Hyper Yielding Cereal Project
A FEED GRAIN INITIATIVE

Thursday 14 November 2019

10:00am – 4:00pm including barbeque lunch and afternoon tea
Badcock Lane, Hagley, Tasmania

The project steering committee would like to thank the following event sponsor:

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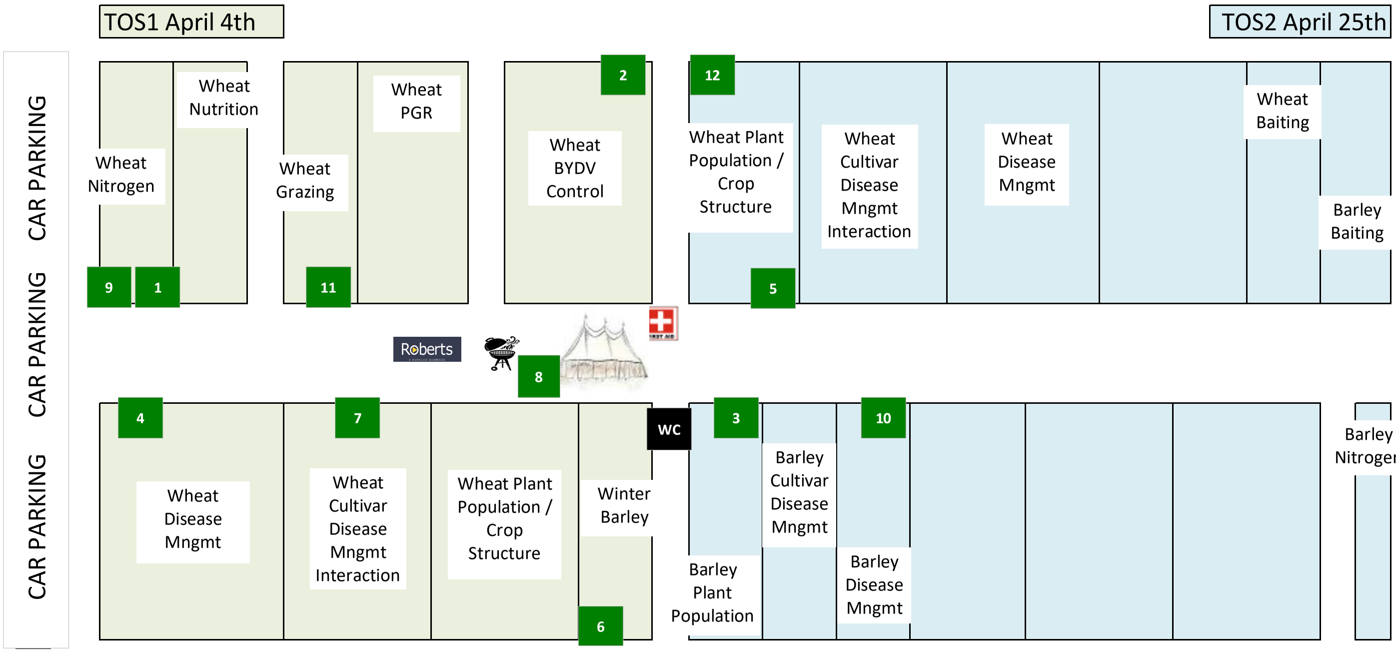
Notes

GRDC HYPER YIELDING CEREAL RESEARCH CENTRE

SITE PLAN 2019

SPEAKING SESSIONS 1 - 12 (Refer to timetable)

Timing of sowing
TOS 1 - 4th April
TOS 2 - 25th April



TIMETABLE

GRDC HYPER YIELDING EVENT: THURSDAY 14 NOVEMBER 2019

Opening address by Craig Ruchs, GRDC Senior Regional Manager - South

In-field presentations	Station No.	10:00	10:15	10:40	11:15	11:45	12:15	12:45	1:40	2:15	2:45	3:15	3:45
UK cereal yields – are they increasing? **Patrick Stephenson, Agonomist, NIAB TAG, UK**	1	Morning tea	Welcome and opening address					Roberts A RURALCO BUSINESS Lunch (kindly sponsored by Roberts)					Afternoon tea and close
Weed control in the high yielding irrigated farming systems of Tasmania. **Dr Christopher Preston, Professor, Weed Management, University of Adelaide**	2												
Getting it right when growing cereals as part of a mixed farming enterprise – importance of fertility, irrigation monitoring and inputs? **Ben Tait, Grower, Tasmania**	3												
The quest for hyper yielding cereals in the High Rainfall Zone (HRZ) of SA - a mainland growers perspective. **Brett Gilbertson, Grower, Millicent, SA**	4												
Looking at the highest yielding cultivars selected in HYC research - how important is plant population and growth regulation? **Darcy Warren, Senior Field Research Officer, FAR Australia and Ian Herbert, Tasmanian Manager, Southern Farming Systems**	5												
Managing autumn sown barley to achieve yields over 10t/ha - HYC results to date? **Jon Midwood, CEO, Southern Farming Systems**	6												
What combinations of germplasm and agronomy have maximised high yields in HYC trials? **Nick Poole, Managing Director, FAR Australia**	7												
Maximising the value of irrigation in cropping systems – the role of soil moisture monitoring and variable rate application. **Dr Carolyn Hedley, Senior Soil Scientist, Landcare research, NZ**	8												
The role of soil organic matter in hyper yielding cereals - why more applied fertiliser is not always the answer to increasing yields? **Jeff Baldock, Senior research scientist, CSIRO**	9												
Ramularia in barley - what do we know about this disease and how can we manage it? **Katherine Fuhrmann, Senior Field Research Officer, FAR Australia**	10												
Trading grain between cropping farmers and dairy producers – how can we make a system work for the betterment of both parties? **Michael Nichols, Grower, Tasmania**	11												
Payment of royalties - a global perspective **Warwick Green, Special Projects, Seed Force Ltd, NZ**	12												
In-field presentations	Station No.	10:00	10:15	10:40	11:15	11:45	12:15	12:45	1:40	2:15	2:45	3:15	3:45

VISITOR INFORMATION

We trust that you will enjoy your day with us at the Hyper Yielding Cereal Project Field Day. Your health and safety is paramount, therefore whilst on the property we ask that you both read and follow this information notice.

HEALTH & SAFETY

- All visitors are requested to follow instructions from FAR and SFS staff at all times.
- All visitors to the site are requested to stay within the public areas and not to cross into any roped off areas.
- All visitors are requested to report any hazards noted directly to a member of FAR or SFS staff.

FARM BIOSECURITY

- Please be considerate of farm biosecurity. Please do not walk into farm crops without permission. Please consider whether footwear and/or clothing have previously been worn in crops suffering from soil borne or foliar diseases. ***In addition, for visitors from the mainland please remember that clothing and shoes worn today may harbor disease spores from rust pathotypes or diseases not found on the mainland. Please change this clothing prior to returning to the mainland and/or ensure it is changed and cleaned before inspecting crops on the mainland.***

FIRST AID

- We have a number of First Aiders on site. Should you require any assistance, please ask a member of FAR or SFS staff.

LITTER

- Litter bins are located around the site for your use; we ask that you dispose of all litter considerately.

VEHICLES

- Vehicles will not be permitted outside of the designated car parking areas. Please ensure that your vehicle is parked within the designated area(s).

SMOKING

- There is No Smoking permitted inside any marquee.

Thank you for your cooperation, enjoy your day.

WELCOME TO THE 2019 HYPER YIELDING CEREAL PROJECT FIELD DAY

On behalf of the industry steering committee and project team, I am delighted to welcome you to the 2019 Hyper Yielding Cereal Project Field Day. This is our fourth and final field day for the project. For those who have attended previously, welcome back; to those visiting for the first time it's great to have your interest in the project and we trust you will enjoy the day. Last year we welcomed over 175 growers, advisors and researchers to the event with almost 50% attending the event from the mainland.

Led by the Foundation for Arable Research (FAR) Australia in collaboration with Southern Farming Systems (SFS), the Hyper Yielding Cereal (HYC) Project is funded by the Grains Research and Development Corporation (GRDC) and is aimed at boosting Tasmania's production of high-quality feed grain cereals, thereby reducing its reliance on supplies from the mainland.

The GRDC recognised some time ago that a huge opportunity exists for Tasmania to produce much greater volumes of feed grain cereals with new irrigation schemes coming online. It also recognised that with favourable quality attributes there was a growing market in the state's livestock sectors. Engagement with the end users is a key element of the research at the centre and of presentations at today's event.

What's happening on the HYC research site in 2019?
With two contrasting seasons (2016 & 2017) as a backdrop to our research the project has moved into a phase of more specific agronomy studies. These studies are being conducted on a range of cereal germplasm that represent different development classes and that have performed well over the last two years. Research work in wheat is being conducted on slower maturing northern European UK types, such as RGT Relay through to faster developing shorter season Australian winter wheats such as DS Bennett. Studies are up and running for the second year on all of these representative plant types at two sowing dates April 4th and April 25th.

Project barley yields have continued to increase in the project despite the presence of a new foliar disease *Ramularia* affecting research in 2016 and 2018. In 2018 despite the presence of this disease plots of RGT Planet and Rosalind topped 12.5t/ha, up from 10.5t/ha in 2016 and 11.4t/ha in 2017. Combatting *Ramularia* is a key target of our research in 2019 with management trials addressing the disease should it eventuate on the site as it did last season. A key area of research in Ramularia is whether there is sufficient genetic resistance available to change the management approach and whether SDHI chemistry is a key component for disease control. Plot yields for wheat have been pegged at 13-13.5t/ha for the last two seasons and its not been possible to repeat the 16-17t/ha yields observed in 2016. The research programme in wheat covers germplasm for early sowing, disease management, canopy management, lodging control, influence of grazing and nutrition.

Following feedback in 2018 there is more research on nutrition this year plus barley yellow dwarf virus studies in wheat. For three years there have been large differences in yield due to the presence of erect heads with poor grain fill at harvest. This has been observed at the new SA Crop Technology Centre as well as here in Tasmania and is the focus of a new study this year. Work with European winter barley cultivars which showed good resistance to *Ramularia* in 2018 continues in 2019 sown in early April.

Speakers and Demonstrations at today's event
The event will feature a range of research trial demonstrations and a line-up of international, mainland and Tasmanian speakers who will discuss various aspects of improved germplasm and agronomy, grain quality and end user interaction.

We are exceptionally fortunate to have Patrick Stephenson from NIAB TAG as our keynote speaker today who returns to the research site after attending the 2016 event. Patrick will update us on developments in the UK regarding the quest for higher productivity, better disease resistant germplasm and the impact of Brexit on the UK cropping industry. The Tasmanian environment is the nearest we get to a UK environment in Australia and we share a number of the disease issues in cereal crops such as Septoria tritici blotch and *Ramularia*.

As well as Patrick we have one of New Zealand's and two of Australia's foremost researchers in their respective fields; Dr Carolyn Hedley from New Zealand talking on irrigation for optimising yields, Dr Jeff Baldock talking on the need for good soil organic matter to underpin high yields and Dr Chris Preston addressing weed control under irrigation. With Warwick Green from SeedForce in NZ, growers Brett Gilbertson from Millicent, SA and Ben Tait and Michael Nichols from Tasmania along with presentations from the project team, the event promises to be a day not to be missed.

I would like to thank Craig Ruchs, GRDC Senior Regional Manager - South for taking the time out of his busy schedule to formally open the event and to GRDC for investing in the research programme on display today. Since the inception of the project we have been fortunate to have the service and input of a twelve strong industry steering group, without whose help the project would have been far weaker, thank you to all those individuals who gave up their time so freely. I would like to place on record my personal thanks to our sponsor for today's event Roberts. Finally, on behalf of the project team I would like to thank Botanical Resources Australia, in particular their farm manager Alan Steven and the landowner Don Badcock for the tremendous practical support given to the team.

Should you require any assistance throughout the day, please don't hesitate to contact a member of the FAR or SFS team (see the reverse of the programme for their identity) who will be more than happy to help.

Thank you once again for taking the time to join us today; we hope that you find the presentations useful, and as a result, take away new ideas which can be implemented in your own farming business. Have a great day and we look forward to seeing you again at future project events.

Nick Poole
Managing Director
FAR Australia

Funding Acknowledgements

The Hyper Yielding Cereal Project steering group would like to place on record its grateful thanks to the Grains Research & Development Corporation (GRDC) for their funding support for this event and project.

Sponsorship Acknowledgements

The Hyper Yielding Cereal Project steering group would also like to gratefully acknowledge the sponsorship support given by Roberts to support the catering for today’s event.

Other Acknowledgements

FAR Australia would like to acknowledge Adama for the provision of a weather station, as part of a collaboration looking at disease forecasting.

How did the project originate?
Despite a more favourable climate for grain production compared with the mainland, and greater yield potential, Tasmania remains a net importer of cereal grains. The average yield of red grain feed wheat in Tasmania is less than 5t/ha and the state imports approximately 150,000-200,000 tonnes of cereal grains compared to a domestic production of 60,000-80,000 tonnes. The HYC project aims to make Tasmania more self-sufficient in its capacity to supply feed grain to the State's dairy industry and other livestock users.

