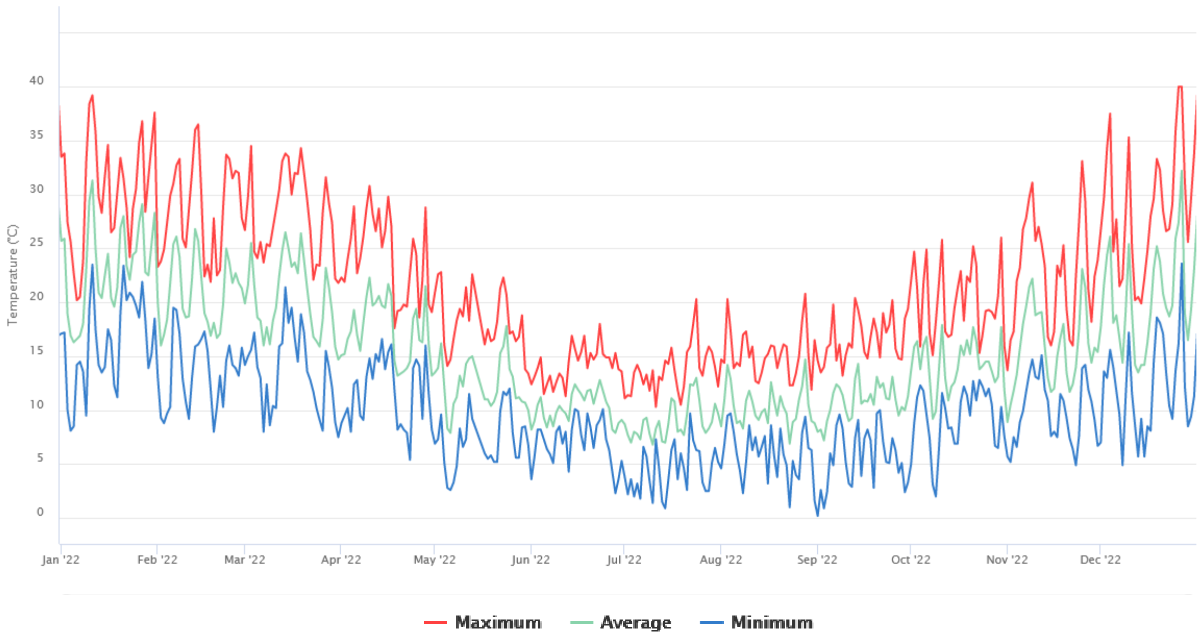


Figure 3. Daily minimum, average and maximum temperature (°C) from January 1 to December 31 at Hart in 2022. Temperature data sourced from Mid North Mesonet.

Table 2. Actual soil physical and chemical properties for the Hart field site, sampled March 31, 2022.

		Sampling Depth (cm)					
Soil property	**Units**	**0-15** (cm)	**15-35** (cm)	**35-55** (cm)	**55-75** (cm)	**75-105** (cm)	**Total profile** (0-90cm)
Texture		Loam	Loam	Loam	Loam	Loam	
Phosphorus Cowell	mg/kg	22	8	10	9	<5	
Potassium Colwell	mg/kg	273	146	145	129	133	
Available soil N	kg/ha	19.6	14.5	14.4	13.7	12	74.2
Sulphur	mg/kg	5.1	5.2	7.3	11	23	
Organic Carbon	%	1.00	0.60	0.59	0.48	0.25	
Conductivity	dS/m	0.15	0.13	0.15	0.27	0.47	
pH ($CaCl_2$)		7.8	7.8	7.9	8.1	8.6	

Yield Prophet® performance in 2022

Rebekah Allen
Hart Field-Site Group

Key findings

- A correlation is observed between Yield Prophet® predictions and actual yields at Hart from 2012 – 2022. Across ten years, 77% of wheat grain yields were close to those predicted by Yield Prophet®.
- Actual yield received for a comparison Scepter wheat crop with similar nitrogen (N) inputs yielded 86% of the predicted Yield Prophet® simulation. N deficiency contributed to low predicted grain yield for wheat at Hart, following excellent rainfall August – November, placing Hart at a decile 8 for GSR.

Introduction

Wheat growth models such as APSIM are highly valuable in their ability to predict wheat yield. This model simulates the effects of the environment and crop management on yield.

Yield Prophet® is an internet-based service using the APSIM wheat prediction model. The model relies on accurate soil information such as plant available water (PAW) and soil nitrogen (N) levels, as well as historical climate data (100 years of data) and current local weather information to predict plant growth rates and final hay or grain yield predictions.

This early prediction of grain yield potential means it can be used to directly influence crop input decisions. No other tool to provide information of this accuracy at such a useful time of the season is currently available to growers.

Yield Prophet® simulation

Location	Hart, SA	**Fertiliser**	May 1: 20 kg N/ha @ seeding
Seeding date	May 1, 2022		July 21: 40 kg N/ha
Variety	Scepter wheat @ 180 plants/m^2		

Yield Prophet® simulations were issued monthly during the growing season (June – October) to track the progress of wheat growth stages and changes in predicted grain yield. This data was published for 8 Mid-North sites and can be viewed on Hart's website:
https://www.hartfieldsite.org.au/pages/resources/hart-beat-newsletters.php

Hart Beat newsletters report the average grain yield prediction for Scepter wheat sown on May 1 and May 20, representing an early and late sowing time. These reported yields are based on a 50% probability (or decile 5 season) for the remainder of the season.

Growing season rainfall (GSR) deciles provide an update on how Hart's rainfall is tracking based on the previous 100 years of rainfall data. For example, if the GSR is decile 3, Hart is in the 30th percentile (or the lowest 30% of rainfall records). A decile 9 would mean that 90% of years had less than the current season.

Soil at the Hart field site ranges from a loam to clay-loam texture (0-30 cm) and provides moderate infiltration and PAW. The estimated starting available soil N entered in Yield Prophet® at Hart in 2022 was 63 kg/ha. Yield Prophet® uses APSOIL, a national soil data base to collect pre-characterised soil information from various locations. Soil data for sites includes; layer depth, EC (dS/m), pH (Cacl2), Cl (mg/kg), ESP%, Boron and Aluminium. Pre-seeding nitrogen and water content (%) values were entered into the prediction model to determine accurate starting levels. It's important to note that only soil water content (%) is physically measured in the field for Hart Beat newsletters. This is to provide an estimate of soil water in each location pre-seeding. Soil water content generally varies as a result of soil type and summer rainfall.

