Irrigated Cropping Council
Promoting irrigated agriculture

2023 IRRIGATION INSIGHTS

Friday 21 July
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Irrigation Farmers Network

The Irrigation Farmers Network (formerly Irrigated Cropping Council) is committed to proactively contributing and influencing a positive future for irrigated agricultural industries by building on our 24-year legacy as the Irrigated Cropping Council. Our mission remains unchanged, to improve the profitability and long-term viability of mixed farmers and croppers in the irrigation areas of northern Victoria and southern New South Wales, through practical research, development and extension that leads to best practice.

Our new name reflects the breadth and scope of the organisation which brings people together to lift the bar of best practice, our members have access to the extensive network of 50 partners that help us deliver solutions to farmers in the region. We provide members with access to local, farmer-driven small plot research; demonstration sites; field days, conferences, and other events; and timely information across multiple media to address the issues and they are facing.

Our current research focuses on winter and summer grain and fodder crops and comprises of variety trials; agronomic management including nutrition, canopy management and fungicides; irrigation scheduling; soil carbon; and drought resilience.

The Irrigation Farmers Network continues to manage our permanent research site at Kerang, where we have been delivering quality trial results since 2002. We are looking to increase the diversity of trials, demonstrations and events we offer through the development of a second research hub in Deniliquin.

Our Region

Our region spanning across the Murray River from the northern Victorian irrigation regions to Southern Riverina in NSW presents a unique opportunity to build a knowledge base across many regions, environmental conditions, crop types, management systems and irrigation systems.

Become a Member

Membership provides access to all the latest research results, news and discounted events. Memberships are exceptional value at $50 (inc. GST) per year.

Thank you to our sponsors that enable us to provide high quality research and extension for the grain industry

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IRRIGATION INSIGHTS 2023

Program

8:30am	Registration
9:00am	Welcome
	Session 1 – Navigating our Changing Climate Proudly supported by Southern NSW Innovation Hub With our changing climate it's vital for farmers and industry to understand how they can adapt their farming system to thrive in the future. Gain an insight into bridging the gap between predications and practice in terms of climate and our water operating environment.
9:10am	**Bridging the gap between predications and practice** ***John Clarke, Research Team Leader, Regional Projections, CSIRO*** Gain insights into long term climate projections, what they mean for Agriculture and how we can make appropriate use of them.
9:40am	**Water strategies and trigger points** ***Dr Simon Banks, the Commonwealth Environmental Water Holder*** The Commonwealth Environmental Water Office makes decisions on how best to use the water it has available. Learn more about their strategies and trigger points for environmental watering.
10:15am	**2023 Seasonal Outlook, the answer is blowing in the wind** ***Dale Grey, Climate Specialist, Agriculture Victoria*** A comprehensive overview of the projected seasonal outlook, equipping you with valuable insights to make informed decisions in challenging weather conditions.
10:45am	Morning tea
11:10am	**Water Outlooks** NSW – ***Deep Singh, Senior Hydrologist, NSW DPIE*** Victoria – ***Andrew Shields Manager, River Operations, Goulburn Murray Water*** Gain insights into the water outlook for the year ahead and what this means for your planning, how do you maximise opportunities in good water seasons?
	Session 2 – Optimising Irrigated Farm Systems Take a systems approach to explore the core principles that will enable you to optimise your yield and enhance water use efficiency, understand systems approaches to sustainable soils and delve into technologies that monitor, manage, sense and automate.

12:00pm	**Optimising irrigated grains** ***Damian Jones, Trials Manager Irrigation Farmers Network*** Resilient Irrigated Farm Systems - explore the core principles that will enable you to optimise your gains and enhance the efficient utilisation of water.
12:30pm	**Fundamentals of growing high yielding crops** ***Rohan Brill, Agronomist Brill Ag*** Delve into the essential principles of achieving high yields with canola as a focus. This session covers a wide range of critical factors, including optimal nutrition, effective disease management, strategic variety selection, crop selection, N legacy, and sowing dates.
1:00pm	Special Presentation
1:10pm	Lunch
2:00pm	**Farmer Insights Panel** With such dynamic operating environments farmers are making decisions about complex systems to optimise water use and maximise returns while looking after the long-term sustainability of the land. Hear from local farmers about how they are adapting including crop sequencing, summer crop/forage options, sustainable soil management, strategic tillage and N legacy. Kaleb and Greg Quinn, Nick and Oliver Evans and Chris Leed.
2:40pm	**Systems approach to sustainable soils** ***Dr. Cassandra Schefe, Principal Scientist/Co-owner AgriSci*** To cut through all the hype about carbon, what is it that farmers should really focus on in terms of sustainable soils for the future, and how do we manage our soils as a system, rather than focus on just one element 'C' in isolation.
3:20pm	Afternoon tea
3:40pm	**Engaging in Agtech** ***Mark Sloan, AgTech Project Lead, Department of Energy, Environment and Climate Action*** Technologies that monitor, manage, sense and automate and smart farm equipment offer huge benefits, hear more about what's available and how farmers are engaging with them to enable best practice. **Farmer Insights Panel** With so much information about Agtech out there, how do you work out what's going to work for you? In this session get the scoop from farmers that are using the tech on farm to assist with the business and/or farm systems. Trev Elliot and Tony McCarthy
4:30pm	**Session 5 – Revitalize and Thrive** Proudly supported by GrainGrowers "**Formidable Fundraising Farmer"** ***Luke Barlow, Farmer Moama*** Running a farm business is hectic! But doing a three day ultra endurance triathlon comprising a 10km swim and 421km ride and a double marathon 84.3Km is next level! Be inspired by Luke as he shares his story about their farm business and his mission to encourage others to improve their health and wellbeing.
5:00pm	Close

Speakers

John Clarke - Research Team Leader, Regional Projections, CSIRO
John leads Regional Projections Team in the CSIRO Climate Science Centre where he has worked since 2009. John has a passion for ensuring the vital research undertaken by the climate science community is used to inform real world decisions. His current work has a strong focus on helping Australians get the most out of climate change projections. John was recently a lead author of the State of the Climate 2022 Report for Australia.