The project aims to bridge the gap between actual and potential yields through genetic improvement of cereal crops, best practice in terms of management of those crops and recognition of quality for the key end users. To that end, much progress has already been made in the initial screening of new cultivars for high yields, disease resistance and traits suitable for the Tasmanian environment.

Project objectives
With input from national and international cereal breeders, growers, advisers and the livestock industry, the project is working towards setting record yield targets as aspirational goals for growers of feed grains. In year one we achieved this in the research plots, now the project team has to translate this into commercial yield gains. The newly established focus farms which have been trying out high flying candidates from 2016 are the first steps towards commercial gains but dare I say establishing a new Australian wheat yield record for commercial crops here in Tasmania would be a great way to build on the objectives of this project. With the right incentives, the project steering group believe it will be possible to encourage breeders to place greater focus on the needs of Tasmanian growers and the more general needs of the long season High Rainfall Zone (HRZ).

To focus on these objectives, the project has been set the challenge of:

- Increasing average Tasmanian red grain feed wheat yields from 4.4t/ha to 7t/ha by 2020;
- Delivering commercial wheat crops which yield 14t/ha by 2020;
- Identifying and endorsing the value of metabolisable and digestible energy in feed grain cereals through engagement and collaboration with the dairy and other end users in the Tasmanian industry.

The research plots have more than proven that these yields are possible its now time to take the research outputs and make the yield gains in commercial crops.

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Station 1

10:40am and 1:40pm

Patrick Stephenson
Agronomist, NIAB TAG, UK

UK cereal yields – are they increasing?

It is incredible how much the world can change in a relatively short time. It is three years since my last visit and in the meantime Donald Trump has embarked on an economic sanctions battle with China leading to huge Government subsidies to US corn and soya bean harvesters. South America has met the vacuum in demand and the Amazon is on fire! Global warming continues to be an issue. Governments around the world are failing to form a collective action plan to address any of it! Meanwhile, Britain is suffering from a 'Jekyll and Hyde' personality issue, named Brexit. Add to this. a shift in popular culture to a demand for sustainability, veganism and the disrespect of science, where does that leave farmers?

In 2013, the UK embarked on a collaborative project called the 'Yield Enhancement Network' (YEN). The background to this cross industry supported project, was that there was a perception that yields had plateaued in National terms. This was despite varietal improvement continuing, as monitored by the UK national variety trials. The object of the collaboration was to investigate what associated factors were common to the highest yields of Wheat, Barley and Canola. Could these associations then be used to help all growers improve crop performance? Over the six years, there were 570 'sites' entered into the project, from in excess of 250 farms. 'Sites' had to be a minimum size of 2 ha and, from what the farmers' thought would be, the highest potential yield area. All input data had to be recorded from weather, soil type, cultivations and agronomy. The vast majority of the crops were wheat and work carried out by Roger Sylvester Bradley et al. produced the maximum theoretical yields across the UK (details shown in Table 1).

Table 1. Theoretical Yield Expectations for the UK

Key T/Ha

	≤ 18
	≤ 19
	≤ 20
	≤ 21
	≤ 22
	≤ 23

The average yield from all of the sites over the last 6 years was 10.8 t/ha, with a range from 5.0 to 16.5 t/ha. Table 2 below highlights the most common factors in the highest yielding crops.

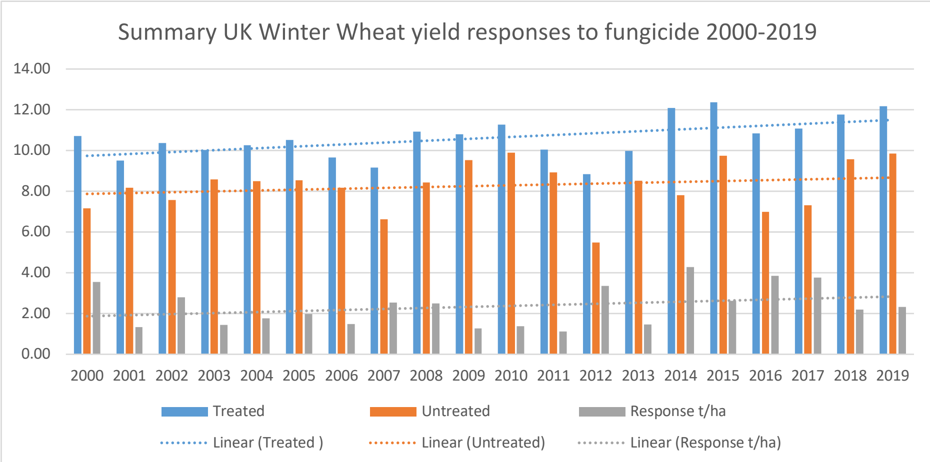
Table 2. Summary of associations that influenced output in the YEN project

Factor	Positive	Negative
Ear Numbers	Greater Numbers	
Straw	Tending to be taller with greater N%	
Nutrition	Sufficient Nitrogen little and often Fresh Phosphate Applying Slurry	Liquid Nitrogen Micro nutrients Potash Sulphur
Disease Lodging	Good Control	
Weather		25% variation
Individual Farmer	75% of the factor	
Soils	Moisture Retentive	Sands
pH	+0.3 T/HA per unit	
Cover Crops		Lower yield
Rotation	Break Crops	
Drill width	Narrow Rows	

This is only a brief synopsis of the findings, and it is by no way a blue print for the highest yielding crops, but is a summary of the most common factors across the submitted entries. ***The biggest association was that the growers who had 'paid the most attention to detail' produced the best results.***

In the UK, high yields produced by high input farming has historically been the most profitable way to farm. This has led to a culture of using chemistry as the first line of attack. The YEN project started in 2013 was inevitably associated with high input and high output of chemicals. Since 2013, we are in the process of losing 40 active ingredients (10 insecticides, 12 fungicides, 16 herbicides, and 2 molluscicides), and added to this we have a rising resistance to the available pesticides in use. So where do we stand now? Table 3 shows the average wheat yields in AHDB levy funded trials in the UK from 2000 - 2019.

Table 3. UK Winter Wheat yield 2000-2019 (AHDB levy funded trials)



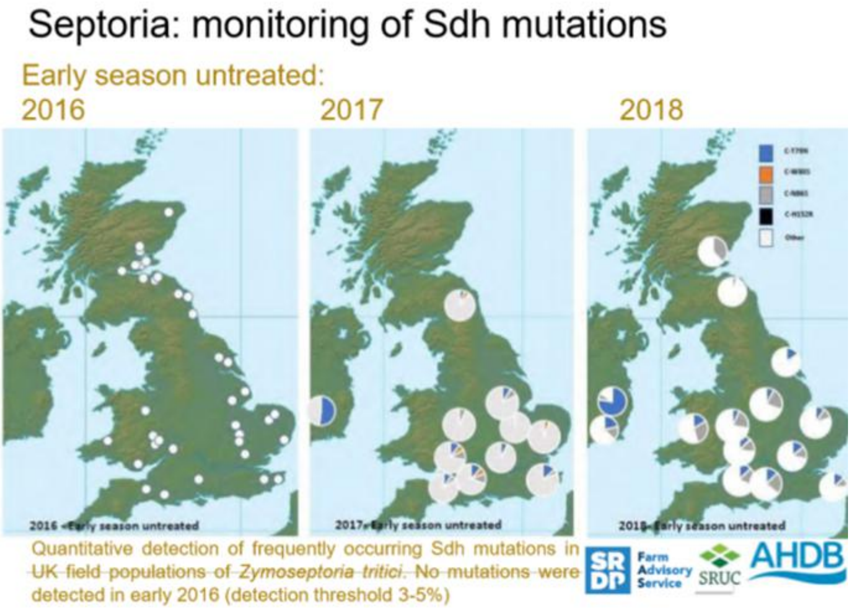
The table confirms an upward trend in yields by both breeding, and the use of an extensive fungicide program. Despite the constraints farmers have been able to maintain and improve yields. However, there has been a significant change in the UK. The impending loss of the much used multisite Chlorothalonil (Use up by May 20th 2020) and the increasing resistance build up to the available chemistry the industry is at a cross roads. Table 4 shows the rising resistance levels to the current SDHI actives.

The four resistant strains shown on the map have varying impact at field level. The most resistant being the black and blue colours and these appear to have complete immunity to the current SDHI products. Although new chemistry is just around the corner, the long-term prognosis is not good for all chemistry. The wheat breeders have reacted by targeting septoria resistance as a key priority. The average resistance rating for wheat on the Winter Wheat Recommended List has risen from an average of 5.4 in 2016/17 to 5.8 in 2018/19. This now includes the variety KWS Extase with the highest ever resistance at 8.1. Growers are now accepting that the answer to maintaining and increasing yields is not solely in the form of a can. The evolution of the Barley Yellow Dwarf Virus (BYDV) resistant wheat variety, RAGT Wolverine, will also help with the loss of insecticides, and resistance in the aphid population to pyrethroids. This interestingly, has for the first time, put a price on a specific genetic trait at $60/Ha.

It seems almost immoral to talk about the benefits that global warming could bring, but the UK agricultural industry would certainly be one that could. One example is the French Champagne House Taittinger, who have invested heavily in the South Downs planting over 1 million vines to insure against climate issues. Overall, the warming climate would enable the Northern parts of Europe to grow a wider range of crops. This would have to be offset against more intense rain periods and new invasive species.

In summary, despite the constraints, farmers have managed to keep yields increasing. The threats both politically and environmentally are becoming increasingly more difficult. The challenge going forward maybe to maintain the status quo by using innovative breeding, improved cultural techniques and a willingness to adapt.

Table 4. Showing SDH resistant mutations



Dr Christopher Preston
School of Agriculture, Food & Wine, University of Adelaide

Getting weed control in the high yielding irrigated farming systems of Tasmania

Key messages

- Annual ryegrass has evolved resistance to most post-emergent herbicides in Tasmania.
- Annual ryegrass can rapidly replenish the seed bank in the HRZ by producing a large number of seed.
- Individual pre-emergent herbicides tend to have limited persistence in high rainfall zones making mixtures and sequences better.
- Crops mature later in the HRZ meaning that more than 50% of the annual ryegrass seed can shed prior to harvest. This reduces the efficacy of harvest weed seed management practices in the HRZ.
- Rotations are an important tactic for achieving annual ryegrass management.

One of the challenges of irrigated cropping is keeping weeds under control. Annual ryegrass is the most important weed of cereal crops in southern Australia and can easily build up to large numbers. Early competition from weeds is most important in reducing crop yield. Weeds germinating later in the crop have less impact on yield, but do maintain weed populations.

The long, cool growing season and availability of moisture encourages annual ryegrass to germinate over a long period. This means that post-emergent herbicides are the first choice of control. Unfortunately, like the rest of Australia, annual ryegrass has evolved resistance to the Group A herbicides in Tasmania with nearly half the ryegrass samples collected in 2014 resistant to the Fop herbicides and 8% resistant to clethodim. In addition, 20% of samples were resistant to imidazolinone herbicides.

Resistance to the post-emergent herbicides makes pre-emergent herbicides more important. However, pre-emergent herbicides are much more difficult to use than post emergent herbicides. The main considerations of pre-emergent herbicides in irrigated systems is: how to use them for crop safety; will they move out of the weed root zone with irrigation; and how long will they provide weed control. The table lists some pre-emergent herbicides for use in wheat and considers their potential behaviour in irrigated systems. One of the challenges with irrigated systems is that watering events typically provide a lot of water in a short time and tend to move herbicides further through the soil, particularly if soil was previously dry.

The more persistent herbicides can result in plant back problems for rotational crops and this needs to be considered in their use. As pre-emergent herbicides are applied prior to sowing, the extended season means there is typically insufficient persistence to control annual ryegrass through the season. Mixtures and sequences of pre-emergent herbicides will increase the amount of annual ryegrass controlled.

Other controls should be considered. Crop competition can be a helpful partner with pre-emergent herbicides in reducing the impact and seed set of annual ryegrass. The value of crop competition on annual ryegrass seed set is less in longer season areas. Harvest weed seed control is another useful tactic; however, in later maturing crops about 50% of ryegrass seed is shed prior to harvest. Even so, removing 30% of ryegrass seed from fields will aid in driving down weed seed banks, particularly when coupled with other tactics.

Crop rotations will be one of the most useful practices in managing annual ryegrass and other weeds. Weeds that are difficult to target in one crop may be more easily targeted in other crops. Using crop rotations as an opportunity to reduce annual ryegrass seed banks will enable greater yields in cereals.

Table 1. Pre-emergent herbicides available for annual ryegrass management in wheat.

Herbicide	Trade name	Soil movement	Persistence	Notes
Trifluralin	TriflurX	Very low	Long	Fails to control ryegrass in crop rows
Pendimethalin	Stomp	Low	Long	Less effective on annual ryegrass
Triallate	Avadex Xtra	Low	Moderate	Less effective on annual ryegrass
Pyroxasulfone	Sakura	Moderate	Moderate	Low binding to organic matter can see herbicide move too far in light soil types
Prosulfocarb	Arcade	Moderate	Short	Short persistence results in more late ryegrass emergence
Prosulfocarb + S-metolachlor	Boxer Gold	Moderate	Short	Short persistence results in more late ryegrass emergence
Bixlozone	Overwatch	Low	Moderate	IBS use only
Cinmethylin	Luximax	Moderate	Moderate	Low margin of crop safety, so unsuited to irrigated systems

Ben Tait
Grower, Tasmania

Getting it right when growing cereals as part of a mixed farm enterprise – importance of fertility, irrigation monitoring and inputs

Ben and Stephanie Tait farm 800ha at Epping Forest in the Northern Midlands and are approaching their second harvest. Having operated in the Ashburton District of New Zealand for ten years in a mixed arable business and operation they produced some good cereal crops in rotation with seed crops and livestock finishing.