Results and discussion

The first yield prediction was simulated on June 16, 2022 for Scepter wheat sown on May 1 and was estimated to yield 3.6 t/ha in 50% of years. In 20% of years, the same crop would achieve a grain yield of 4.4 t/ha and in 80% of years, 2.15 t/ha (Figure 1). The 20%, 50% and 80% level of probability refers to the percentage of years where the predicted yield estimate would have been met, according to the previous 100 years of rainfall data at Hart.

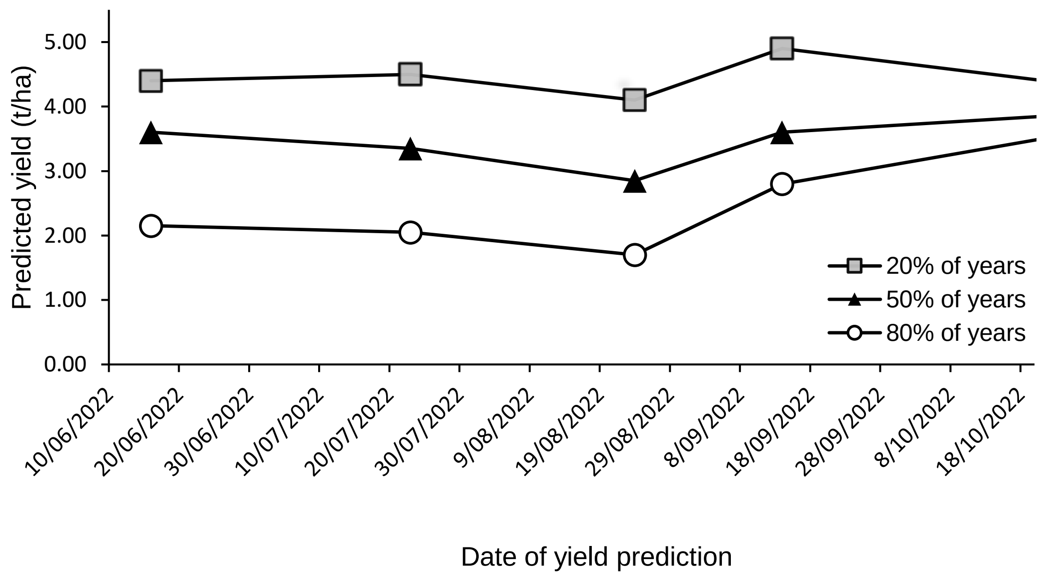


Figure 1. Yield Prophet® predicted yields at 20%, 50% and 80% probabilities at Hart, 2022.

Below average rainfall was received for July (15 mm), reducing predicted yields to 3.35 t/ha (a difference of -0.25 t/ha since June). At this time GSR was 102 mm and total soil PAW was 50 mm (Figure 2). The August Yield Prophet® prediction estimated an even lower yield of 2.85 t/ha, with a prediction of 98 mm rainfall left for the growing season, based on historic rainfall data. The reduction in yield potential was likely due to N-limiting factors with increased rainfall received.

September and October both received well above average rainfall, totalling 185 mm, with the October simulation predicting an increase in wheat grain yield to 3.9 t/ha, similar to yield estimated in June. A wheat crop sown at Hart on May 5 with similar N inputs, yielded 2.69 t/ha (86% of predicted yield). Many wheat crops at Hart, and more broadly within the Mid-North region, produced well above average yields, however N deficiency contributed to low predicted grain yields at Hart, with excellent decile 8 GSR rainfall (355 mm) and decile 10 for annual rainfall, receiving 519 mm (Table 1) in total.

A model of predicted and actual yield at Hart over ten years (2012-2022) demonstrates a moderate to strong correlation between Yield Prophet® predictions and observed yields. Over ten years, 77% of wheat grain yields were close to those predicted by Yield Prophet® (Figure 3).

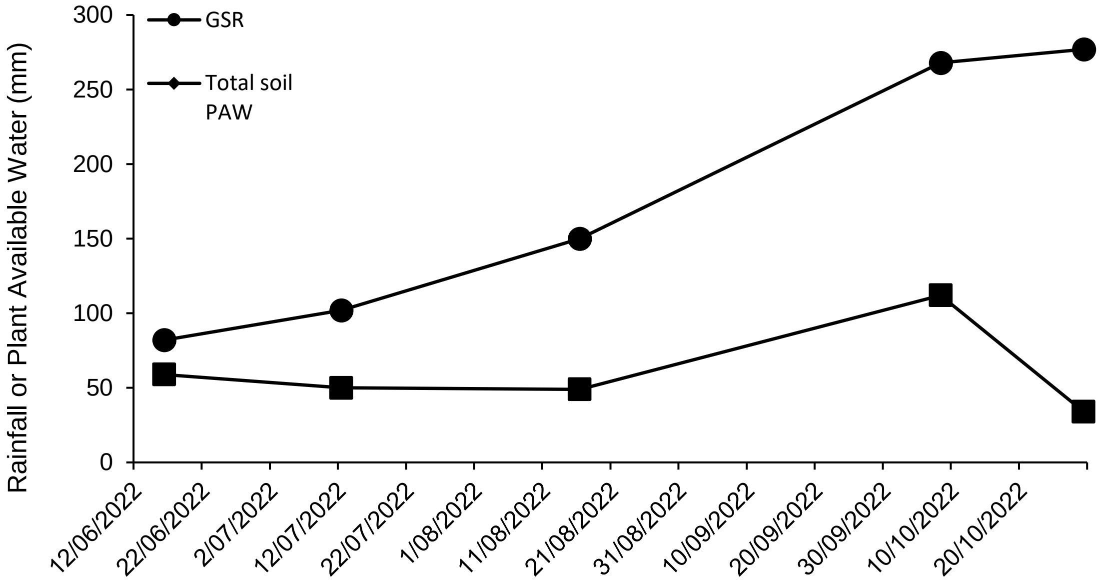


Figure 2. Growing season rainfall (GSR) and plant available water (PAW) on simulation dates at Hart in 2021.