Dr Simon Banks - The Commonwealth Environmental Water Holder
Dr Banks has a wealth of experience and a good understanding of the work, having previously been in senior roles at the Commonwealth Environmental Water Office. Simon's experience in natural resource management spans policy development and implementation, research and analysis, and program implementation. Simon holds Bachelor of Applied Science (coastal management), a Master of Applied Science from Southern cross University and a Doctor of Philosophy (biological sciences and decision support) from The University of Queensland.

Dale Grey - Seasonal Risk Agronomist, Agriculture Victoria
Dale has worked with Agriculture Victoria for 29 years at Rutherglen, Cobram and Bendigo. He has been interpreting seasonal climate models from around the world every month since 2008. Dale is the author of "The Fast Break" climate newsletters for Vic, SA, Tas and southern NSW and produces a monthly YouTube climate update called "The Very Fast Break" for Victoria, South Australia and southern NSW.

Andrew Shields - River Operations Manager, Goulburn-Murray Water
Andrew is an environmental engineer and environmental scientist. Andrew has over 16 years of experience in water resource management and leads the Goulburn-Murray Water team responsible for assessing water availability in all regulated water systems across northern Victoria, flood operations and environmental water delivery.

Damian Jones - Trial Manager, Irrigation Farmers Network
Damian is an irrigated cropping agronomist. He worked with DPI for 15 years and is now with Agronomic Results. Damian manages the Irrigation Farmers Network's Trial Block at Kerang. His expertise is vast including variety evaluation, irrigation management, nutrition, disease management and grazing cereals. Damian has specialist expertise in irrigated crop trial design, establishment and management as well as extensive knowledge about crop agronomy.

Rohan Brill - Agronomist/Farmer, Brill Ag
Rohan Brill is an agronomist and farmer based at Ganmain NSW with Brill Ag. Brill Ag co-ordinates canola research for the GRDC Hyper yielding Crops project as well as leading the NSW Pulse Agronomy Project which has a focus on understanding nitrogen balance of pulse crops in southern NSW. Rohan provides farm consultancy to growers in the Ganmain district and crops canola, wheat, barley, faba beans and vetch on his family property around Ganmain.

Dr. Cassandra Schefe - Soil Scientist/Co-owner, AgriSci
Cassie is a renowned research scientist in soil chemistry. Cassie specialises in soil chemistry and soil-plant interactions, completing a GRDC-funded PhD with Monash University on the interactions between carbon and fertilisers to improve nutrient availability in acid soils. After completing a Bachelor of Agricultural Science (Hons) at The University of Melbourne, Cassie worked with the Department of Environment and Primary Industries (DEPI), before establishing 'Schefe Consulting' to continue working with farmers.

Mark Sloan - AgTech Project Lead, Department of Energy, Environment and Climate Action
Mark has a diverse background: from working as a technology support and product development specialist in the AgTech space, to creating his own start-up providing technological solutions for the heavy vehicle industry. Since joining Agriculture Victoria Mark has been involved in a range of AgTech initiatives that have helped farmers begin their journey with AgTech and he is keen to share the AgTech stories of farmers from across all sectors.

Deep Singh - NSW Department of Planning and Environment, Water Allocations Senior Hydrologist
Deep is an experienced water resources engineer with exceptional expertise in water management, water sharing, numerical analysis and modelling. He holds a Post graduate from UNSW, Sydney.

State of the Climate Report

The biennial State of the Climate report series draws on the latest climate research, encompassing observations, analyses and projections to describe year-to-year variability and longer-term changes in Australia's climate. The 2022 State of the Climate report released by CSIRO and the Bureau of Meteorology is now available.

Report at a glance

The Bureau of Meteorology and CSIRO play an important role in monitoring, analysing and communicating observed and future changes in Australia's climate.

This seventh biennial State of the Climate report draws on the latest national and international climate research, encompassing observations, analyses and future projections to describe year-to-year variability and longer-term changes in Australia's climate.

The report is a synthesis of the science informing our understanding of Australia's climate. It includes new information since the last report in 2020, such as that published in the 2021 Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC). The State of the Climate report is intended to inform a range of economic, environmental and social decision-making by governments, industries and communities.

Observations, reconstructions of past climate and climate modelling continue to provide a consistent picture of ongoing, long-term climate change interacting with underlying natural variability. Associated changes in weather and climate extremes—such as extreme heat, heavy rainfall and coastal inundation, fire weather and drought—have a large impact on the health and wellbeing of our communities and ecosystems. These changes are happening at an increased pace—the past decade has seen record-breaking extremes leading to natural disasters that are exacerbated by anthropogenic (human-caused) climate change. These changes have a growing impact on the lives and livelihoods of all Australians. Australia needs to plan for, and adapt to, the changing nature of climate risk now and in the decades ahead.

The severity of impacts on Australians and our environment will depend on the speed at which global greenhouse gas emissions can be reduced.