Ben's parents survived the NZ downturn of the eighties when the family went out of sheep breeding and focused on arable. The Tait's farmed dryland until 2007 when they connected to a new pressurised irrigation scheme. Wheat yields tripled in the twenty years leading up to the family moving to Tasmania in 2018.

Stephanie grew up on a grain farm in Northern Saskatchewan, Canada, producing cereals in rotation with canola, Lucerne and Hemp. Ben will discuss their influences and what drives them in the development of their new mixed farm 'Fairfield.'

Topics:

- Science. Plant breeding and chemistry. Being grateful for research and development.
- Should I become an expert or just surround myself by them?
- Being practical with inputs. The balance of Nitrogen and PGR's.
- Secret weapons. I don't think water is the only way to keep it green.
- Cereal Straw. Chopping versus baling.
- Utilising growing degree days, Cereal in rotation with Dairy agistment and sheep in mixed farming.
- Fixed costs and variable costs. Production costs versus opportunity costs.
- Understanding *What drives you?*
- Understanding your limiting factors.
- Tasmania from the outsiders perspective. Comparing the Midlands to Mid Canterbury.
- Conclusion: Our bright future in Tasmania what about environment compliance?

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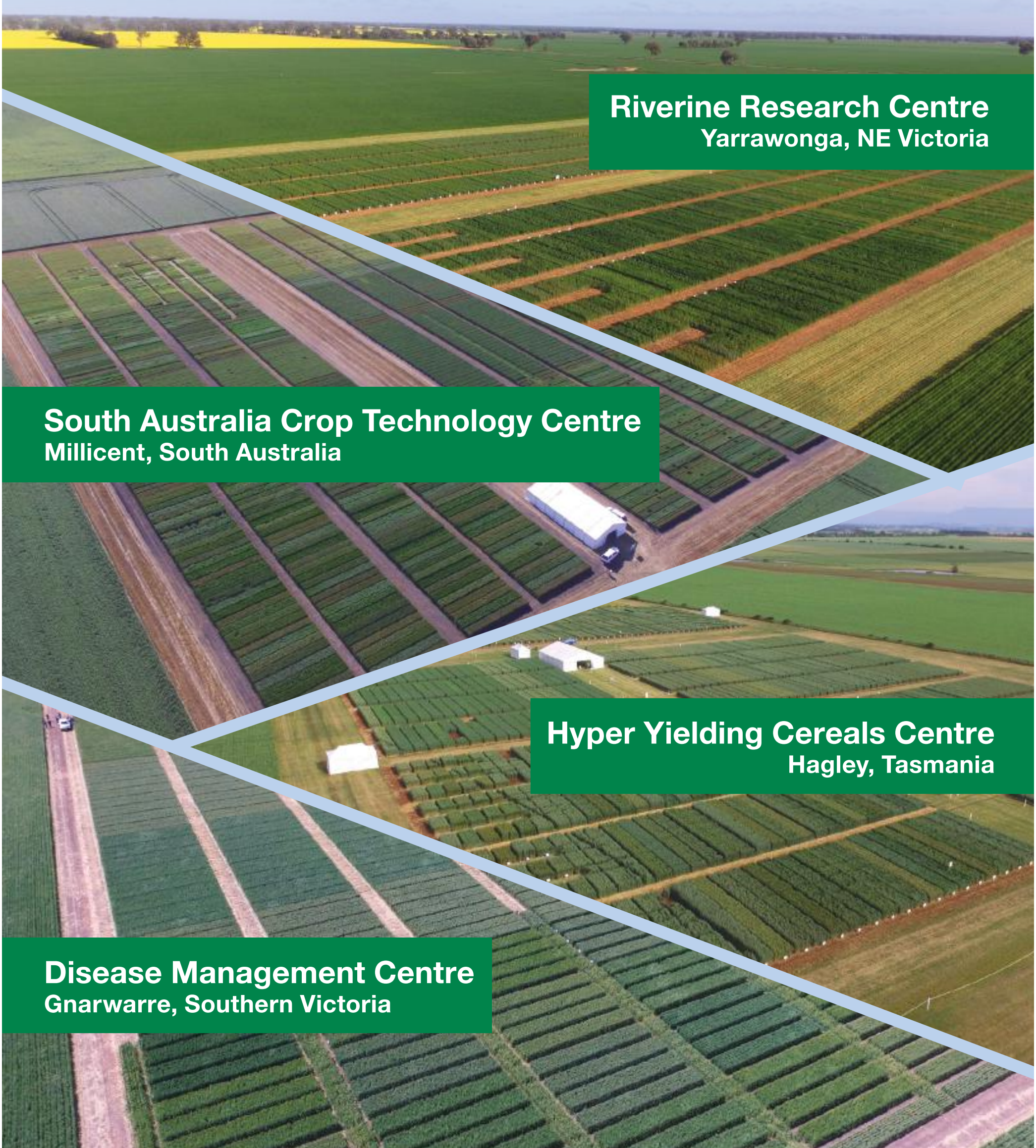

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Brett Gilbertson
Grower, Millicent, SA

The quest for hyper yielding cereals in the High Rainfall Zone (HRZ) of SA – a mainland grower's perspective

Growing hyper-yielding cereals is a generational passion on Gilbrae. In 2016 we were able to produce an 11.5 tonne/ha Trojan wheat crop on a 40ha site. This was enabled by not only a great season but it was the first time I had sat down with a local agronomist John Henderson, with a similar passion, and wrote on paper the steps we would take to produce a hyper-yielding wheat crop. The list is still a work in progress but gives me a disciplined reference for the coming years production.

2016 12t/ha Wheat Plan

- Select top performing paddock or part paddock with greatest potential
- Soil test plus nitrogen test – John
- 1000 seed count to determine sowing rate – John
- Target 160 plants/m^2 @ 5 tillers/plant = 800 tillers/m^2 at GS30
- Sow with MAP @ 180 kg/ha to deliver large load of phosphorus without too much N
- Apply potash post emergence
- Use flutriafol on MAP fertilizer to deliver 400ml/ha for septoria tritici = 220ml/100kg
- Do plant counts for records/performance in future – John
- Do tiller counts for records and to determine if nitrogen pre-GS30 is necessary – John
- Maintain usual trace element regime
- Nitrogen applications dependant on soil moisture and rainfall outlook but if season is going well, look to apply up to 500kg/ha Urea over 3-4 applications
- Apply some Urea pre-GS30 if required to push tiller numbers – 60-80kg/ha
- 180kg/ha Urea @ GS 30-31
- 180kg/ha Urea @ GS 32-33
- 80kg/ha Urea prior to flowering i.e. when wheat head has fully emerged

PGR Program
GS 30 – Stabalin @ 1.25L/ha plus Moddus @ 200ml/ha
GS 31 – Stabalin @ 700ml/ha plus Moddus @ 100ml/ha

Fungicide Program
GS 32 – Amistar Xtra 400ml/ha
Flag – Tazer Xpert 500ml/ha

2019 Actual Wheat Inputs

Pre sowing – Spread 50kg/ha MOP

5/6/19 Sowing – 130kg/ha Trojan wheat + 140kg/ha MAP

7/6/19 – Incorporate by prickle chain 118g/ha Sakura + 2 ½ L/ha Avadex Xtra

12/7/19 (GS13) – Sprayed 2kg/ha Mn + 1kg/ha Mg + 0.5 kg/ha Zn + 5L/ha NCal + 150ml/ha Astound

18/7/19 (GS) – Spread 70kg/ha Urea

30/7/19 (GS) – Sprayed 2kg/ha Mn +1kg/ha Mg + 0.5kg/ha Zn + 5L/ha NCal + 1L/ha Triathlon + 120ml/ha Archer + 150ml/ha Astound

15/8/19 (GS) – Sprayed 2kg/ha Mn +1kg/ha Mg + 0.5kg/ha Zn +10L/ha NCal + 1.5L/ha K

16/8/19 (GS) – Spread 100kg/ha Urea

27/8/19 (GS32) – Sprayed 500g/ha Rapisol 3.2.1. + 450ml/ha Aviator Xpro + 200ml/ha Moddus Evo + 1.25L/ha Errex + Wetter

28/8/19 (GS32) – Spread 200kg/ha Urea

1/10/19 (GS39) – Sprayed 1.5kg/ha Mn + 1kg/ha Mg + 0.5kg/ha Zn + 200g/ha Cu + 5L/ha NCal + 400ml/ha Amistar Xtra + Wetter

Darcy Warren, FAR Australia
Ian Herbert, Southern Farming Systems

Looking at the highest yielding cultivars selected in HYC research – how important is plant population and growth regulation?

Key Points

- Early April sowings gave positive yield responses from increasing plant populations from 60-80 plants/m^2 to 100-120 plants/m^2 irrespective of cultivar tested (RGT Relay, Annapurna, RGT Calabro and RGT Accroc).
- Late April sowings showed significant yield benefits from increasing plant populations to 150 - 190 plants/m^2 range.
- Sown in early April Annapurna, RGT Calabro and RGT Accroc are yield responsive to PGR application (low rate Moddus/Errex sequence) at populations of 100-120plants/m^2.
- In the case of Annapurna and RGT Calabro these yield increases to PGR (0.61-1.12t/ha) were observed in the absence of lodging.
- In the testing conducted in 2018 RGT Relay (the stiffest strawed cultivar tested) showed no significant response to PGR application, irrespective of plant population tested (70-130plants/ m^2).
- The most cost-effective PGR programmes for prevention of lodging in early sown wheat (or crops at high risk due to fertility) have been sequences of two PGRs applied at GS30 (pseudo stem erect) and GS32 (second node).
- When sown in late April these cultivars were less responsive to PGR with no lodging in the trial.

What was the influence of plant population on wheat yields in April sown HYC trials in 2018?

After the selection of the highest yielding cultivars in HYC trials in 2017, the research programme has been further evaluating the management of these cultivars in an early April and late April sown scenarios. The phenology of the four selected candidates varies from Annapurna and RGT Accroc as earlier developing options to RGT Relay as the longer season wheat with RGT Calabro intermediate between these two groups. When sown in early April (April 5) the influence of plant population has been similar across all three development groups with a significant fall off in yield when plant populations establish below 100 plants/m^2 (60-80 plants/m^2) compared to plant populations at 100 – 120 plants/m^2. Although the early sown crop has more time to compensate for lower plant population (increased tiller survival) all four cultivars showed a significant reduction in yield at 60-80 plants/m^2. Like wise there was little indication with the exception of RGT Relay that plant populations for this early sowing window needed to exceed 100-120 plants/ m^2. RGT Relay was significantly higher yielding at the highest plant population whilst the other three cultivars displayed no significant difference in yield in the 100 – 140 plants/m^2 range.

With the late April sowing date (April 26) there was a stronger trend for higher plant populations to be more productive (Table 1). All cultivars tended to give their highest yields when grown at 150-190 plants/m^2, although RGT Accroc and RGT Calabro did not respond to populations above 160 plants/m^2, RGT Relay, Annapurna and Bennett all showed significant yield gains from moving to plant populations between 180-200 plants/m^{2}compared to 130-155 plants/m^2.

Table 1. Influence of cultivar and plant population on grain yield (t/ha) (% site mean), protein, test weight and screenings – sown 26 April.