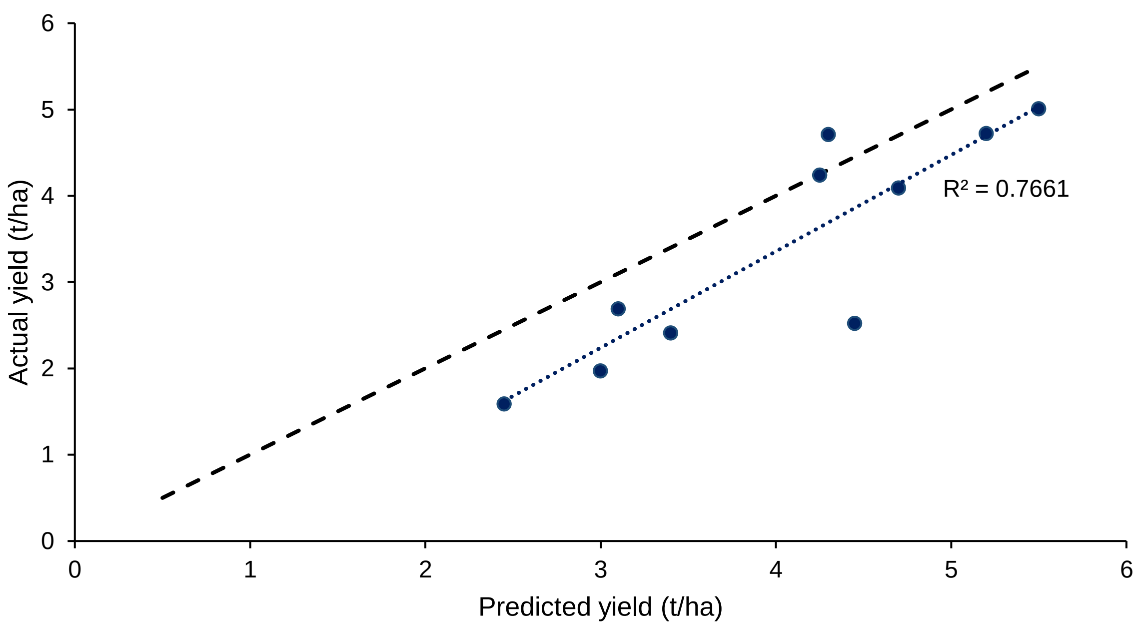


Figure 3. The relationship between Yield Prophet® grain yield predictions and actual yield at Hart across ten seasons (2012 – 2022). Predicted yields have been generated from August simulations. Yields from 2021 are not included in this data set, due to grain losses prior to harvest.

Table 1. Long-term average (100 years) and 2022 rainfall at Hart. Shaded values show months with above average rainfall (mm).

Month	Long-term monthly rainfall average (mm)	2022 Monthly rainfall (mm)	+/- Rainfall difference (mm)
January	20	27	+7
February	22	15	-7
March	16	0.8	-15
April	29	6	-23
May	43	45	+2
June	47	47	0
July	47	15	-32
August	47	58	+11
September	43	68	+25
October	35	117	+82
November	27	62	+35
December	24	59	+35
Rainfall total	**400**	**519**	

Acknowledgements

The Hart Field-Site Group would like to acknowledge the generous support of our sponsors who provide funding that allows us to conduct this trial. Proceeds from Hart's ongoing commercial crop also support Hart's research and extension program. We would like to thank Andrew Cootes, Daniel Neil, Justin & Bradley Wundke, Rob Dall, Kelvin Tiller, Damien Sommerville, Trevor Day and Anthony Pfitzner for providing paddocks for sampling in 2022.

Useful Resources

Yield Prophet Lite (Free online tool)
https://www.yieldprophet.com.au/yplite/

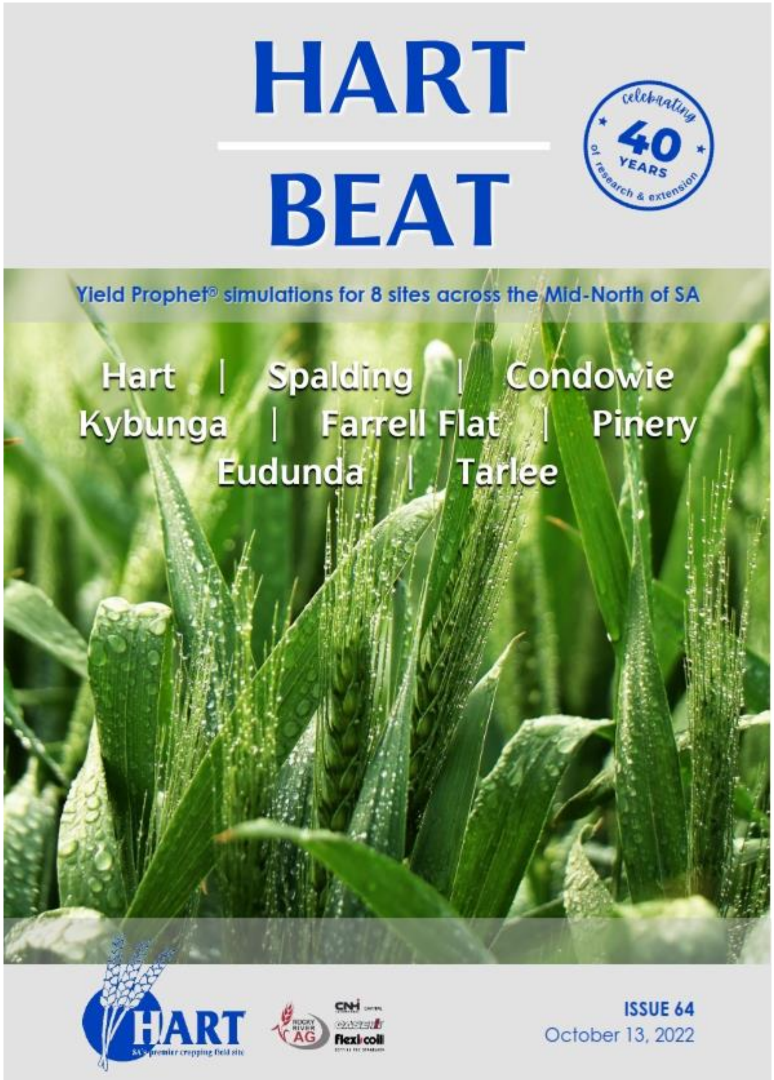
Hart Beat Newsletters (updated June – October each year)
https://www.hartfieldsite.org.au/pages/resources/hart-beat-newsletters.php

Yield Prophet 2017, 'How it works'
https://www.yieldprophet.com.au/yp/HowItWorks.aspx

The Very Fast Break
https://www.youtube.com/channel/UClDCIIl7gRZhUs03opGqH1g/videos

Climate outlooks – weeks, months and seasons
http://www.bom.gov.au/climate/outlooks/#/overview/summary

HART BEAT - yield predictions through the growing season for 8 Mid-North sites



VIEW & SUBSCRIBE ON THE HART WEBSITE

The *HART BEAT* newsletter, first introduced in 2009, is an initiative of the Hart Field-Site Group.