Download the full report
www.csiro.au/en/research/environmental-impacts/climate-change/State-of-the-Climate

Commonwealth Environmental Water Holder

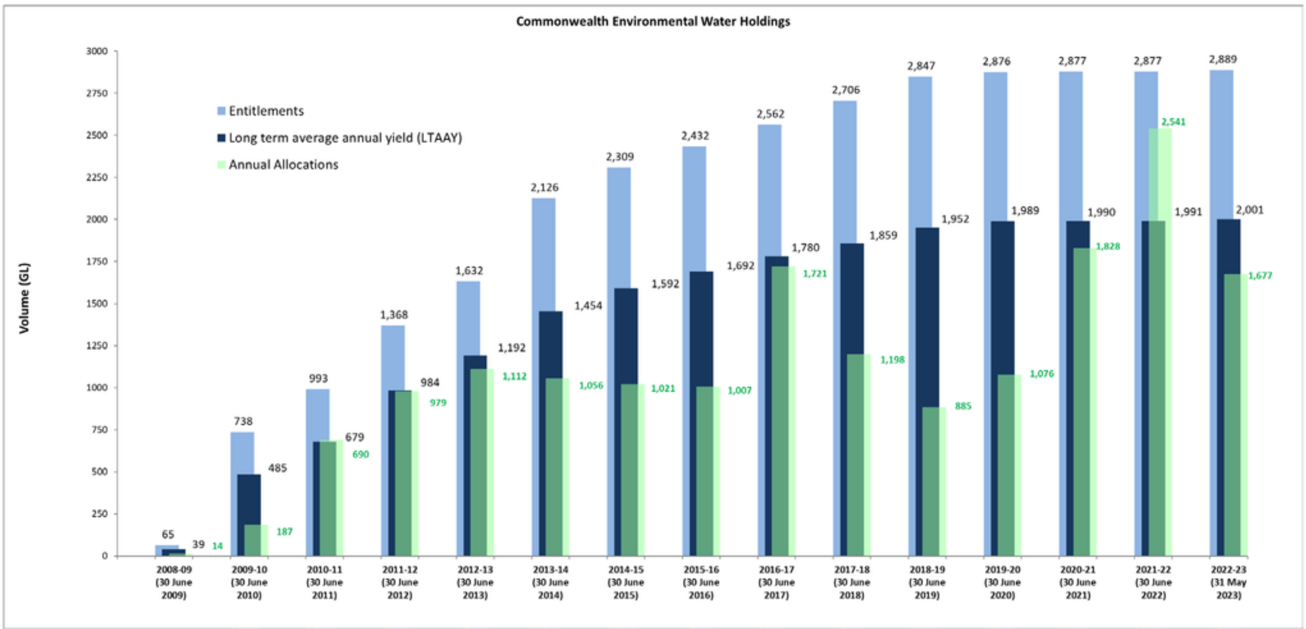
About the Commonwealth Environmental Water Holder

The Commonwealth Environmental Water Holder (CEWH) is a position established by the *Water Act 2007* to manage the Commonwealth environmental water holdings.

This water is used to protect and restore the rivers and wetlands of the Murray–Darling Basin. Water is delivered when and where plants and animals need it most, including to internationally significant Ramsar wetlands.
The CEWH is supported by a highly qualified team from a variety of fields including environmental and biological science, engineering, natural resource management, communications, engagement, research, project management and business services.

Commonwealth Environmental Water Availability

The Commonwealth holds 2,899 gigalitres of entitlements. The long term average annual yield is 2,001 gigalitres. The water is a mix of entitlement types held in valleys across the Basin. The rules governing the entitlements vary across states and across valleys, but they are subject to the same fees, allocations, carryover and other rules as equivalent entitlements held by other water users.



Management options

There are three broad options available for the CEWH in managing the available water:

USE

Deliver water to meet identified environmental demands

HOLD

Carry water over for use in the next water year ('carryover')

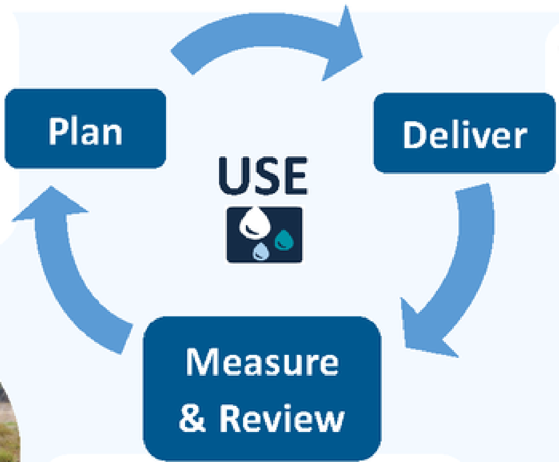
TRADE

Trade (sell or buy) water for equal or greater environmental benefit or to fund environmental activities

Planning, delivering, monitoring and adapting

Every year is different and the amount of water available changes from year to year. The CEWH makes decisions annually on how best to use the water it has available. We partner with state governments, First Nations people, communities, industry and scientists to plan, deliver and monitor water for the environment. This includes investing over $100 million since 2009 in independent scientific monitoring, evaluation and research.

Work with **First Nations peoples, local water managers, scientists, river operators, landholders and state governments** to identify where and when water for the environment is needed.



Work with partners to deliver water when and where plants and animals need it most.

Scientists monitor **impact** on river and wetland health. **Over 10 years of robust scientific research.**

The CEWH plans for all climatic scenarios and then adapts depending on how the season unfolds.