				Grain Yield				Grain Quality					
Seed Rate	**Variety**	**Plants**		**Yield**		**Site Mean**		**Protein**		**Test wt**		**Screenings**	
(m^2)		**(m^2)**		**(t/ha)**		**(%)**		**%**		**kg/HL**		**%**	
100	RGT Accroc	77.5	de	10.79	e	107.0	e	11.6	de	79.2	de	0.9	d
	Annapurna	73.1	e	11.42	cd	113.3	cd	12.8	c	80.9	ab	1.5	c
	RGT Calabro	80.6	de	11.62	cd	115.3	cd	11.4	de	78.5	e	1.7	c
	RGT Relay	98.1	d	7.8	h	77.3	h	11.9	d	72.6	h	2.9	ab
	DS Bennett	77.5	de	6.00	k	59.5	k	13.9	a	80.2	bcd	1.6	c
	Mean	**81.4**	**c**	**9.52**	**c**	**94.5**	**c**	**12.3**	**a**	**78.3**	**c**	**1.7**	**a**
175	RGT Accroc	127.5	c	11.37	cd	112.7	cd	11.6	de	79.3	de	0.9	d
	Annapurna	128.8	c	11.72	c	116.2	c	12.8	c	80.8	abc	1.5	c
	RGT Calabro	158.1	b	12.45	ab	123.5	ab	10.9	e	79.4	de	1.3	c
	RGT Relay	151.3	bc	8.81	g	87.4	g	11.9	d	73.8	g	3.1	a
	DS Bennett	155.6	b	6.61	j	65.5	j	14.2	a	80.9	ab	1.3	c
	Mean	**144.3**	**b**	**10.19**	**b**	**101.1**	**b**	**12.2**	**a**	**78.8**	**b**	**1.6**	**a**
250	RGT Accroc	189.4	a	11.30	d	112.0	d	11.4	de	79.9	bcd	0.8	d
	Annapurna	190.6	a	12.33	b	122.3	b	13.1	bc	81.0	ab	1.4	c
	RGT Calabro	189.4	a	12.77	a	126.6	a	11.3	de	79.7	cd	1.6	c
	RGT Relay	199.4	a	9.23	f	91.6	f	11.6	de	75.7	f	2.7	b
	DS Bennett	194.4	a	7.04	i	69.8	i	13.7	ab	81.6	a	1.3	c
Mean		**192.6**	**a**	**10.53**	**a**	**104.5**	**a**	**12.2**	**a**	**79.6**	**a**	**1.5**	**a**
LSD Pop. (p = 0.05)		9.80		0.31		3.10		0.40		0.50		0.40	
LSD Variety		14.40		0.22		2.20		0.40		0.60		0.20	
LSD Var x Pop		ns		0.39		3.80		ns		1.10		ns	

Interaction with Plant Growth Regulation

With early sown crops (April 5) RGT Accroc was the only cultivar to lodge, as a consequence it gave significant yield responses to PGR application. However, with RGT Calabro and Annapurna positive yield responses were observed to a PGR programme (Moddus Evo 100mL/ha + 0.65L/ha Errex applied at GS30 & GS32-33) in the absence of lodging. There was no response to PGR in RGT Relay which has been observed to be the stiffest strawed of these four cultivars. There was a significant interaction between PGR application and plant population with greater response to PGR at the higher plant populations than lower plant populations.

In further research conducted on early sown RGT Accroc and Manning results showed that the most effective PGR applications for both yield response and lodging control (evaluated over three years) were combinations of low rate PGR timed at GS30 and GS32. These timings are effective in early sown crops which spend longer (more calendar days) in this development window relative to later sowing dates which progress through these development stages far quicker later in the spring (Table 2 & 3).

Table 2. Grain yield (t/ha), % Site Mean, protein (%), test weight (kg/HL) and screenings (%) – RGT Accroc sown 5 April.

Trt	Product and Rate (L/ha)	Timing	Yield (t/ha)		Mean (%)	Protein (%)		Test wt (kg/HL)		Screenings (%)	
1	Untreated	---	11.63	bc	96.8	11.5	a	79.3	b	1.2	a
2	Moddus Evo 0.2 + Errex 1.3	GS31	12.35	a	102.8	11.2	a	79.5	b	1.3	a
3	Moddus Evo 0.1 + Errex 0.65	GS30	12.54	a	104.4	10.9	ab	79.9	ab	1.0	a
	Moddus Evo 0.1 + Errex 0.65	GS32									
4	Moddus Evo 0.2 + Errex 1.3	GS32	12.41	a	103.4	11.2	a	80.6	a	0.9	a
5	Errex 0.65	GS16	12.28	a	102.2	10.9	ab	80.0	ab	0.9	a
	Moddus Evo 0.1 + Errex 0.65	GS32									
6	Moddus Evo 0.2 + Errex 1.3	GS31	12.28	a	102.2	11.3	a	80.1	ab	1.1	a
	Experimental Trt 1	GS37									
7	Moddus Evo 0.1 + Errex 0.65	GS30	12.23	a	101.8	10.6	ab	80.2	ab	0.9	a
	Moddus Evo 0.1 + Errex 0.65	GS32									
	Experimental Trt 1	GS37									
8	Experimental Trt 1	GS32	11.49	bc	95.6	11.3	a	80.2	ab	0.9	a
9	Grazing	GS22	11.26	c	93.8	10.2	b	80.1	ab	1.0	a
	Grazing	GS30									
10	Errex 1.3 + Experimental Trt 1	GS32	11.68	b	97.2	11.5	a	79.8	ab	1.2	a
	Mean		**12.01**		**100**	**11.1**		**80.0**		**1.0**	
	LSD (p=0.05)		0.41		3.38	0.95		1.02		0.48	
	P val		<0.001		<0.001	0.185		0.390		0.738	

Table 3. Margin over input cost for PGR and grazing treatments in RGT Accroc sown April 5.

Trt	No. of PGR sprays	Application and chemical cost	Income from grazing ($)	Additional Income from PGR/graze ($/ha)	Margin over input cost ($/ha)
1	0 (Untreated)	0	0	0	0
2	1	42	0	252	210
3	2	54	0	**318**	265
4	2	42	0	273	231
5	2	46.5	0	227	181
6	3	79	0	227	148
7	3	91	0	210	119
8	1	37	0	-49	-86
9	0 Grazed twice	0	312	-130	182
10	1	64	0	17.5	-47

Assumptions: PGR cost based on Errex $11.55 L, Moddus Evo $75/L and an estimated cost of $25/ha for Experimental 1 and application cost based on $12/ha per application have been deducted from the value of additional yield over the untreated at $350/t. Dry matter from grazing assumed at 26 c/kg DM.

Jon Midwood
Southern Farming Systems

Managing autumn sown barley to achieve yields over 10 t/ha – HYC results to date

Key Points

- A large part of HYC's early research in 2016 and 2017 was to screen for suitable varieties of barley that have matched some of the key features for the Tasmanian environment, when sown in April. These are:
    - The correct phenology, suitable for producing high yields from the optimum sowing date
    - Good disease resistance in order to reduce fungicide use in this long season HRZ environment.
    - Consistent and reliable performance across different seasons
    - Good standing power in order to support yields in excess of 10t/ha.
- In 2018, and now in 2019, the focus has moved into a phase of more detailed agronomic management, focusing on disease control, minimizing the effects of lodging and brackling and optimizing nutrition
- Two spring barleys; RGT Planet and Rosalind have been selected to take forward into 2019 trials
- Yield improvements have seen RGT Planet's highest yield in 2016 of 10.69 t/ha increase to 11.39 t/ha in 2017 and to 12.42 t/ha in 2018.
- Rosalind's highest yield in 2016 was 10.11 t/ha, 10.53 t/ha in 2017 and 12.62t/ha in 2018
- These yields were achieved by growing barley straight after a break crop; following vining peas in 2016, pyrethrum in 2017 and chickpeas in 2018
- In 2018 winter barley varieties were introduced into the barley trial program. These, predominately French varieties, were sown on April 5th and are being compared to RGT Planet.
- The best of these varieties yielded 9 t/ha which was 2 t/ha less than the RGT Planet in the same trial. Work continues with these varieties in 2019.

Seasonal summaries:

- 2016 Barley
    - RGT Planet yielded highest at 10.69 t/ha but not significantly (p= 0.05) more than Conquest, Oxford, SMBA12-1361, IGB1575 and Rosalind
    - These varieties all yielded significantly (p= 0.05) more than the control – Westminster
    - The top yielding varieties had an average head count of 860/m^2 which was higher than the mean at 815/m^2
    - Lodging and brackling scores were all low in the highest yielding varieties

- Rosalind was the only variety that developed considerably earlier than other varieties

- 2017 Barley
    - RGT Planet yielded highest at 11.39 t/ha. Rosalind highest yield was 10.53 t/ha which was significantly (p= 0.05) less than RGT Planet.
    - Head counts to achieve these yields were 1080/m^2 for RGT Planet and 1265/m^2 for Rosalind.
    - Spring varieties focused on RGT Planet, Conquest and Rosalind
- 2018 Barley
    - Early sown (April 5) RGT Planet significantly (p= 0.05) out yielded the winter types by >2t/ha even though it was frosted.
    - Changing the sowing date by three weeks delayed flowering into mid Oct and so RGT Planet wasn't frosted
    - With the highest plant population, PGR and three well timed foliar fungicides sowing RGT Planet on 26th April yielded 12.23 t/ha and 12.21 t/ha from Rosalind.
    - 2018 recorded the highest barley yields in the project so far with Rosalind yielding 12.62 t/ha and RGT Planet 12.42 t/ha, statistically there was no significant (p=0.05) difference between these yields.
    - The key to achieving these yields came from Ramularia control based on newer fungicide chemistry, using QoI (strobilurins)/triazole mix at GS31 and SDHI/trazole mix at GS49.

In terms of optimising the yield potential of barley in Tasmania we need to make sure we've addressed all the key interactions that will drive the best, or the highest yield potential we can currently achieve. This interaction can be looked at as:

Variety (genotype) x Environment x Management

- We've selected the best **varieties** we currently have available in RGT Planet and Rosalind
- We have a cool, long season **environment** in Tasmania with irrigation on free draining soils, with high organic carbon, adequate levels of macro nutrients and high residual N from previous cropping
- Now we are looking at the **management** opportunities and how we piece these together in 2019

Management considerations based on the cumulative results in the project work over the previous 3 seasons

- There is a suggestion from the previous HYC trials that head counts for both varieties need to be higher than traditionally considered. Head counts/m^2 in the order of 900 to 1100 appear to be contributing to the highest yields. This is set initially by calculating sowing rates based on 1000 grain weight and establishment percentages.

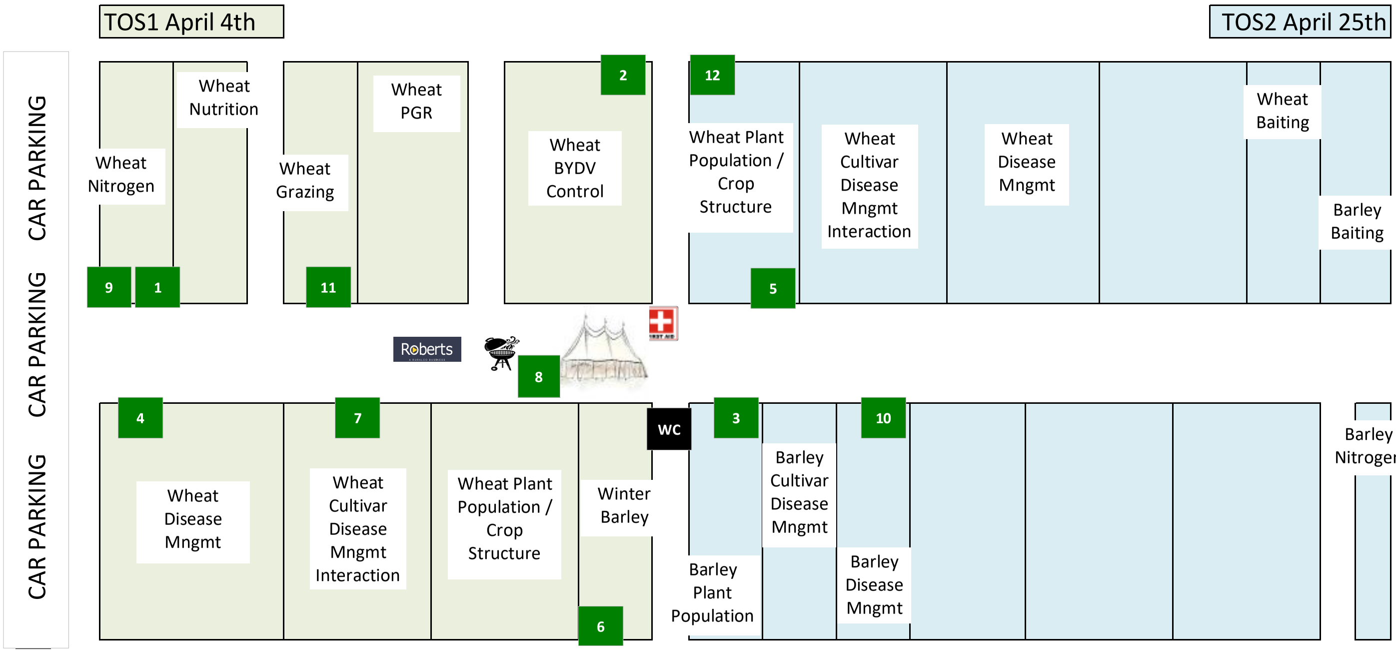
Continued on page 28...