It is aimed at providing farmers and agronomists with regular updates of current and predicted crop and soil conditions as a season progresses.

We believe it will assist in making informed choices on the need for additional nitrogen and fungicide applications.

The Yield Prophet® simulations featured are not a crystal ball but provide a realistic prediction of the available soil water and nitrogen status of your crop.

Current (and historical) editions are all available online now, for free:

www.hartfieldsite.org.au

Rainfall variability trial at Hart in 2022

Declan Anderson and Rebekah Allen

Hart Field-Site Group

Key findings

- Growing season rainfall varied by 14.5 mm (5%) across the Hart field site in 2022. Annual rainfall also varied by 5% (21 mm) with high levels of variation across the site.
- Individual rainfall patterns remained variable, with no location in the paddock recording consistently high rainfall.
- Autumn rainfall was recorded to be the most variable, with a CV% of 13.9%. Winter, spring and summer received the most consistent rainfall, with less variation between locations in the paddock.
- Rainfall variability and inconsistency in spatial distribution of rainfall remain similar across 2021 and 2022, meaning predictable trends are not likely to develop during growing seasons.

Introduction

Rainfall is known to be widely variable across broad agricultural areas. Factors that contribute to variability include rainfall duration, intensity, location and topography. This knowledge can help growers understand where it is more likely for higher rainfall to occur.

The use of remote weather stations, including the Mid-North Mesonet, have become useful tools for growers to track rainfall events and compare measured rainfall against various locations. Variation on a paddock level, however, is not well understood.

This two-year trial aims to identify seasonal trends and capture variability of rainfall differences for individual rainfall events within a single paddock.

Methodology

In 2021, 11 manual rain gauges were positioned across 40 hectares (ha) at the Hart field site. In 2022, there were changes to positioning of some gauges to reflect the change in the location of 2022 trials (Figure 1). Rainfall measurements from all gauges were measured and recorded after each rainfall event.

Rainfall events ranged from 1-5 days, dependent on the persistence of rainfall during this time. This is displayed in Table 1, showing that 34 rainfall events were recorded manually at Hart, compared to the Mesonet's recording of 112 days of rainfall.

All gauges were calibrated in 2021, prior to the first rainfall event, ensuring the volumetric capacity of water (mm) was consistent for measurement accuracy. Events under 0.4 mm were not recorded.

Rainfall at the Hart field site was mapped using a GIS program to display rainfall patterns for each event, through inverse distance weighted (IDW) interpolation maps (Figure 2).

The variability of autumn, winter, spring and summer rainfall, growing season rainfall (GSR), annual rainfall and individual rainfall events was measured.

Table 1. Growing season and annual rainfall summary for the 2022 season at Hart. Rainfall data was sourced from the Mid-North Mesonet.

	Rainfall (mm)	**Decile**
Annual rainfall	519	10
Growing season rainfall (GSR)	355	8
	Mesonet (rainfall days)	**Manual gauges** (recorded rainfall events)
Number of recorded rainfall events	112	34

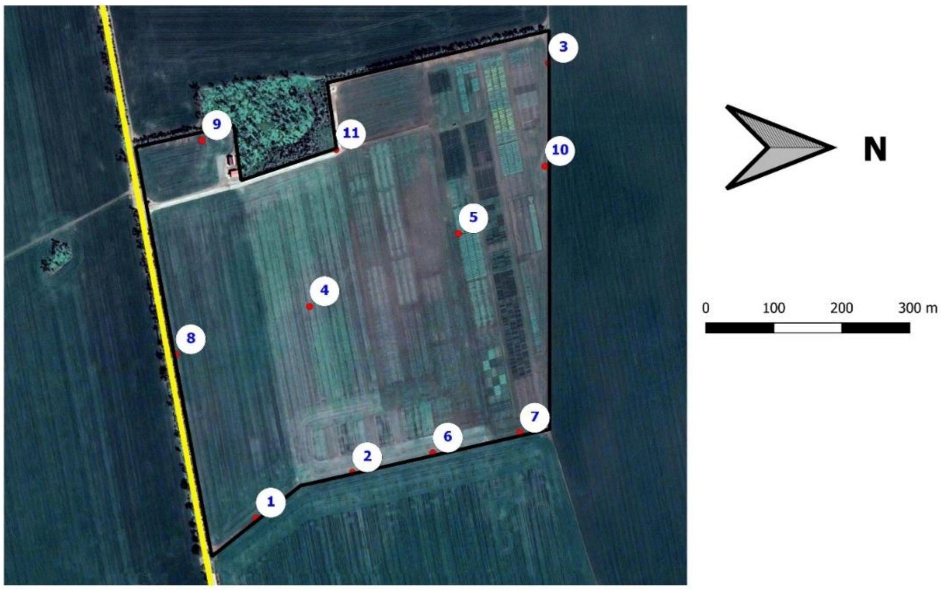


Figure 1. Location of manual rain gauges positioned across the Hart field site in 2022.

Results and discussion

Growing season and annual rainfall

During 2022, a total of 34 rainfall events were recorded, with 24 of these events occurring during the growing season. Annual rainfall at Hart in 2022 was 425 mm with a GSR of 288 mm across all 11 rain gauges. Growing season rainfall varied by 14.5 mm (5%) across all gauges (Figure 2). This volumetric difference is similar to what was observed in 2021, with 17 mm difference across the 40 ha site at Hart (Anderson & Allen 2021).

Annual rainfall varied by 21 mm (5%), with the highest amount of rainfall received in the south-west corner and northern fence line (Figure 3). The lowest amount of rainfall was recorded near the middle of the southern fence line.

The close proximity of high and low rainfall areas in 2022, continue to indicate high spatial variability of rainfall.