In dry years, water is used to:

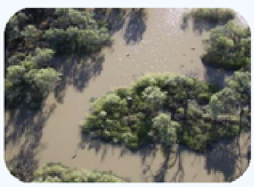
- Provide flows to drying rivers to replenish and reconnect waterholes, supporting native fish and local communities
- Keep core vegetation and wetlands alive so they bounce back in wet times
- Supporting critical populations to avoid species loss
- Restore winter flows in southern rivers to help native fish feed and get ready to breed

In wet years, water is used to:

- Improve health of wetlands and river red gum forests so they are resilient in dry times
- Maintain water levels at waterbird breeding sites to provide food and protect nests from predators
- Support native fish breeding and migration throughout the Basin, including providing refuge for fish from low oxygen floodwaters
- Connect rivers from top to bottom and (where possible) with important floodplain wetlands

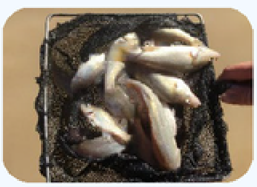
Delivering outcomes

Since 2009, the CEWH has delivered around 15,000 gigalitres of water to support river and wetland health – this is equivalent to 30 Sydney Harbours. This water has been used to support more than 22,000 kms of waterways and over 370,000 hectares of lakes and floodplains. It has also supported:

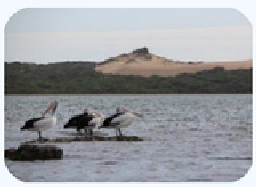


10 internationally significant Ramsar wetlands

98 species of waterbirds, including large-scale breeding



survival, spawning and migration of native fish



river connectivity to the Coorong, flushing salt and mitigating poor water quality

2023 Seasonal Outlook, the Answer is blowing in the Wind

Dale Grey, Seasonal Risk Agronomist, Agriculture Victoria,

Key Points

- Caution should always be exercised when using forecasts in Autumn.
- 2023 early predictions of El Nino and +IOD were well versed in possibility given the deep ocean set up.
- Trade wind activity to date has not been enough to get either event to fully form.
- Models predict drier and warmer months ahead, but localised weather is showing the opposite!

El Nino, La Nina, positive IOD and negative IOD are coupled ocean atmosphere phenomena. When these events are mature and in full swing, the ocean temperatures at the surface and at depth, the winds and pressure patterns across the equator and the cloud at the dateline all have distinctive and characteristic behaviour. For each climate driver to be fully function and capable of delivering the classic climatic effects, each of these five characteristics needs to be present and when they aren't, then uncertainty arises as to what might occur.

There has been much talk this year about a possible El Nino, in fact it started as early as February. Climate models were emphatically sniffing a potential event in the wind. The problem is at that time of the year, models are notoriously inaccurate at predicting such events. We have seen similar model excitement about El Nino or La Nina in the autumns of 2014 (El Nino), 2016 (La Nina), 2017 (El Nino). Each of these failed to fire once the season progressed into winter. The reasons for this are varied, but common to the autumn season in all years, is the fact that the world's tropical oceans are reverting from what they have been in summer or spring the previous year to a period of normality. In autumn it is rare to have a tropical climate driver like the El Nino Southern Oscillation (ENSO) or the Indian Ocean Dipole (IOD) in action (the 2015 El Nino was a rare exception, fully formed in late May). So how are models even coming up with these predictions? In almost all cases the main signal of a possible climate drivers formation comes from the deep ocean. The existence of colder or warmer water to depth in key regions around the equator in some years indicates the possibility that these phenomena could form. Whether this water arises to the surface and manifests itself as a climate driver often comes down to surface wind activity to kick things off.

Much of this wind activity occurs due to tropical weather, with a predictability of seven days or less. Sometimes this change of wind occurs starting the progression of water movement to the surface and sometimes it simply fails to fire up. The earlier the pre signal in the deep ocean occurs in autumn the more time there is for the winds to change, so sometimes models eventually get things right after many months of nothing happening. In the three failed prediction years indicated earlier, reversed trade winds around the Solomon Islands failed to occur for the El Nino's and stronger trade winds across the Pacific failed to intensify for the La Nina. The 2015 El Nino was different in that the winds reversed strongly in early Autumn and continued for the rest of the season maintaining the El Nino.

So, what of 2023?

In the only three other triple La Nina events we have on record, an El Nino has formed in either the first or second year after the triple. It appears such things prime the ocean to want to be an El Nino soon after. In the Pacific, the triple La Nina's of the previous three years had evolved a lot of surface and undersea heat in the western Pacific. Every model could see this and was predicting the warm water to make a transition over to the South American coast and form an El Nino. The trade winds which had been cranking stronger since mid-2022 finally relaxed in March. This immediately had the effect of warming the undersea ocean which started to appear at the surface of South America in the space of six weeks. In mid-June, the central region of the Pacific (scientist's title NINO3.4) finally got to the El Nino threshold of 0.8oC warmer than normal. Almost immediately the pressure increased at Darwin and decreased at Tahiti in the South Pacific, and the Southern Oscillation Index (SOI) went strongly negative below a value of -8.0. This indicated the pressure patterns around the equator were showing El Nino behaviour. We now have three of the five key characteristics of a proper El Nino, but at this stage the other two remain elusive.

Classic El Nino's exhibit reversed trade wind activity from a westerly direction off the Solomon Islands. This causes two things to happen. It pushes the warm water pool over towards the central Pacific and cooler water upwells to the north of Australia to replace it. This has the effect of killing off the evaporation and cloud formation north of Australia and causing greater cloud to accumulate around the junction of the international Dateline with the Equator. The other thing the reversed winds do is cause the central Pacific ocean surface to calm off, allowing the sun to heat it up further. At the time of writing (22/6/2023) there are no signs of reversed trade winds or extra cloud at the dateline. This suggests that the current ocean and atmosphere are not fully coupled. The Coral Sea temperatures have been close to record warmth for almost 12 months, evaporating record amounts of moisture into the atmosphere, and somewhere in Qld, NSW, Victoria, Tasmania and New Zealand has been getting record amounts of rainfall when the right ducks have lined up. The Coral Sea is still very warm, and this is the bogey in the mix this year. Without that region going colder as a result of reversed trade winds its hard to see how a drying effect can occur from the Pacific Ocean.