GRDC HYPER YIELDING CEREAL RESEARCH CENTRE

SITE PLAN 2019

SPEAKING SESSIONS 1 - 12 (Refer to timetable)

Timing of sowing
TOS 1 - 4th April
TOS 2 - 25th April



TIMETABLE

GRDC HYPER YIELDING EVENT: THURSDAY 14 NOVEMBER 2019

Opening address by Craig Ruchs, GRDC Senior Regional Manager - South

In-field presentations	Station No.	10:00	10:15	10:40	11:15	11:45	12:15	12:45	1:40	2:15	2:45	3:15	3:45
UK cereal yields – are they increasing? **Patrick Stephenson, Agonomist, NIAB TAG, UK**	1	Morning tea	Welcome and opening address					Roberts A RURALCO BUSINESS Lunch (kindly sponsored by Roberts)					Afternoon tea and close
Weed control in the high yielding irrigated farming systems of Tasmania. **Dr Christopher Preston, Professor, Weed Management, University of Adelaide**	2												
Getting it right when growing cereals as part of a mixed farming enterprise – importance of fertility, irrigation monitoring and inputs? **Ben Tait, Grower, Tasmania**	3												
The quest for hyper yielding cereals in the High Rainfall Zone (HRZ) of SA - a mainland growers perspective. **Brett Gilbertson, Grower, Millicent, SA**	4												
Looking at the highest yielding cultivars selected in HYC research - how important is plant population and growth regulation? **Darcy Warren, Senior Field Research Officer, FAR Australia and Ian Herbert, Tasmanian Manager, Southern Farming Systems**	5												
Managing autumn sown barley to achieve yields over 10t/ha - HYC results to date? **Jon Midwood, CEO, Southern Farming Systems**	6												
What combinations of germplasm and agronomy have maximised high yields in HYC trials? **Nick Poole, Managing Director, FAR Australia**	7												
Maximising the value of irrigation in cropping systems – the role of soil moisture monitoring and variable rate application. **Dr Carolyn Hedley, Senior Soil Scientist, Landcare research, NZ**	8												
The role of soil organic matter in hyper yielding cereals - why more applied fertiliser is not always the answer to increasing yields? **Jeff Baldock, Senior research scientist, CSIRO**	9												
Ramularia in barley - what do we know about this disease and how can we manage it? **Katherine Fuhrmann, Senior Field Research Officer, FAR Australia**	10												
Trading grain between cropping farmers and dairy producers – how can we make a system work for the betterment of both parties? **Michael Nichols, Grower, Tasmania**	11												
Payment of royalties - a global perspective **Warwick Green, Special Projects, Seed Force Ltd, NZ**	12												
In-field presentations	**Station No.**	**10:00**	**10:15**	**10:40**	**11:15**	**11:45**	**12:15**	**12:45**	**1:40**	**2:15**	**2:45**	**3:15**	**3:45**

- The crop needs to stand for the duration of the season and have minimal brackling and head loss. Correctly timed PGRs will significantly help shorten and thicken the stems and applications at GS39 can aid head retention and minimize bounce back.
- We need to limit the impact of foliar disease, which in an irrigated, long season environment is much more damaging. The objective of disease control being to enhance the green leaf retention and duration.

Currently RGT Planet has been widely adopted both in Tasmania and on the mainland. Disease ratings for RGT Planet and Rosalind can be seen in table 1 below. Although these are not Tasmanian ratings, they're the closest we have to being relevant to Tasmania.

Table 1. 2019 Victorian winter crop summary (GRDC).

Variety	Leaf scald	Spot form	Net form	Powdery mildew	Leaf rust
Rosalind	MRMS	S	MR	MR#	MR
RGT Planet	MS	S	SVS	R	MRMS

These wet weather diseases, particularly NFNB and Scald can cause significant yield loss in an irrigated Tasmanian environment. In a high disease pressure scenario where the variety is predisposed to these diseases, early season fungicide protection can be achieved using a seed treatment such as fluxapyroxad (Systiva). However, seed treatment protection typically runs out during stem elongation depending on the product used, with the requirement for one or two follow up foliar fungicides. Alternatively, a foliar fungicide program of two sprays will generally be required.
In table 2. we can see the effect of different levels of disease control and the yield of the three varieties selected for the ongoing barley management trial work, under the high input two spray fungicide approach. Radial 840ml/ha (epoxiconazole/azoxystrobin mixture) at GS31 followed by Aviator Xpro 500ml/ha (prothioconazole/bixafen mixture) at GS49.

The control of Ramularia leaf spot (RLS) and yield response produced by this high input fungicide programme was significantly better than where only triazole fungicides (Tilt followed by Prosaro) were used alone in the same three varieties.

Table 2. Grain yield (t/ha), % Site Mean, % grain protein, test weight (kg/HL) and % screenings.

	Fungicide product, rate (mL/ha) & timing		**Yield**		**Mean**	**Protein**		**Test wt**		**Screen**	
Variety	**GS31**	**GS49**	**(t/ha)**		**(%)**	**(%)**		**(kg/HL)**		**(%)**	
RGT Planet	Untreated	Untreated	10.04	de	88.8	13.0	ab	55.4	d	8.1	ab
Conquest	Untreated	Untreated	9.74	e	86.1	12.7	b	58.6	c	6.9	bc
Rosalind	Untreated	Untreated	10.55	cd	93.3	13.6	a	58.9	c	9.8	a
RGT Planet	Tilt 500	Prosaro 150	11.20	bc	99.0	12.6	bc	59.0	c	4.9	cde

Conquest	Tilt 500	Prosaro 150	11.35	b	100.3		12.6	bc	63.1	a	4.5	cde
Rosalind	Tilt 500	Prosaro 150	11.43	b	101.0		13.5	a	60.0	bc	6.7	bcd
RGT Planet	Radial 840	Aviator 500	12.42	a	109.8		11.9	c	60.9	abc	3.0	e
Conquest	Radial 840	Aviator 500	12.45	a	110.1		12.3	bc	61.4	ab	4.2	de
Rosalind	Radial 840	Aviator 500	12.62	a	111.6		13.0	ab	60.6	bc	5.6	b-e
Mean (Untreated)			**10.11**	**c**	**89.9**	**c**	**13.8**	**a**	**57.6**	**b**	**8.3**	**a**
Mean (Tilt & Prosaro)			**11.33**	**b**	**100.2**	**b**	**12.9**	**a**	**60.7**	**ab**	**5.4**	**b**
Mean (Radial & Aviator)			**12.50**	**a**	**110.3**	**a**	**12.4**	**b**	**61.0**	**a**	**4.3**	**b**
LSD Mgmt (p = 0.05)			0.5		4.1		0.5		3.2		1.2	
LSD Variety			0.4		3.7		0.4		1.4		1.6	
LSD Var x Mgmt			0.7		6.4		0.7		2.4		2.7	
P Val Mgmt			<0.001		<0.001		0.027		0.076		<0.001	
P Val Variety			0.185		0.117		<0.001		0.003		0.014	
P Val Var x Mgmt			0.627		0.586		0.728		0.076		0.757	
CV			4.37		4.28		3.78		2.71		30.32	

Figures followed by different letters are considered to be statistically different (p=0.05)

Key points when making decisions around a fungicide programme:

- Rotate between different fungicide modes of action particularly the QoIs (strobilurins) and SDHIs.
- Limit the use of QoI (strobilurins) and SDHI applications to one per season. This includes the use of the SDHI seed treatment Systiva, which applied to the seed counts as a SDHI application within the season since it has activity on foliar diseases.
- The ideal timing for a two-spray programme is GS31 -32(1st – 2nd node) and GS49 (1st awns emerging). However, do not allow the gap between the first spray and the second spray to exceed four weeks regardless of the crop growth stage after the first application.
- If the crop has not reached GS49 1st awns by the time of the second application a third spray may be required if the pressure is sufficient to warrant it.
- The best control of Ramularia leaf spot comes from an SDHI/Triazole fungicide applied between GS45 and GS49

Nick Poole
Managing Director, FAR Australia

What combinations of germplasm and agronomy have maximised yields in HYC trials?

Key Points

- Higher final harvest dry matter (DM) leads to higher yield potential but it is the germplasm selected and management input that partitions this DM into grain that produces higher harvest indices that results in hyper yielding crops.
- RGT Relay has produced some of the highest wheat final harvest DMs in HYC trials, yet in 2018 its grain yields were lower than cultivars with significantly lower harvest DM.
- The highest harvest indices (HI) and grain yields have been produced by the best combinations of cultivar, disease management and other management that reduces the proportion of erect heads at harvest (associated with poor or no grain fill).
- The highest HIs have been produced by RGT Accroc, Annapurna, RGT Calabro and Manning.
- Where leaf rust can be controlled (easier when later April sown) Manning's HI has been amongst the highest (49.2%) and has correlated to significantly less erect heads at harvest.
- The cause of these erect heads that develop in the three to four weeks before harvest are the major causes of disappointing yields in HYC trials.
- There are many possible causes of these erect heads, e.g. stem base and foliar disease, frost, viral infection, differences in pollination strength causing partial sterility.
- Possible causes including viral infection are being investigated in the last year of HYC as Manning is known to be more tolerant of BYDV infection with some evidence that RGT Relay may be more susceptible with April sowings.

What yields have been achieved in the Hyper Yielding Research programme 2016 - 2018?

The HYC project has produced new benchmarks for Tasmanian cereal yields in the three seasons to date 2016-2018. These new benchmark yields have shown opposite trends for wheat and barley yields over this period (Table 1.)

Table 1. HYC Growing season rainfall and irrigation (mm), highest yields (t/ha) achieved in HYC trials 2016-18 (harvest dry matters at harvest).

Year	GSR mm (Apr – Dec)	Irrigation mm	Total mm	Highest Wheat Yield (t/ha) @ 12.5% moisture	Highest Barley Yield (t/ha) @ 12.5% moisture
2016	920.2	50	970.2	17.27 (30.5)	10.69 (n/a)
2017	398.6	119	470.5	13.01 *(23)*	11.36 (19.7)
2018	463.3	60	523.3	13.36 *(21.4)*	12.62 *(29.6)*

Barley yields have increased since the very wet season experienced in 2016, with good control of foliar disease and high final harvest dry matter being key components of the higher yields in 2018. With wheat although 2016 produced the highest dry matters and final grain yields (17.27t/ha from 30.5t/ha DM), water use efficiency (WUE) calculated from final harvest dry matter was the lowest of the three years, indicating that it was a very wet season where water conversion to dry matter was relatively poorer.

2016
Assume 30.5t/ha DM produced at harvest at 55kg/ha per mm of water, therefore assumed 555 mm used to grow canopy with 415mm of water remaining unused. 15.11t/ha grain DM = 15.58kg/ha per mm of GSR plus irrigation.

2018
Assume 23t/ha DM produced at 55kg/ha per mm of water, therefore 418mm assumed to grow the canopy with 105.3 mm of water remaining unused. 11.69t/ha grain DM = 22.34kg/ha per mm of GSR plus irrigation.

Yields have been achieved against a backdrop of cooler and wetter conditions in 2016 and generally warmer and drier conditions in 2018 (see final pages of programme for climate details). However, it is possible that water drainage in winter and early spring in 2016 (when the crop demand is relatively low) reduced available GSR meaning that WUE may been higher than estimated. This feature along with water logging can complicate WUE figures in HRZ regions compared to the mainland grain belt.

High final dry matters (DM's) = yield potential but high harvest index = realisation of that potential in grain yield.

As discussed at last season's HYC event high wheat yields in 2016 were achieved from final harvest dry matters of 30t/ha or more compared to nearer 20-25t/ha in 2017 and 2018. However, although the bigger heavier canopies generate more yield potential it is also clear that ***yield potential*** does not necessarily produce higher grain yields. Mallee growers on the mainland will be all too familiar with the concept of haying off where a crop builds up too much dry matter with an inability to fill the grain through lack of soil water, heat stress or both. But what prevents heavier canopies producing high yields in the HRZ? In HYC trials the longer season UK wheat RGT Relay has produced very high harvest dry matters compared to other cultivars and is one of the cultivars that has been selected for more in depth management studies in 2018 and 2019. In 2018 its yields were low compared to previous seasons, however this was ***not*** due to lower harvest dry matter which was amongst the highest. In 2018 Relay's harvest index (% of final dry matter that is grain) was very poor, illustrating an inability to convert high dry matter into grain. Examining the data in detail it's interesting to compare RGT Relay with Annapurna, Manning and RGT Calabro all of which produced lower final dry matters but higher HI and yields (Table 2).

Table 2. Final dry matter (t/ha), Harvest Index (%) and nitrogen offtake (kg/ha) – TOS 1 April 5th sown with full fungicide protection and no fungicide applied (untreated).

	Dry Matter				Harvest Index				Grain Yield @12.5% moisture			
	Full Protection		Nil (untreated)		Full Protection		Nil (untreated)		Full Protection		Nil (untreated)	
Cultivar	**t/ha**				**%**				**Kg/ha**			
RGT Accroc	23.1	a-f	21.0	e-h	47.4	ab	41.6	cd	12.49	ab	9.94	def
Annapurna	21.4	d-h	21.1	e-h	49.8	a	43.0	bc	12.18	abc	10.29	de
RGT Calabro	23.7	a-e	21.7	d-g	47.0	ab	38.1	d	12.60	a	9.45	fg
RGT Relay	25.7	a	22.8	b-f	33.0	e	26.7	fg	9.67	ef	6.87	ij
DS Bennett	23.0	a-f	18.8	h	39.5	cd	27.7	f	10.40	d	5.88	kl
Conqueror	24.0	a-d	22.2	c-g	38.0	d	27.3	fg	10.38	d	6.68	ij
Genius	25.2	ab	20.8	fgh	40.0	cd	37.0	de	11.53	c	8.78	gh
Kittyhawk	24.6	abc	22.0	c-g	23.3	fg	22.8	g	6.52	jk	5.68	l
Manning	25.5	ab	19.5	gh	40.9	cd	37.0	de	11.83	bc	8.21	h
Mean	**24.0**	**a**	**21.1**	**b**	**39.9**	**a**	**33.5**	**b**	**10.58**	**a**	**7.9**	**b**
LSD Fung. (p=0.05)	1.2				1.9				0.48 t/ha			
LSD Cultivar	2.0				3.4				0.41 t/ha			
LSD Cult. x Fung.	2.8				4.8				0.68 t/ha			
P val Fung	0.005				0.002				<0.001			
P val Cultivar	0.044				<0.001				<0.001			
P val Cult. x Fung.	0.179				0.036				<0.001			

So the question becomes how can we improve final harvest index with our management and what germplasm gives us the best potential for turning biomass into grain yield when irrigation allows us to offset the effects of haying off? Table 2 shows differences in HI due to fungicide management and germplasm taken from HYC project trials in 2018.