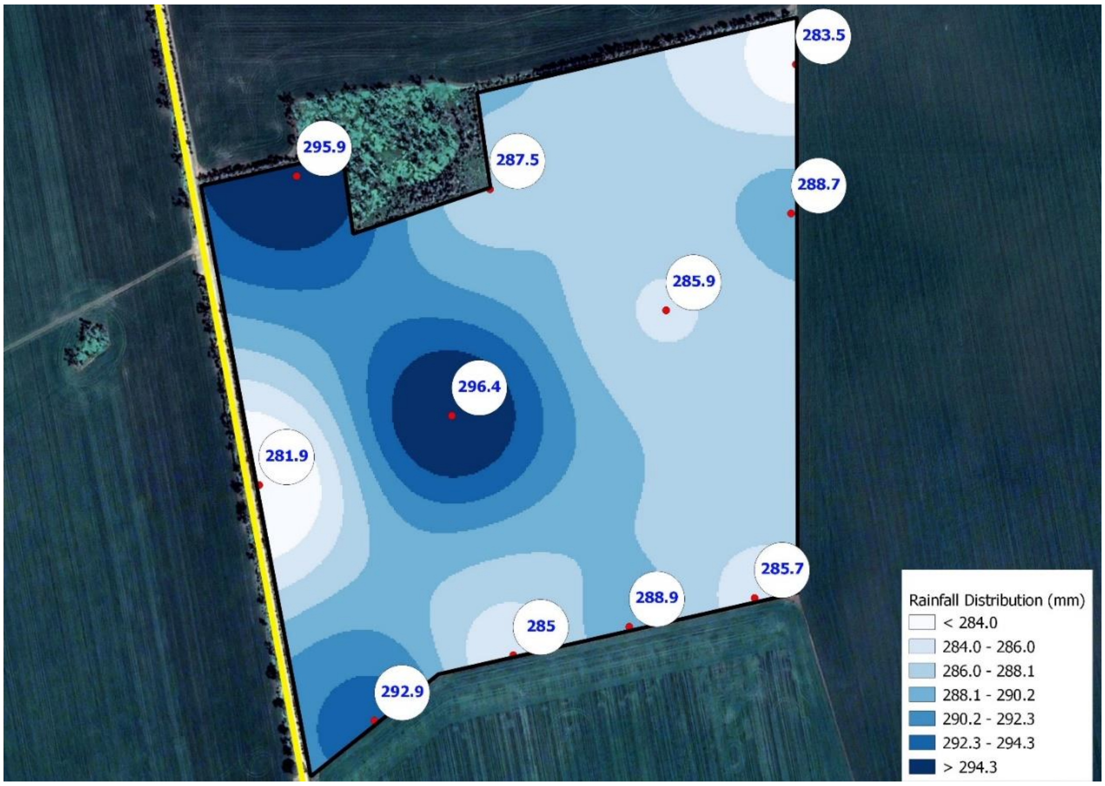


Figure 2. Distribution of recorded rainfall for the duration of the 2022 growing season (April – October) for each gauge at Hart.

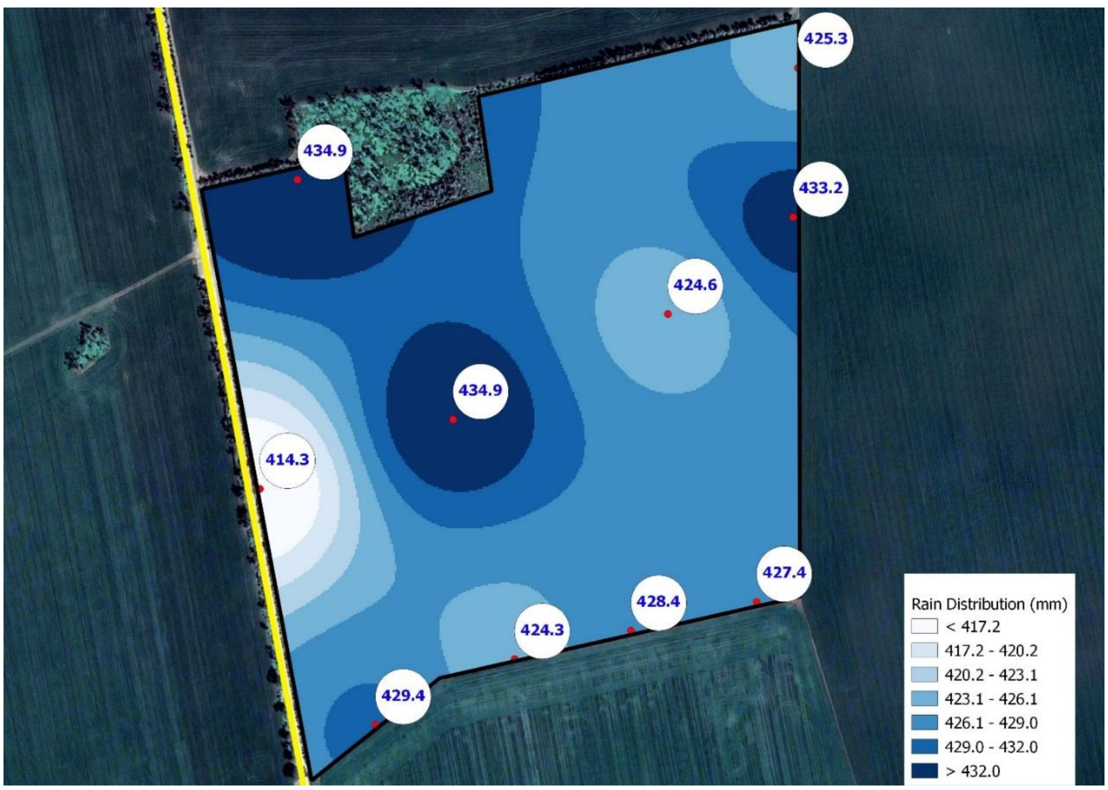


Figure 3. Distribution of recorded rainfall for 2022 for each gauge at Hart. Gauge 11 not present due to missing values.

Comparison of single rainfall events

A high coefficient of variation (CV%) was recorded for rainfall events of less than (<) 5 mm when compared to events over 5 mm.

This results in larger differences between rain gauges when smaller rainfall events are observed. This is supported by the percentage (%) difference between highest and lowest recorded amount in each rainfall event. Events that were < 5 mm varied by 12-48% between the highest and lowest recorded rainfall across gauges (data not shown). The variability of rainfall across gauges was lower in 2022 when compared to 2021. This was likely a result of an increase in average rainfall per event in 2022, averaging 12.7 mm compared to 7.8 mm in 2021.

Rainfall that was greater than (>) 5 mm had a lower difference (%) between high and low recordings with events averaging 15% between gauges compared to 31% when < 5 mm (data not shown).

When rainfall events of similar volume were compared, the spatial distribution of rainfall still varied greatly, as shown in Figure 4 and Figure 5. The rainfall patterns suggest that there are no paddock locations that consistently record higher levels of rainfall. Across both years of this trial, there has been no spatial trend observed, meaning assumptions of where rainfall is going to be higher cannot be made for Hart.