The Indian Ocean exhibited cooler water off Sumatra and warmer water off Africa to depth in early Autumn. The models were all convinced of a +IOD. To this date there is scant evidence for one. Slightly stronger southeast wind in the Timor Sea has caused the water to cool off Australia's NW coast. This is poking towards Indonesia and is looking a little +IOD like, with very warm water off the African coast. In the last month the undersea conditions have completely flipped with warmer water off Indonesia and cooler water off Africa the opposite of a +IOD. The trade wind conditions have been benign to get any of this water to upwell cooler or warmer and pressure and cloud patterns have also showed no +IOD signature. At the time of writing the winds are actually blowing stronger into Sumatra more like -IOD. The Indian Ocean is a confused beast! Unless we see some stronger easterly wind off Indonesia to get the water to upwell cooler, it's unlikely we will see the classic drying effect from the Indian Ocean either.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the author would like to thank them for their continued support.

Useful resources
https://agriculture.vic.gov.au/support-and-resources/newsletters/the-break/the-fast-break-victoria
https://www.youtube.com/channel/UCIDCIII7gRZhUs03opGqH1g

Key learnings for Optimising Irrigated Grains

Damian Jones, Trials Manager, Irrigation Farmers Network

Key Points

- Nothing replaces a fertile farming system
- Irrigation offers the benefit of a wider window of N application to increase yield and the plant's ability to extract soil N later in the season.
- It's pointless getting all the agronomic operations right if the crop isn't irrigated on time.
- Faba beans remain a crop that has a gap between what yields are currently achieved and what the theoretical yields can be.
- Modelling offers some interesting insights into identifying the gap between the current and predicted yields and some of the practices that need to be investigated.

The presentation isn't about the various recommendations that will end up in the Good Management Guide resulting from the Optimising Irrigated Grains project, rather some key points from the trials and the modelling done in conjunction with the WaterCan Profit component of the OIG project. I've split this into 5 agronomic facets, but most are inter-related.

1. High yielding crops come from a fertile farming system rather than high artificial inputs

"Previous crop histories and nutritional starting points can have a greater impact than subsequent management" Nick Poole, director of FAR Australia and OIG project manager.

This statement relates mainly to the nitrogen dynamics in irrigated cropping. Monitoring the N status of the soil and '0' treatments where no additional N was applied (apart from starter N), the soil supplied anywhere from 100 to 180 kg N/ha. As soil organic matter (SOM) is approximately 10% N, then we are seeing between 1 and nearly 2 t/ha of our organic matter mineralised each season. This is not a problem if we replenish the SOM, and we can especially when we grow pulses/legumes as demonstrated in our Beyond Soilcare project, in partnership with the Goulburn Broken CMA.

If we don't supply enough N for the crop demand, the soil supply is used but there is reduced replacement of the SOM. A decline in OC has been proven to be difficult to restore, and not without cost as SOM is not simply N, it is a combination of other nutrients, in particular, phosphorus, sulfur and calcium. Apart from the loss of fertility, the loss of SOM results in soil structure issues, particularly slaking. An AgVic soils project focusing on irrigation suggested a 2% soil organic carbon target for our soils.

Noted at Kerang, pre-irrigation in autumn or spring provides the ideal conditions for mineralisation of SOM and the release of nitrogen and other nutrients prior to the crop being sown. For mineralisation to occur, moisture and warm temperature are the key requirements for the soil microbes to break down plant residues and SOM. Depending on the stubble/rotation, we have measured soil N of up to 140 kg N/ha at sowing. Even in a relatively grass dominant paddock, mineralised N in the first year of our maize trials saw approximately 160 kg N/ha become available.

2. Nitrogen Use Efficiency (NUE) of irrigation

We can be starting with so much more N than our dryland counterparts – a presentation of the results for the canola portion of the OIG project at a GRDC Update at Boort highlighted the differences in the systems – we had 100-120 kg N/ha whereas an example from the mallee had 11 kg N/ha. This had huge ramifications for the calculation of N required as the efficiency of topdressed N may not be as high as soil N and from memory the N required by the good dryland crop was around 96 kg N/t .

When we irrigate into the spring, we give the plant an opportunity to access soil N for a longer period compared to dryland. Calculating the N required for a tonne of canola, our trials suggest approximately 60 kg N/ha, or about 20 Kg N/ha less than the 'rule of thumb' for dryland canola. Barley NUE was 30 kg N/ha, durum wheat NUE was 50 kg N/ha (timing plays a part) and maize NUE was 25 kg N/ha.

Is waterlogging an issue for free draining layouts (ignoring rice layouts)? This seems to be on the minds of irrigators and most drylanders. The ICC Trial Block hasn't the best layout/infrastructure but we don't waterlog – spring irrigation takes 6-8 hours and it gets quite wet, but we don't get conditions that see de-nitrification. Of course, there are times when we do, but these tend to be rainfall on top of a full profile rather than from irrigation itself.

3. Soil Moisture Monitoring and Irrigation

All of the good management guide recommendations about sowing rates or N management are pointless if we don't manage soil moisture properly to ensure we maintain yield potential (and I'm discussing this in the context of full irrigation being the most profitable strategy). Whether it be watermark (gypsum) sensors, calculating crop water use from evapotranspiration data or capacitance probes, understanding the output from each system is crucial as well as after sales advice, particularly with the capacitance probes that need to be calibrated to your soil.

My favourite is the Gbugs we bought several years ago coupled with watermark sensors. Data transmission is non-existent and it only holds data for 3 weeks (and there are better systems now available), but they are simple to use and let you know what is happening in the rootzone. Generally, they suggest (demand?) irrigation happen way before any poking around with a shovel does.