Clearly any management input that maximises grain fill will improve HI. At present the fungicide management and germplasm chosen appear to have the greatest impacts on harvest index particular if the cultivar is susceptible to disease. Where disease is controlled other factors have become apparent, for example, at the later sowing date in 2018 (April 26) Manning produced the highest HI 49.2% and highest yields at this sowing date 13.08t/ha. As well as disease control these plots had noticeable less erect heads at harvest (Figure 1).

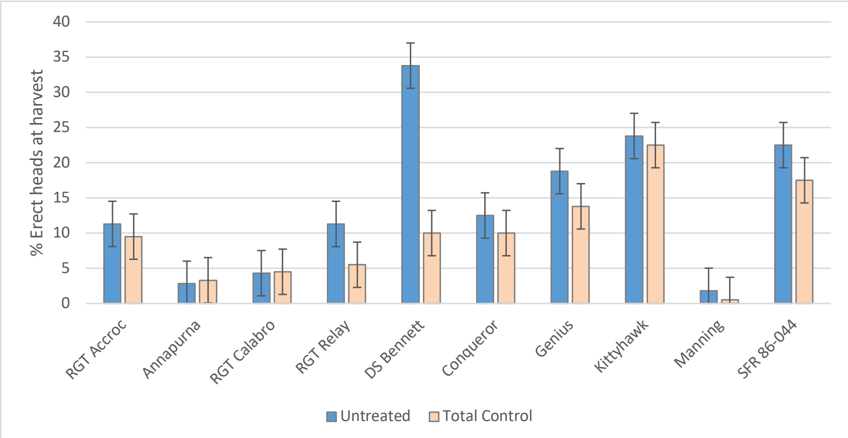


Figure 1. Differences in the % of erect heads at harvest – April 26 sown with and without full protection of fungicide (untreated and total control).

Control of erect heads at harvest and the correlation to better HI.

For the past three wheat harvests at HYC it has been noted that in the last three to four wheats prior to senescence crops develop a proportion of erect heads that varies with both management and germplasm. These erect heads are associated with either no grain fill or poor grain fill and reduce HI. The exact cause of these erect heads can be obvious in some cases, e.g. frost and poor grain set affecting Kittyhawk or high foliar disease with Bennett when left untreated, however in other cases it is less obvious to determine and is a combination of effects. From a management perspective this feature of harvest along with grain protein analysis (to determine if fertiliser rates are sub optimal) should be where the quest for higher yields starts. Where these erect heads (whatever their cause) are eliminated HI's are maximised along with grain yields (all other factors being equal). In HYC where they are eliminated it is clear we get closer to our genetic potentials offered by germplasm. The 2019 trials are examining the cause of these erect heads looking at stem base and foliar disease, virus infection, frost effects and root disease. However at present it is noted that there are significant differences amongst cultivars and Manning's tolerance to Barley Yellow Dwarf Virus (BYDV) is being examined as one possible reason for its very high yields when foliar disease can be controlled (leaf rust is particularly aggressive in an irrigated scenario with Manning).

Dr Carolyn Hedley
Landcare Research, New Zealand

Maximising the value of irrigation in cropping systems – the role of soil moisture monitoring and variable rate application

Key points

- Soil moisture monitoring guides efficient irrigation scheduling
- Position and number of monitoring sites needs to be informed by soil, crop, and landscape variability, and the type of irrigation system
- Management zone maps delineate variability and guide variable rate irrigation
- Variable rate irrigation enables accurate timing, positioning, and placement of irrigation to improve overall irrigation water use efficiency

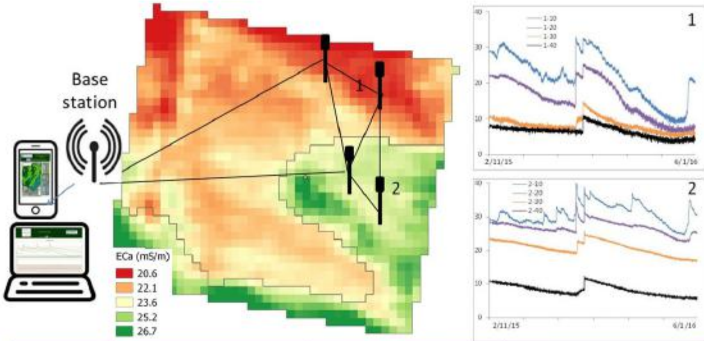
Soil moisture monitoring together with a knowledge of soil water-holding properties indicate millimetres of plant available water in the soil at any one time and is the key to efficient irrigation scheduling. In addition, when soil moisture sensors are built into Internet of Things (IoT) systems that continuously send data in near real-time to remote devices and apps, irrigation timing can be fine-tuned using daily depletion rate, which can be adapted to the current needs of the crop.

A 6-year multi-institute research programme, "Maximising the Value of Irrigation", in New Zealand has developed precision soil and crop mapping and monitoring methods to inform precision irrigation decisions. Field trials at focus farms and experimental sites that implemented these methods indicated that precision mapping and monitoring with adaptive irrigation control gave between 5 and 35 % water saving and reduced drainage. Effective precision irrigation shifts water to parts of the cropped area before too little plant available water limits yield. Our research has also shown that irrigation water can be withheld from heavy, poorly draining soil zones to reduce negative impacts of too much water on yield.

In an irrigated pea crop trial, a wireless soil moisture sensor network was installed into two soil zones under a variable rate irrigation system to guide variable irrigation to both soil zones. The trial results showed that this method reduced water use by 34% with no yield penalty, compared with irrigation informed by a water balance model but with no soil moisture monitoring (Fig. 1).

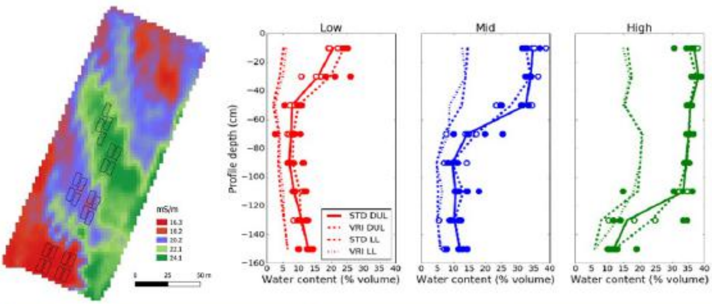
In addition, a new crop sensing method to predict daily crop water use has been trialled using radiometric measurements of canopy surface temperature, normalised difference vegetation index (NDVI), and climate data. Two irrigation treatments were compared: standard irrigation (STD) applied the same amount of irrigation to all soil zones based on the mid zone; and variable rate irrigation (VRI) used the crop sensing method to tailor irrigation to individual soil zones. The irrigation amounts applied to the VRI treatment were smaller by between 34 and 75 mm (9–30%) than those applied by the STD treatment. The smaller amounts of water applied caused no reduction in yield, and reduced drainage to near zero (Fig. 2).

In summary, zoning informed by in-field monitoring improves irrigation scheduling decisions.



Zone	Profile Available Water (mm/m)	Model-based scheduling (mm/season)	Sensor-based scheduling (mm/season)
1-low EC	123	110	85
2-high EC	203	97	53

Fig. 1 Soil moisture monitoring in two EC (electrical conductivity) defined soil zones was used to fine tune irrigation time and amount to each zone, and compared with irrigation scheduling informed by a soil water balance but with no soil moisture monitoring.



Zone	Profile Available Water (mm/m)	STD scheduling (mm/season)	VRI scheduling (mm/season)
1- Low EC	70	254	183
2- Mid EC	111	254	210
3-High EC	149	254	220

Fig. 2 Crop sensing in three EC (electrical conductivity) defined soil zones was used to fine tune irrigation amounts to each zone (VRI), and compared with a standard rate of irrigation scheduled using a soil water balance model (STD).

Jeff Baldcock
CSIRO Agriculture & Food

The role of soil organic matter in Hyper yielding cereals - why more applied fertiliser is not always the answer to increasing yields?

Keywords

- Soil, nitrogen, N, soil organic matter, soil fertility, profitability, productivity.

Take home messages

- Stocks of soil organic matter and nitrogen are a limited resources and current trends across Australian agricultural soils indicate that these stocks are declining. Establishing threshold values of composition and stock appropriate to different combinations of soil type and climate is required.
- Soil derived N can make significant contributions to the amount of N seen by a crop. As the capacity of a soil to deliver available N to crops declines increased rates of fertiliser N will be required. As fertiliser N rates increase, the potential for N loss increases and fertiliser N use efficiency is reduced. As a result, with decreasing soil N supply capacity, optimised productivity (where marginal benefit=marginal cost) may move to lower yields.
- Completing N balance calculations is essential to gain an understanding of how their management practices are altering the stock of N present in their soils. N balance calculations should be completed annually and integrated over time. Where negative N balances are obtained, the soil N resource is being mined. Under such circumstances, it is important to consider whether future long term (decadal) productivity and potential profit is being eroded to maximise short term (annual) values.
- Altering management practices to maintain soil organic matter and N status are likely to be associated with increased costs (either increased expenditure or opportunity costs). Mechanisms for offsetting these costs exist and more are coming on line. Taking a long term view on the economics of current management on future productivity is important.

Introduction

Soil organic matter and soil organic carbon are used interchangeably and on average soil organic matter contains 58% carbon. Soil organic matter content is therefore 1.72 times greater than soil organic carbon content. Analysis labs typically provide values for soil organic carbon content as a percentage of soil mass. The amount of organic carbon in a soil is referred to as the soil carbon stock. Both the content and stock represents the net balance between the rates of carbon addition (dominated by plant residue additions) and loss (dominated by decomposition). Management practices that can enhance rates of organic carbon addition or reduce losses beyond what is currently being achieved have the potential to increase the amount of carbon in soil.

Declines in soil organic matter and nitrogen status in agricultural soils

Conversion of soils under native condition to agriculture has often resulted in a decline in soil organic carbon content and stock. Under Australian conditions, soil organic carbon stocks have declined by 20% to 70%. A strong link exists between the contents of organic carbon and nitrogen in soil organic matter. Decreasing soil organic carbon content is indicative of a loss of soil nitrogen status. The implication of this is that where the organic carbon content of the 0-10 cm soil layer with a bulk density of 1.3 g cm^{-3} and no gravel declines from 2% to 1% by weight, approximately 1081 kg N/ha will have been mineralised. If this loss of organic matter occurred over a 20 year period, then an average of 50 kg N/ha/year would be mineralised. The possible fates of the mineralised N would be uptake and removal in agricultural products or loss. As the organic carbon continues to decline, two possible outcomes will become evident: 1) the rate of organic carbon loss decreases with less N being mineralised and available to growing crops and 2) once a lower threshold value of organic carbon is passed, little N will be mineralised and released. Under both scenarios, crop production will become more reliant on fertiliser N addition.

Implications of declining nitrogen status

A declining soil nitrogen status means that to achieve yield and protein targets defined by the availability of water, additional fertiliser N will be required. The efficiency of fertiliser N use declines as fertiliser application rates increase (Figure 1a). Each additional incremental increase in yield requires more fertiliser N and therefore costs more, particularly when progressing towards the biological optimum (point B in Figure 1a). As a result, where fertiliser N application rates must increase in response to a decreased supply of N from soil, the cost of achieving an additional yield increment will increase and the profitability ($ of product/kg of fertiliser N applied) of applying additional fertiliser N will decrease. Assuming all other variable costs remain fixed, the economic optimum yield (where marginal benefit = marginal cost, point A on the profit curve in Figure 1a) will decline as the ability of a soil to supply N decreases (point D versus point E in Figure 1b). The responses presented for low and high N supply capacity soils in Figure 1 are conceptual and have been accentuated to demonstrate the points being made. A more complete economic assessment is required to fully assess the implications.

Part of the benefit provided by soil N supply, relative to fertiliser N application, resides in the fact that N derived from organic matter decomposition is metered out over the growing season and responds positively to the same environmental conditions controlling crop growth (e.g. availability of water and temperature). With an increasing reliance on soil derived N, the supply and crop demand for N are likely to be more synchronised, leading to a lower chance of available N accumulating and a reduction in the N loss mechanisms operating on available N.