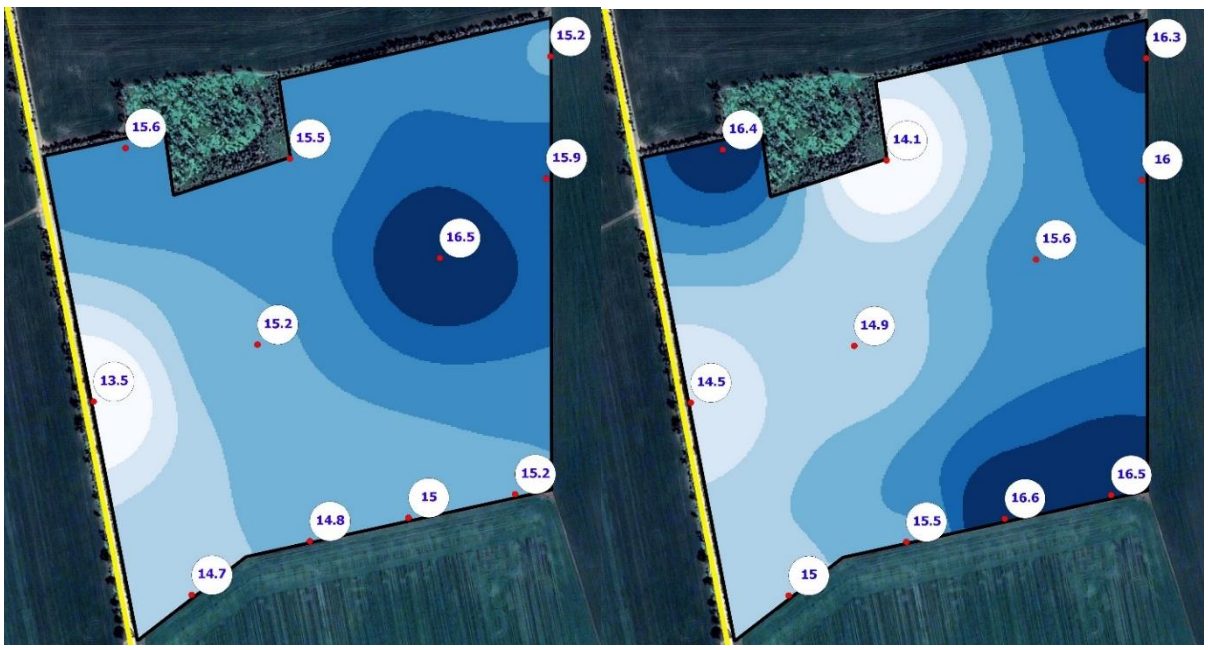


Figure 4. Rain distribution maps of two 15 mm rainfall events on June 27 (left) and December 23 (right) at Hart in 2022.

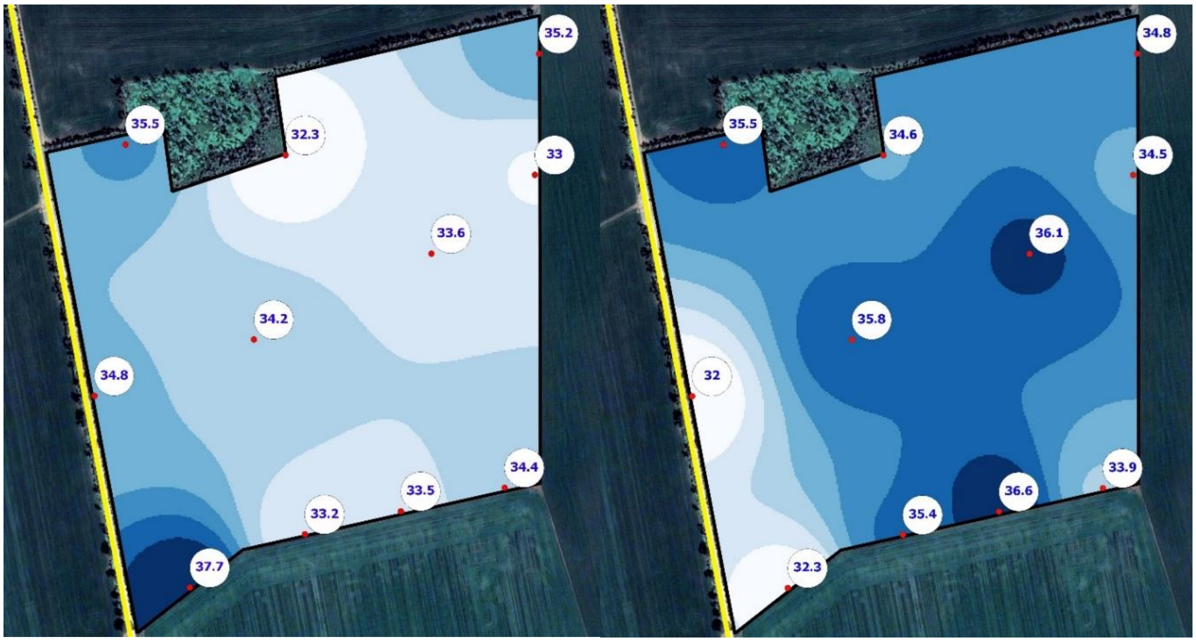


Figure 5. *Rain distribution maps of two 35 mm rainfall events on May 31 (left) and October 26 (right) at Hart in 2022.*

Rainfall variability across seasons

As expected, the volume of rainfall was different across seasons, with low recordings of 51 mm in autumn, and high rainfall of 246 mm in spring (Table 2).

Similar to 2021 observations, winter and spring had the most consistent distribution of rainfall with low CV% (variability) of 8.1 and 3.4 respectively. Summer months in 2022 also had consistent rain distribution with a CV% of 5.3 (Table 2).

As observed in 2021, autumn recorded a high rainfall CV% across the 11 gauges, suggesting that differences in rainfall across a paddock would be greater than in other seasons.

Table 2. Seasonal rainfall data including coefficient of variation (CV%), rainfall event average (mm), rainfall days and total seasonal rainfall (mm) for Hart in 2022. Rainfall data sourced from the Mid North Mesonet.

	Autumn	Winter	Spring	Summer
CV%	13.9	8.1	3.4	5.3
Event average	3.7	2.9	6.6	7.3
Rainfall days	14	41	37	14
Total season rainfall (mm)	**51.2**	**120.0**	**246.4**	**101.6**

Rainfall distribution for each season across the Hart field site was variable (Figure 6). There are no similarities between corresponding rainfall distribution maps in 2021 or 2022 (Anderson & Allen 2021). This suggests there are not predicable rainfall distribution patterns for each season at Hart.