Looking at years where decisions have to be made about whether to irrigate or not, there are critical stages in some crop's lives where avoiding moisture stress is critical to maintaining yield potential. In wheat, this is the early booting stage where ICC trials as part of the Smarter Irrigation for Profit project demonstrated yield losses due to moisture stress during (and before) this stage. Once this stress occurred, resulting in a reduction in the number of flowers developed, yield couldn't be restored and the only influence subsequent irrigation strategies had was to increase grain size.

A similar response occurred in the previous season where 'winter drought' thanks to the lack of pre-irrigation and insufficient winter rainfall saw tiller death and a loss of yield potential that could not be re-instated by a mid-August irrigation. In the broadleaf crops, yield potential is reliant on biomass. So late emergence, stalled growth due to moisture stress or any other stress factor that reduces the opportunity to grow more crop before flowering, reduces yield.

4. Fabas

Still many questions. The minimum plant population is about 15 pl/m2, but the Finley trials saw increasing yield as population increased, with no plateau at even 48 pl/m2 (or about a 300 kg/ha sowing rate for larger beans). Yields were better at Finley than Kerang but Kerang produced more biomass, which was approaching 20 t/ha. So why are we not seeing higher yields? Is lodging part of the issue where PGRs really didn't do much to control lodging (but reducing seeding rate did). Some of our trials have had a Harvest Index of over 0.5 (grain yield divided by the total biomass), meaning that if we could translate 20 t DM/ha, we should see bean yields close to 11 t/ha.

One thing that became apparent is that irrigation, either surface or overhead, did not increase disease. For two seasons, a fungicide strategy wasn't required to keep disease at bay but 2022 demonstrated that we need a robust disease management plan if the season demands it.

5. Modelling

The next comments need to be taken with a grain of salt. I have seen some 'interesting' information produced by APSIM for the project, I think driven by the lack of experience of growing our irrigated crops in the real world. But it does throw up a few different ideas to investigate further or highlight some of the constraints we cannot avoid due to where we farm.

The most interesting modelled responses was to the question of 'what are our yield targets for irrigated grains in our part of the world?', as I think knowing the 'target' allows us to know if we have to start looking for reasons if there is a considerable gap between the theoretical and the current expectations. A word of warning – the model tells us when to grow a crop for maximum yield but doesn't have to harvest the crop!

The first that stood out was faba beans. The modelling suggested 11.5 t/ha at Kerang. Initially I was skeptical, but looking at the harvest index, a potentially achievable target. But to achieve this, the model recommends they should be sown in late March, to flower in late June. A couple of agronomic details to be worked out, but we could achieve these 'recommendations' in an irrigated environment.
The second interesting output from the model was maize. Rather than look to the USA and see 38.6 t/ha as the target, the model suggests approximately 22 t/ha from a Christmas sowing, therefore avoiding the high temperatures likely around silking from a more traditional mid-October, early November sowing date.

Table 1: Modelled predicted yields at Finley and Kerang based on climatic conditions 1910 – 2020 (courtesy Albert Muleke, University of Tasmania).

Region	Genotype	Crop	Predicted Highest Yield (t/ha)	Sowing Date	
				Earliest	Latest
Kerang	Late	Chickpea	5.8	12-Apr	24-May
	Late	Canola	6.3	12-Apr	17-May
	Late	Durum	9.1	10-May	28-Jun
	Late	Barley	10.6	24-May	5-Jul
	Late	Faba bean	11.5	15-Mar	19-Apr
	Early	Maize	21.6	15-Dec	5-Jan
Finley	Late	Chickpea	5.9	19-Apr	24-May
	Late	Canola	6.5	19-Apr	24-May
	Late	Durum	9.8	10-May	5-Jul
	Late	Barley	11.3	24-May	5-Jul
	Late	Faba bean	11.3	22-Mar	19-Apr
	Early	Maize	22.0	20-Dec	5-Jan

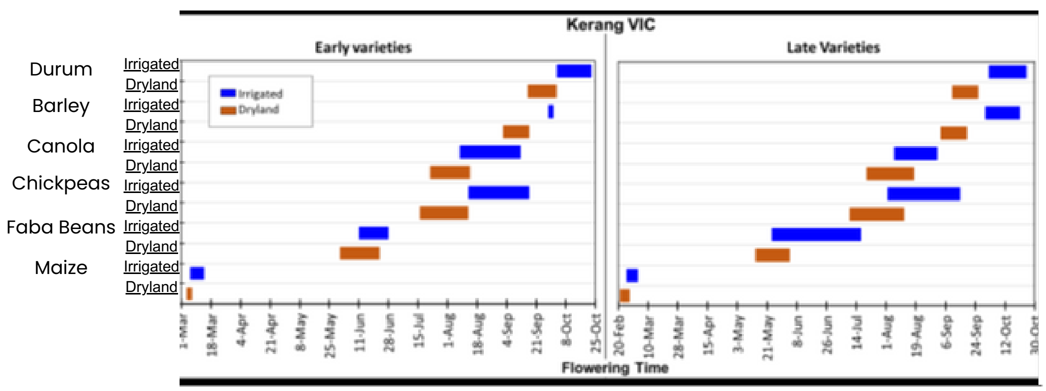


Figure 1: Optimal flowering periods for early and late maturity varieties of dryland and irrigated grain crops at Kerang in Victoria (data courtesy of Matt Harrison and Albert Muleke, University of Tasmania)

Of note is the later flowering for irrigated crops compared to their dryland counterparts. It would seem that avoiding moisture stress does offer the crop some protection to high temperatures during grain fill. This is an advantage in wheat where the temperature and solar radiation in the 30 days prior to flowering set the yield potential. So, if flowering can be delayed, there is the opportunity to receive more solar radiation in as the days become longer in spring and so have a higher potential yield. Although bread wheat wasn't part of the OIG project, we can still calculate our potential yield based on solar radiation. An analysis published in the 'Soils under an Irrigated Environment' (Sam North, NSW DPI), the median yield for Tullakool NSW was 9.0 t/ha but could be reduced to 7.2 t/ha in a low solar radiation (cloudy) year, irrespective of there being sufficient N in the system to drive higher yields.