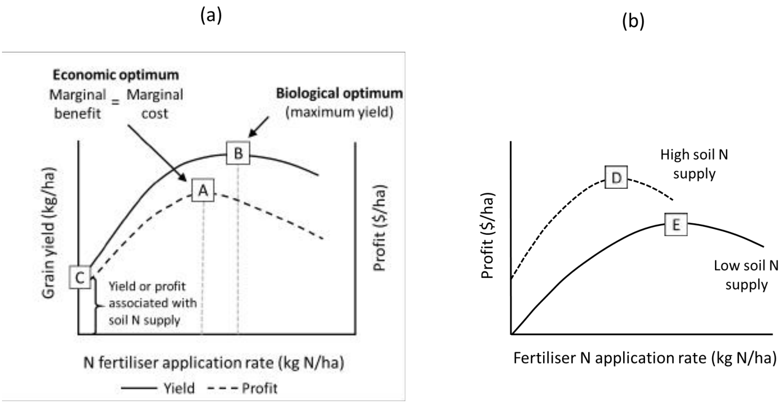


Figure 1. Changes in (a) the efficiency of fertiliser N use in terms of grain producing grain and potential relationship between biological and economic optimum yields (b) profitability of grain production with increasing fertiliser N application rates for soil with a low (solid line) or high (dashed line) N supply capacity. Note that these diagrams are conceptual and differences between low and high N supply capacity have been accentuated for the purpose of demonstrating potential differences.

Increasing soil organic matter content or stock

Given that the amount of organic matter present in a soil results from the balance between inputs and losses, to shift soil organic matter stocks to higher values will require an increased flow of organic carbon into the soil. An exception to this may be where rates of soil organic matter loss due to erosion can be reduced through maintaining a greater amount of soil cover. Questions associated with defining the potential to increase soil organic carbon content include:

1) Are organic materials being removed (e.g. crop residues) and can this practice be halted?
2) Are current management practices maximising water use efficiency per mm of available water? If not, are there alternative practices available that can be used to move towards greater water use efficiency and enhanced biomass production?
3) Is there scope to alter the production system to include a greater proportion of legumes, particularly legumes grown as a green or brown manure?
4) If erosion is an issue, can management practices be imposed that maintain a higher level of soil cover or slow the movement of water or wind over the soil surface.

Acknowledging that the current levels of soil organic matter are a function of the history of management practices employed, if the answer to any of the above questions is yes, then there is scope to increase the storage of organic matter in the soil.

A tendency has existed to suggest that the adoption of defined management practices (e.g. reduced tillage, rotational grazing) can alter soil organic matter stocks. Sampling many Australian grain growing soils has suggested that increasing stocks of soil organic matter is less about the nature of management practice itself and more about whether carbon flow to the soil was altered. Adopting a perceived "carbon friendly" management practice provides no guarantee that soil carbon stocks will increase. The way the practice is implemented and impact on carbon flow to the soil is critical. For example, a farmer maximising productivity of grain crops (continually achieving close to the water limited yield) and retaining all residues may end up with a higher SOC stock than a grazier operating with a stocking rate that is too high.

Maintaining soil nitrogen status

Agronomic indices have been developed to quantify the effectiveness of fertiliser N management. Using these indices, results for 514 paddocks across 4-5 years indicated that, on average, growers were mining soil N. Understanding the implications of management practices on soil N status requires N balance calculations. Deriving values for all components of the N balance calculation is difficult. At a minimum, farmers should be quantifying the difference between N added (fertiliser N plus biologically fixed N) and N leaving in products (grain plus livestock products) and monitor this over time to provide an indication of any trend. Although a trend to increasing N stocks is encouraged, it should be acknowledged that temporary periods of mining soil N are acceptable, provided it is followed by a rebuilding phase in which N stocks are replenished.

Other than the application of fertiliser N, the main mechanism for growers to enhance N status is the inclusion of legumes in rotation with grain crops. This could include pulses and pasture options in rotation with grain production. To maximise N inputs, it may be appropriate to maximise the biomass production and retention (e.g. green manure). Although this may be associated with a significant opportunity cost, the benefits to subsequent crops and longer term implications on soil N status and productivity may be positive. Longer term (>10 years) economic analyses of such options are required since the most profitable short term (annual) result will always be to maximise the extraction of N from the soil (i.e. mine the soil N reserve).

Acknowledgements

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SFS

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Katherine Fuhrmann
FAR Australia

Ramularia in barley - what do we know about this disease and how can we manage it?

Ramularia leaf spot (*Ramularia collo-cygni*) is an emerging threat to Australian barley production. Incursions of the disease were identified in Hagley, Tasmania (2016 & 2018) and South Stirling, Western Australia (2017). Ramularia is a seed and wind borne fungal pathogen, characterised by brown rectangular lesions with a chlorotic halo, often expressed during flowering. Globally Ramularia has significantly reduced barley yields in Europe, South America and New Zealand, with fungicide resistance and reduced sensitivity a growing concern with triazoles, Quinone outside Inhibitors (QoIs - strobilurins) and succinate dehydrogenase inhibitors (SDHIs) fungicide groups experiencing reduced efficacy where Ramularia pressure is high (McGann & Havis, 2017).

In 2018 Ramularia Leaf Spot was identified in Hagley, Tasmania infecting germplasm screening and disease management trials of the Hyper Yielding Cereals site. It was observed that the severity of Ramularia infection was significantly influenced by cultivar and fungicide management. Winter barley cultivars showed a greater tolerance with infection levels not exceeding 10%. In comparison, eight spring cultivars had infection levels in excess of >25% in all but two cultivars, Rosalind (3.5%) and Conquest (17.5%).

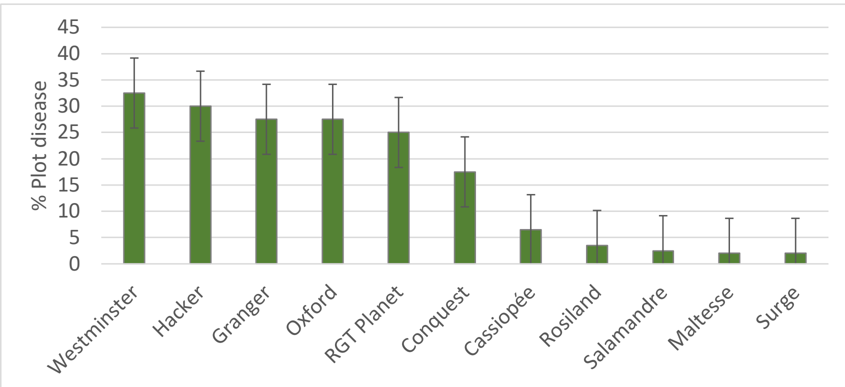


Figure 1. Disease severity of Ramularia leaf spot on 7 spring varieties and 4 winter varieties, assessed on 29 October.

Three spring cultivars (RGT Planet, Conquest and Rosalind) were evaluated under two fungicide strategies, a cost effective triazole regime of Tilt and Prosaro (cheaper double spray) compared to a premium package of Radial and Aviator (double spray expensive programme) utilizing the addition of SDHI and QoI modes of action (MOAs). Yield results demonstrated that fungicide application significantly increased yield (p=<0.001) and reduced Ramularia infection relative to the controls (Figure 2 & Table 1). Despite cultivar differences in the expression of Ramularia in the untreated, all three cultivars gave similar yield responses to fungicide treatment. Utilising SDHI and QoI fungicides resulted in the highest yields with increases of 2.39t/ha (24%) over the untreated. These increases in yield were significantly higher than the triazole based two spray programmes.

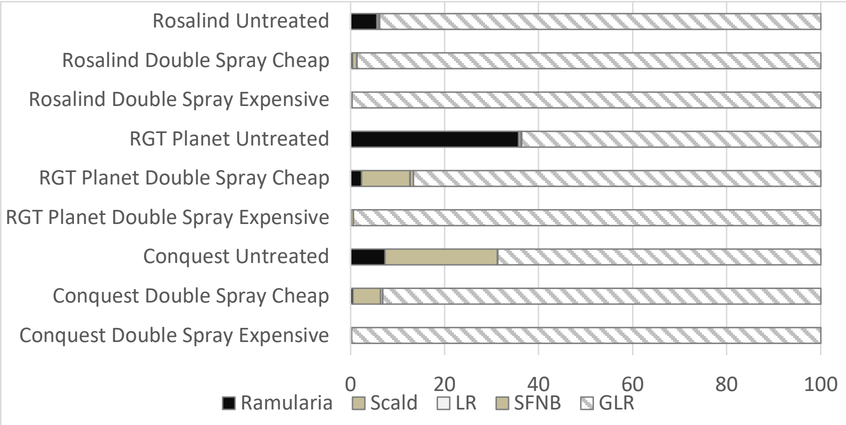


Figure 2. Disease severity and green leaf retention on Flag-2, assessed on 31 October (GS71).

While the current distribution of Ramularia on a national level is unknown, in Tasmania it has been identified across multiple seasons between 2016 and 2019 (all but 2017) and sustainable management strategies are needed to maintain barley yields in Tasmania. Ongoing Integrated disease management is needed to maintain the sensitivity of Ramularia to our full arsenal of fungicide options. This includes utilising resistant germplasm (once variety screening data is available) and rotating fungicide modes of action with limiting the use of SDHI and strobilurin products to once per season each (including seed treatment formulations). At present the evidence would suggest that whilst the disease is endophytic (infection growing within the plant), it is not well controlled by the current range of seed treatments (overseas data). Work on management of this disease issue will continue.

Table 1. *Grain yield (t/ha), % Site Mean, % grain protein, test weight (kg/HL) and % screenings.*

	Fungicide product, rate (mL/ha) & timing		Yield		Mean		Protein		Test wt		Screen	
Variety	**GS31**	**GS49**	**(t/ha)**		**(%)**		**(%)**		**(kg/HL)**		**(%)**	
RGT Planet	**Untreated**	**Untreated**	10.04	de	88.8		13.0	ab	55.4	d	8.1	ab
Conquest			9.74	e	86.1		12.7	b	58.6	c	6.9	bc
Rosalind			10.55	cd	93.3		13.6	a	58.9	c	9.8	a
RGT Planet	**Tilt 500**	**Prosaro 150**	11.20	bc	99.0		12.6	bc	59.0	c	4.9	cde
Conquest			11.35	b	100.3		12.6	bc	63.1	a	4.5	cde
Rosalind			11.43	b	101.0		13.5	a	60.0	bc	6.7	bcd
RGT Planet	**Radial 840**	**Aviator 500**	12.42	a	109.8		11.9	c	60.9	abc	3.0	e
Conquest			12.45	a	110.1		12.3	bc	61.4	ab	4.2	de
Rosalind			12.62	a	111.6		13.0	ab	60.6	bc	5.6	b-e
Mean (Untreated)			**10.11**	**c**	**89.9**	**c**	**13.8**	**a**	**57.6**	**b**	**8.3**	**a**
Mean (Tilt & Prosaro)			**11.33**	**b**	**100.2**	**b**	**12.9**	**a**	**60.7**	**ab**	**5.4**	**b**
Mean (Radial & Aviator)			**12.50**	**a**	**110.3**	**a**	**12.4**	**b**	**61.0**	**a**	**4.3**	**b**
LSD Mgmt (p = 0.05)			0.5		4.1		0.5		3.2		1.2	
LSD Variety			0.4		3.7		0.4		1.4		1.6	
LSD Var x Mgmt			0.7		6.4		0.7		2.4		2.7	
P Val Mgmt			<0.001		<0.001		0.027		0.076		<0.001	
P Val Variety			0.185		0.117		<0.001		0.003		0.014	
P Val Var x Mgmt			0.627		0.586		0.728		0.076		0.757	
CV			4.37		4.28		3.78		2.71		30.32	

Michael Nichols
Grower, Tasmania

Trading grain between cropping farmers and dairy producers – how can we make a system work for the betterment of both parties?

The business started 12 months ago to help the grain growers sell wheat/barley direct to dairy farmers. This year there were 14 grain growers whose cereals were stored on farm at Redbanks and sold to 4 dairy farmers in the local area over a 10 month period. There was a total of 2500 ton sold.

<u>There has been a lot of bad press about local grain</u>

- **Farmers delivering to higher moisture**
  This is what has bitten most dairy farmers hard a silo full of local grain going off turning green and then needs shovelling out because of high grain moisture.

- **Red wheat White wheat debate**
  This is an old debate about what is better but from what I can tell there is no difference just management at cracking/ rolling and the difference between local and mainland grain

- **Production losses going from mainland to local wheat**
  This is the most common problem dairy farmers have changing from mainland to local grain and is very simple to fix. Mainland grain is normally very dry 12% or less and its physical size is smaller too 30-35 gram 1000 grain weight (this is not bulk density) this means it cracks easily and the roller mill or disc mill are adjusted tightly for its small size.
  Local grain on the other hand is softer bigger plumper grain 40-50 gram 1000 grain weight it is normally 12 to 13 % moisture and when it cracks through the mills if not adjusted right it will powderise the grain giving the cow's acidosis causing production losses.

- **Not feeding enough grain**
  Local grain is bulkier when milled so a calibration on bulk density when crushed is required. It is very common to be feeding 10% less, resulting in production losses and the stigma that local grain is bad.

- **Local grain is not as good**
  This one is the easiest to combat. A feed test will show exactly what is going on, for the past 5 years we have been feed testing in our local area. It has consistently been higher in ME and protein to ASW wheat from the mainland, the test sells its self.