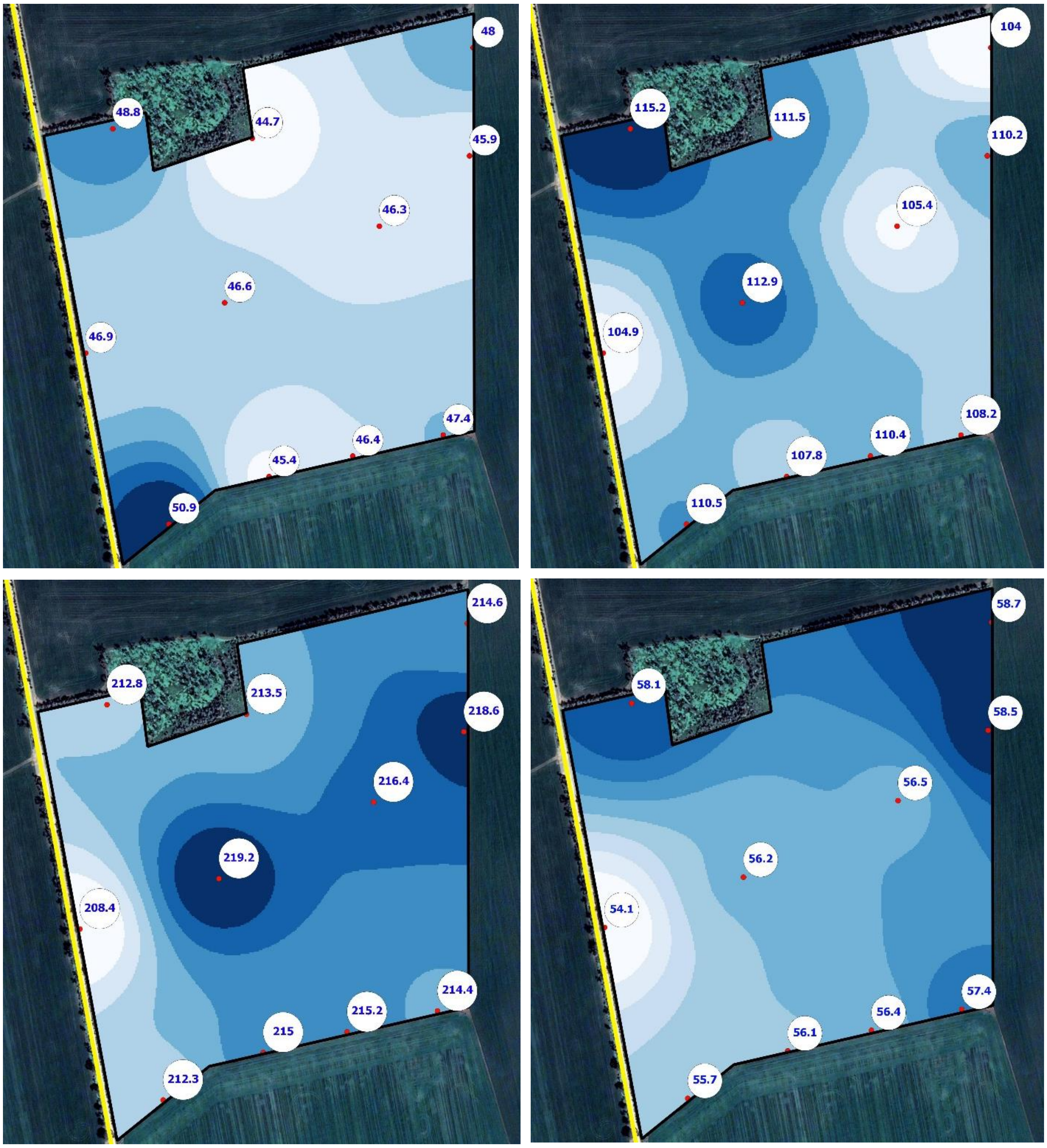


Figure 6. Rainfall distribution maps for autumn (top left), winter (top right), spring (bottom left) and summer (bottom right) at the Hart field site in 2022. Dark blue shading represents greater rainfall areas and white areas indicate lower rainfall.

Acknowledgements

The Hart Field-Site Group would like to acknowledge the generous support of our sponsors who provide funding that allows us to conduct this trial. Proceeds from Hart's ongoing commercial crop also support Hart's research and extension program.

This trial is funded by HART

References

Anderson D and Allen R 2021, 'Rainfall variability at Hart in 2021' *https://www.hartfieldsite.org.au/pages/resources/trials-results/2021-trial-results.php*

Interpretation of statistical data

The results of replicated trials are presented as the average (mean) for each of the replicates within a treatment.

Authors generally use ANOVA, in which the means of more than one treatment are compared to each other. The least significant difference (LSD $P \le 0.05$), seen at the bottom of data tables gives an indication of the treatment difference that could occur by chance. NS (not significant) indicates that there is no difference between the treatments. The size of the LSD can be used to compare treatment results and values must differ by more than this value for the difference to be statistically significant.

So, it is more likely (95%) that the differences are due to the treatments, and not by chance (5%). Of course, we may be prepared to accept a lower probability (80%) or chance that two treatments are different, and so in some cases a non-significant result may still be useful.

Interpretation of replicated results: an example

Here we use an example of a replicated wheat variety trial containing yield and grain quality data (Table 1). Statistically significant differences were found between varieties for both grain yield and protein. The LSD for grain yield of 0.40 means there must be more than 0.40 t/ha difference between yields before that variety's performance is significantly different to another. In this example Trojan is significantly different to all other varieties as it is the only variety followed by a superscript (^{a}). Scout, Mace and Cosmick are not significantly different from each other and are all followed by a superscript (^{b}) as they all yielded within 0.4 t/ha of each other.

Similarly, for grain protein a varieties performance was significant from another if there was more than 0.9% difference in protein. In the example, Arrow contained a higher protein level compared to all other varieties which were not different to one another.

Where there are no significant differences between treatments, NS (not significant) will be displayed as seen in the screenings column (Table 1).

Table 1. Wheat variety grain yield, protein and screenings from a hypothetical example to illustrate interpretation of LSD.