Smarter Irrigation for Profit 2 Irrigation Timing Demonstration

Damian Jones, Trials Manager, Irrigation Farmers Network

Key Points

- Bearing in mind that this was a demonstration rather than a replicated trial, conclusions are difficult to be regarded as definitive and rather taken as a guide.
- Spring irrigations did result in higher yields, but the resulting improved grain size explained much of this increased yield in the 'later' irrigation strategies that did enforce some moisture stress on the crop prior to booting. Where the crop was not stressed through the stem elongation and flowering period, the increase in yield cannot be attributed to larger grain size alone. This would suggest that if the crop is suffering from moisture stress prior to booting, yield is being lost through the abortion of florets in the developing head.
- This would also indicate that SMM is vital if high yields are being targeted, moisture stress needs to be avoided through the entire stem elongation, flowering and early grain fill period. Timing irrigations to make sure that the crop is not moisture stressed at a particular crop stage is not a viable strategy.
- Gross margin analysis indicated that the best return per megalitre was from a single irrigation applied in the autumn that had the lowest grain yield. The best return per hectare was from 3 spring irrigations as well as pre-irrigation in the autumn ensuring the crop did not suffer moisture stress during the entire growing season.

Summary

The demonstration was established to test the yield and grain quality of wheat to various irrigation scenarios. The demonstration was pre-irrigated in April 2021 and this avoided the 'winter drought' that affected the results in 2020.

Overall irrigation did improve yield and grain size, more frequent irrigation resulted in higher yields but not necessarily greater profit (dependent of whether water or hectares are the limiting factor) and the 'no spring irrigation' treatment yielded surprisingly well given the water received.
Moisture stress prior to booting did reduce yield potential, although this loss of grains was compensated by increased grain size.

Objective
Demonstrate the effect of timing and quantity of irrigation water on wheat yield and grain quality.

Table 1. Method summary

Sowing Date	12th May
Target Plant Population	160 plants/m²
Seeding Rate	Scout @ 91 kg/ha based on TGW*
Irrigation	9 April 1.5 Ml/ha All treatments
	27 August 0.9 Ml/ha Timing based on SMM@
	7 September 0.9 Ml/ha Booting Timing
	17 September 0.9 Ml/ha Timing based on SMM@
	24 September 0.9 Ml/ha Flowering Timing
	8 October 0.9 Ml/ha Timing based on SMM@ plus late Flowering Timing
	160.4mm GSR (April – October) Decile 2
N application	13 July 95 kg N/ha 10 August 55 kg N/ha
Harvest	7 December
Average Yield	6.7 t/ha

*: Thousand Grain Weight. @ Soil Moisture Monitoring equipment reading 60-70 kPa

Methodology

The wheat variety Scout was selected as a high yielding variety under irrigated conditions.
Demonstration design and randomisations were produced via DiGGer software. Plot size was 5m by 20m. The sowing rate was 91 kg/ha targeting 160 plants/m2. Seed was treated with Gaucho seed dressing (200 ml/100 kg) 24 hours prior to sowing on May 12th.

Pre-emergent herbicide plus a knockdown was applied on May 11th (Sakura 118 g/ha + Gramoxone 2.0 l/ha). Seed was sown using Shearer drill, fitted with knife points and chain harrows. Soil moisture was excellent at sowing following pre-irrigation in April and showers through early May.
Weed control consisted of a broadleaf spray on August 5th (Precept 1.0 l/ha).

Irrigation Treatments

Irrigation treatments were planned as per Table 2.

All plots were pre-irrigated on April 9th. The amount of water applied was an estimation based on flow rate and application time.

Spring irrigations were applied via surface dripper tape (Netafim Streamline X 16080) which was capable of delivering 90mm or 0.9 Ml/ha of water in five hours, mimicking a flood irrigation event.

Growing Season Rainfall was 160.4mm. April, May, August and October received below average rainfall.

The trial was harvested on December 7th. Grain samples were taken and analysed for protein and moisture content, grain size and test weight.

Table 2: Planned and actual irrigation strategies

Planned Treatments	Treatment Dates
No spring irrigation	Pre-irrigation only
1 irrigation at booting	Irrigated on September 7th only
1 spring irrigation at flowering	Irrigated on September 24th only
2 spring irrigations based on SMM	Irrigated on 27/8 and17/9
Irrigation at booting + late flowering	Irrigated on 7/9 and 8/10
Full irrigation based on SMM	Irrigated on 27/8, 17/9 and 8/10

Table 3: Summary of irrigation water applied (Ml/ha)

	Treatment	9-April	27-Aug	7-Sep	17-Sep	24-Sep	14-Oct	Total
1	No spring irrigation	1.5						1.5
2	1 irrigation at booting	1.5		0.9				2.4
3	1 irrigation at flowering	1.5				0.9		2.4
4	2 spring irrigations based on SMM	1.5	0.9		0.9			3.3
5	2 irrigations at booting + flowering	1.5		0.9			0.9	3.3
6	Full irrigation based on SMM	1.5	0.9		0.9		0.9	4.2