<u>There are several key things to take into consideration to make the system work.</u>

- There needs to be a good relationship with Seller and Dairy farmers ***(trust is paramount***)

- Consistent quality of grain, clean sample, no foreign material (***rocks, bird nests, chaff)***

- Moisture 12.5% (***don't delivery that high load to get rid of it, it's not worth it***)

- Good storage with aeration to keep grain fresh all year (***a drier helps***)

- Reliable delivery service (***blower truck is preferred option for its simplicity)***

- At least 6 month supply or more (***this can be contracted easier and guarantees a supply***)

Warwick Green
Seed Force Ltd NZ

Payment of Royalties – a global persepective

Summary
Globally today the majority of plant breeding is undertaken by the private sector and commercial reality must prevail - where a return on the investment is measured and used as a basis for further investment in plant breeding .

Plant Variety Rights(PBR) is the mechanism for protection of plant varieties and is recognised internationally and legislated under UPOV. The majority of countries have adopted the latest legislation UPOV91 which includes legislation that covers farm saved seed and the payment of royalties to the breeder.

In NZ I have been involved with the NZPBRA (a body representing breeders) and Government reviewing the current outdated NZ legislation (UPOV78) with the outcome being to bring NZ up to and a member of UPOV91. This is a necessary requirement for membership of The Comprehensive and Progressive Agreement for Trans-Pacific Partnership, a trade agreement between Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam.

Plant breeders across the world and the Companies they work for invest millions of dollars annually in the development of new plant varieties. The process for developing a new variety can take as long as 10 years and relies on having a global legislative framework that enables the breeder to get a return on that investment primarily via the payment of a ROYALTY on the seed commercialised.

Specifically, the goal of plant variety rights is to encourage investment in plant breeding to make sure the very best cultivars are available for farmers globally and ensure breeders receive a reasonable return on their investment.

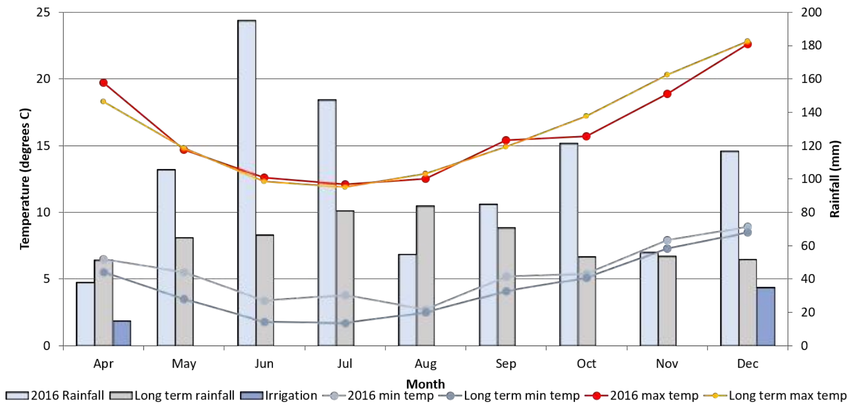
Whilst there is a longstanding and traditional practice of farmers saving seed to sow future crops, what the UPOV91 legislation does is provide for this right allowing farmers to save seed for use on their own holdings. In Australia UPOV91 applies and farm saved seed and the collection of royalties are both within the framework.
The Hyperyielding project is a demonstration of the potential genetic gain that plant breeders have been able to deliver which in turn will mean potentially higher yields per hectare for farmer growers. These gains would not be available if there wasn't a global legislative framework in place to ensure a return on the investment.

Farmers need to recognise that without this investment the potential genetic gains would not be possible.

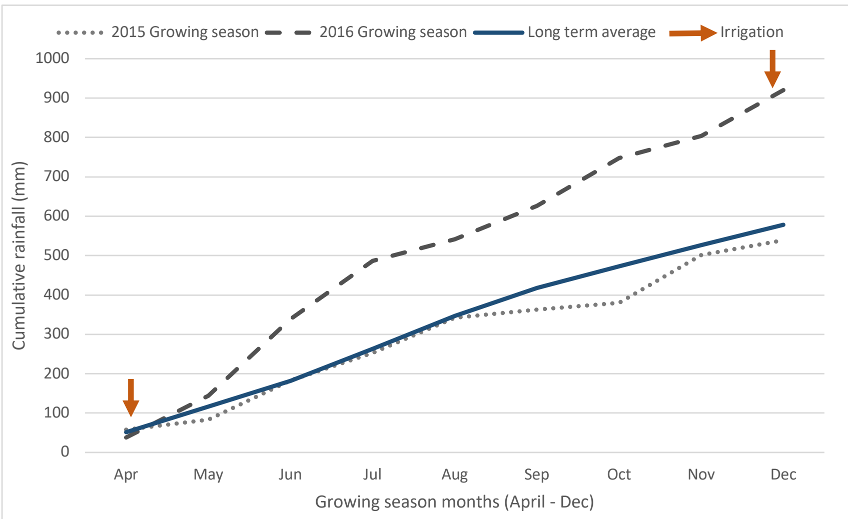
Globally the mechanisms implemented for payment of royalties vary by country. Most have adopted the mechanism to collect the royalty on either the seed sown or the resultant grain produced and sold. However other options include tax incentives for payment of royalties, a royalty based on the hectares sown annually. In countries like France and UK the collection of royalties is in excess of 90% efficient. While here in Australia many farmers continue to trade over the fence and between themselves. This is continuing to undermine both the legislation and the investment in new varieties.
In the case of Australia the PBR Act balances the farm saved seed tradition with reasonable opportunity for the PBR owner to commercialise their new plant variety. The challenge is for farmers to embrace the legislation and comply.

2016 Hyper Yielding Cereal Site, Hagley, Tasmania

Temperature and Rainfall

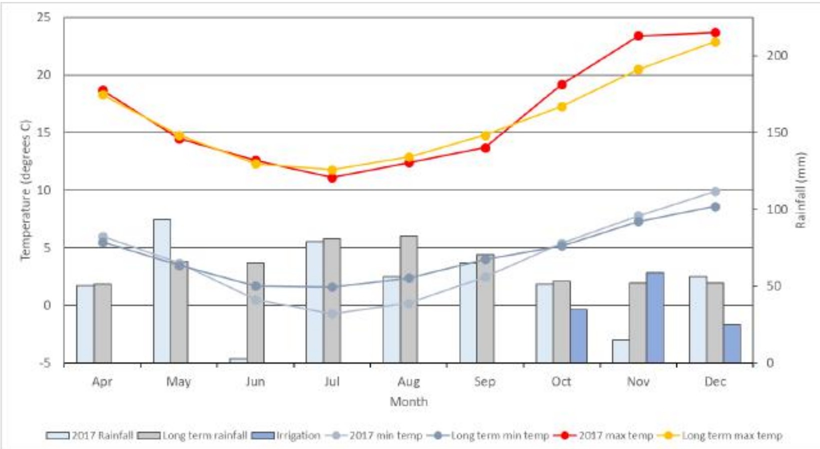


Cumulative Rainfall

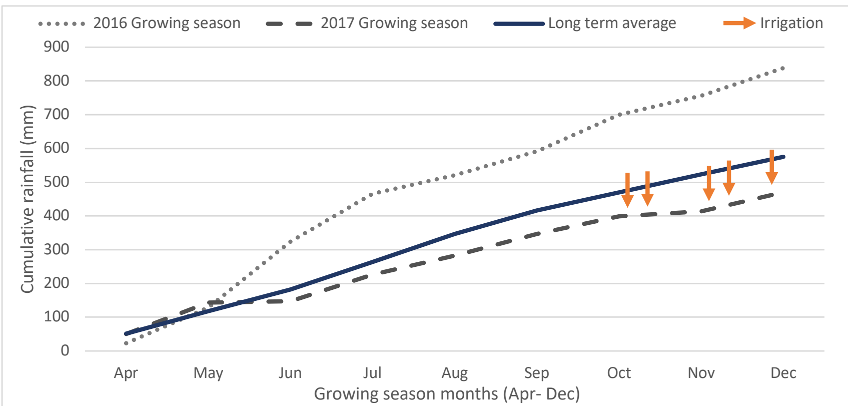


2017 Hyper Yielding Cereal Site, Hagley, Tasmania

Temperature and Rainfall

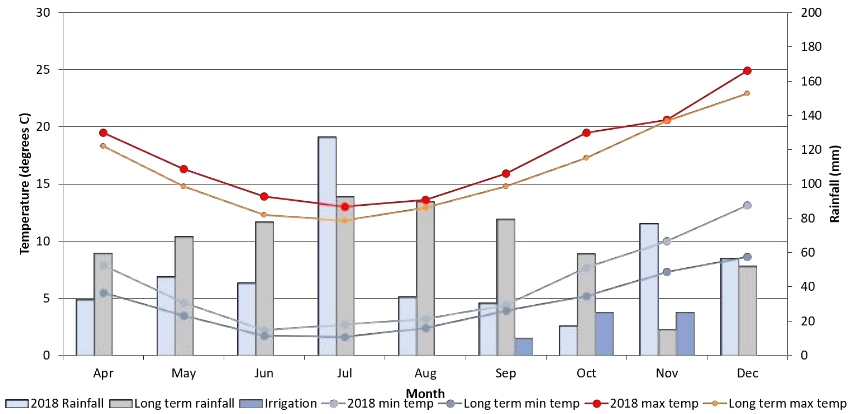


Cumulative Rainfall

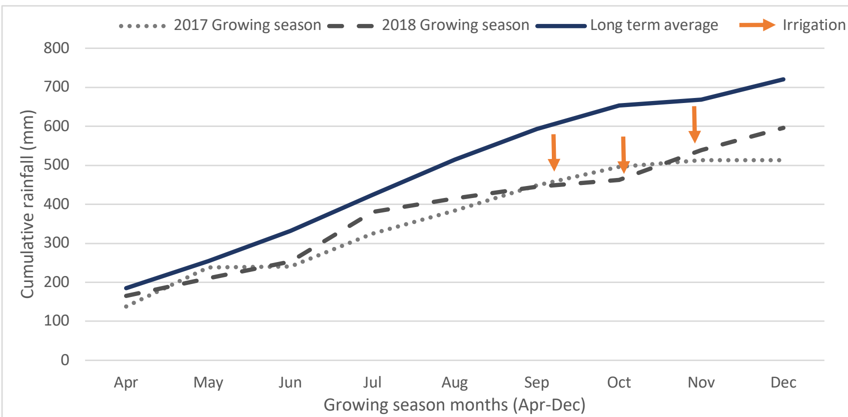


2018 Hyper Yielding Cereal Site, Hagley, Tasmania

Temperature and Rainfall

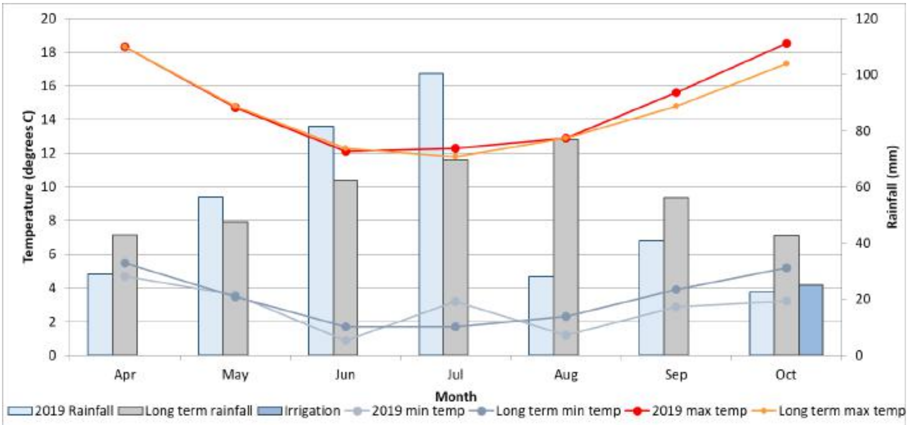


Cumulative Rainfall

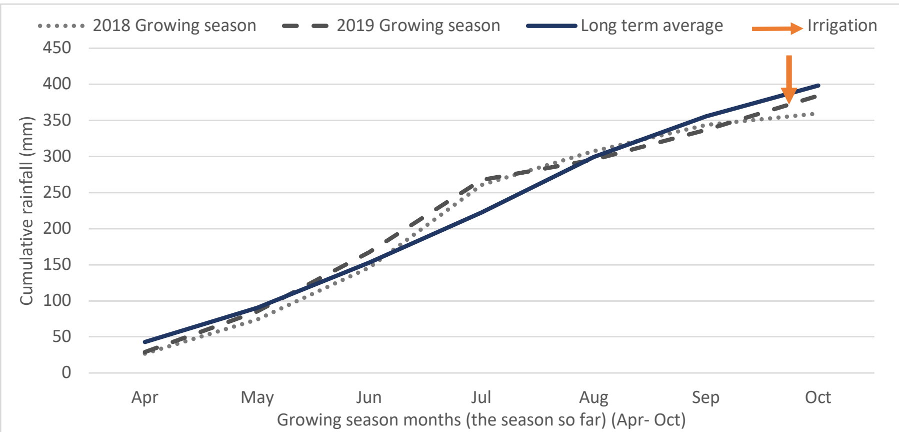


2019 Hyper Yielding Cereal Site, Hagley, Tasmania

Temperature and Rainfall



Cumulative Rainfall



Notes

Notes

Meet the HYC Project Team - 2019

Nick Poole, Tracey Wylie and Darcy Warren
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Ian Herbert and Brett Davey
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