Variety	Grain yield (t/ha)	Protein (%)	Screenings (%)
Arrow	3.50^{c}	10.3^{a}	0.2
Cosmick	3.98^{b}	8.4^{b}	1.0
Mace	3.75^{bc}	9.1^{b}	0.5
Scout	4.05^{b}	8.9^{b}	0.9
Trojan	4.77^{a}	8.4^{b}	0.4
LSD (P≤0.05)	**0.40**	**0.9**	**NS**

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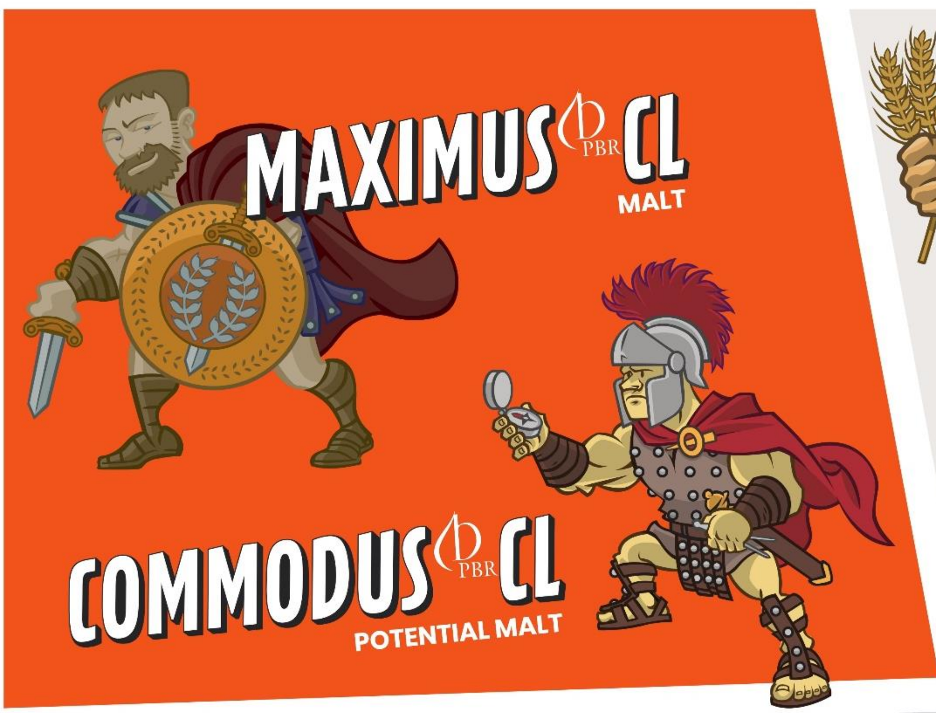

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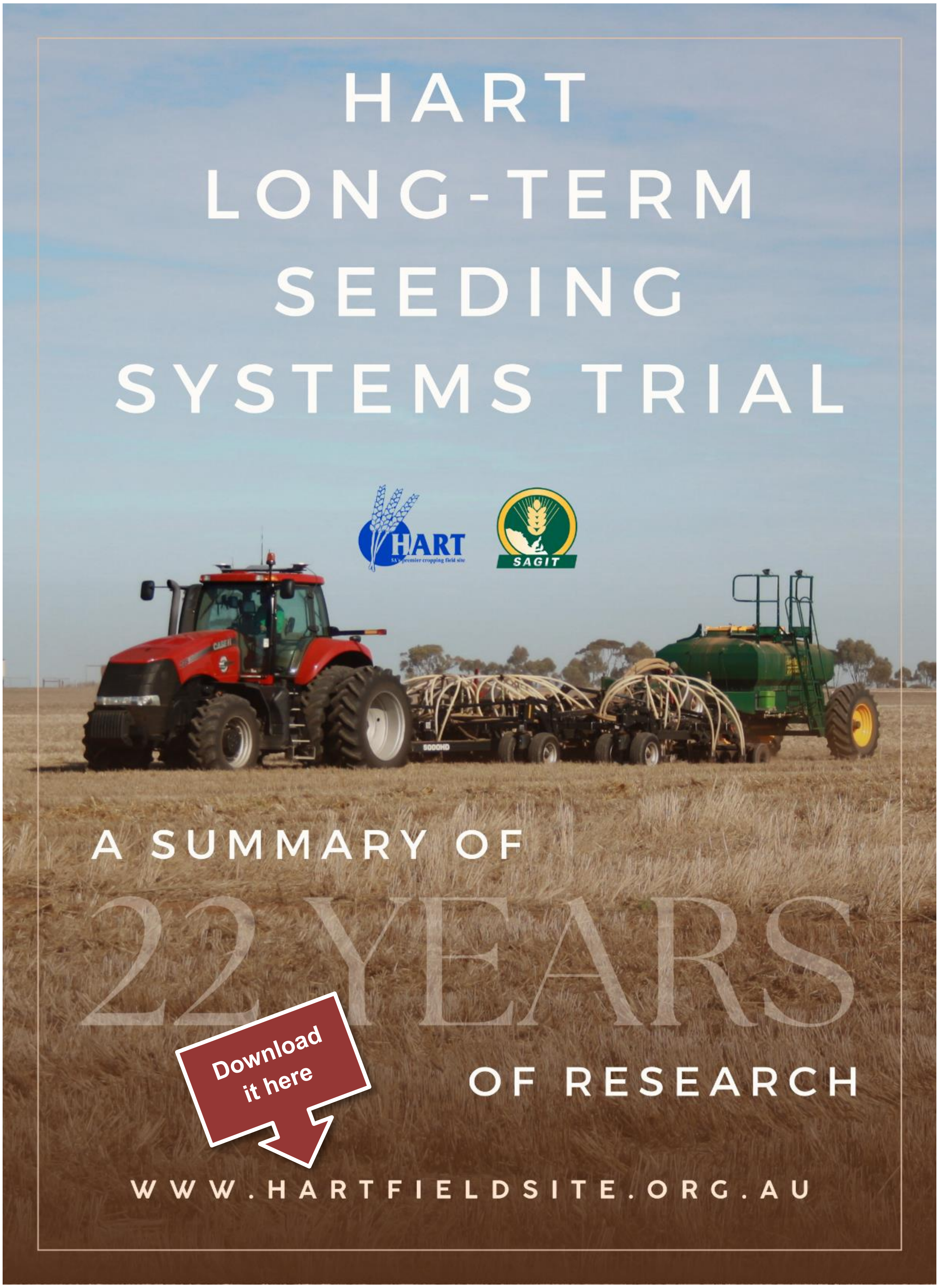

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