Results

Table 4: Yield and Grain Quality

	Irrigation Treatment	Yield	TGW*	Protein	Screen-ings	Test	WUE@
		t/ha	g/1000s	%	%	kg/hl	kg/mm
1	No spring irrigation	5.8	39.6	10.1	2.7	83.5	28.5
2	1 irrigation at booting	6.4	45.8	9.3	1.1	85.7	21.4
3	1 irrigation at flowering	6.4	45.6	10.4	1.0	84.7	21.6
4	2 spring irrigations based on SMM	7.3	43.4	8.8	1.3	83.4	18.6
5	2 irrigations at booting + flowering	6.6	45.0	9.3	0.7	85.4	17.0
6	Full irrigation based on SMM	7.7	45.0	9.3	1.8	85.0	15.9

WUE@- Water Use Efficiency

Harvest results show a yield response to irrigation

Grain size was improved by irrigation. If the 'no spring' yield of 5.8 t/ha is assumed to be the base yield, the increase in grain size by the 'booting', 'flowering' and the "boot + late flowering' treatments all yielded equal to (boot + flowering) or less than that predicted by the increase in grain size. Only the treatments that received the earlier irrigation as determined by soil moisture monitoring yielded higher than that can be attributed to larger grain size. Water use efficiency (WUE) was highest in the treatment that received the lowest amount of irrigation and generally followed the trend of higher irrigation inputs resulting in lower WUE. A WUE of greater than 22 kg/mm suggests that either the amount of pre-irrigation water applied was underestimated or the yield was higher than expected due to site/soil variability i.e. the strip harvested for yield was 'better bit' rather than the average of the plot.

Table 5: Gross margin analysis

	Irrigation Treatment	Gross Margin $120/Ml	
		$/ha	$/Ml
1	No spring irrigation	904	603
2	1 irrigation at booting	950	396
3	1 irrigation at flowering	961	401
4	2 spring irrigations based on SMM	1095	332
5	2 irrigations at booting + flowering	912	276
6	Full irrigation based on SMM	1102	262

Gross margins were calculated using the cost of irrigation water at $120/Ml (the approximate cost of temporary water in Zone 7 at the time of irrigation.

The best return per Ml was the "no spring' strategy. Best return per hectare was from 'full' spring strategy, although the '2 spring' strategy was very similar.

Australian Government
Department of Agriculture, Water and the Environment
This project is supported by funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program.

Summer forage crops under various irrigation strategies

Damian Jones, Trials Manager, Irrigation Farmers Network

Key Points

- Maize and sweet sorghum proved to have the highest yield potential, but did suffer yield loss when their irrigation requirements (based on evapotranspiration) were not met. However, looking at the water use efficiency, some water savings could be made, as demonstrated by the water use efficiency (kg DM/mm) being highest in the irrigation strategies that did not meet crop evapotranspiration requirements ie a deficit irrigation.
- The alternative summer fodder crops, red and white grain sorghum, did require less water than maize, but their reduced potential biomass did not compensate for the water saved, and had poorer water use efficiency (kg DM/mm) than maize.
- Feed quality was higher from the grain sorghums.
- Maize remains the king of summer fodder crops, but there could be alternative irrigation strategies to maximise water use efficiency rather than maximise production.
- It has demonstrated that grain sorghums can be grown for quality silage using less water than maize, but are still not as efficient or have the same yield potential as maize.
- There is potential for water savings in drier years. But these savings need to be quantified in 'the real world' and in seasons where heat stress is more prevalent.
- Grain sorghums as alternative fodder crops are likely to have inferior yield potential than maize but may make a higher quality silage.

Background

The trial was established to evaluate a range of summer forage crops under various irrigation strategies, aiming to ascertain crop performance based on both quantity and quality of the forage (silage) produced. The Year 1 saw some teething problems with irrigation management that may have impacted crop yields and production efficiency. Year 2 saw modifications to trial agronomic management and the introduction of a fourth irrigation strategy based on calculated crop evapotranspiration for determining irrigation timing.

Objective

To assess the potential of red and white grain sorghums as an alternative to irrigated maize for silage, focusing on the potential water savings that sorghum may offer.

Methodology

Forage varieties sown

Crop	**Variety**
Sweet Sorghum	Megasweet
Red Grain Sorghum	Sentinel
White Grain Sorghum	Liberty
Corn mid-season	Pac 606IT
Corn short season	PAC440

Table 2: Irrigation strategy summary. 80mm of water was applied when the various scheduling targets were met.

Strategy	**Scheduling**
High	Based on calculated crop evapotranspiration – irrigate when moisture deficit = 80mm
75%	75% of the calculated crop evapotranspiration used to determine the moisture deficit
Medium	Soil moisture monitoring using Watermark sensors – irrigation applied when soil moisture = -140-160 kPa
Low	Soil moisture monitoring using Watermark sensors – irrigation applied when soil moisture = -200-220 kPa. Lower plant population and/or greater row spacing

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Irrigation strategies were based on the following assumptions:

Irrigation strategy 1 **‘High**’. Maximum corn production would occur when the crop was irrigated following best practice recommendations for corn sown for grain. Using daily evaporation data, the crop evaporation was calculated and irrigation scheduled when the crop had ‘used’ 80mm of soil water. When irrigation was triggered, 80mm of water was applied.

Irrigation strategy 2 **‘75%’.** Daily crop evapotranspiration was calculated as per the ‘high’ treatment, but 75% of the crop evapotranspiration was used when calculating the moisture used. Irrigation was triggered when the calculated crop use reached 80mm and 80mm of water would be applied.

Irrigation strategy 3 **‘Medium’.** Increased drought stress would be applied to the crops by irrigation triggered by the Watermark soil moisture sensors reaching -140-160 kPa. Once triggered, 80mm of water would be applied.

Irrigation strategy **4 ‘Low’.** Increased drought stress would be applied to the crops by irrigation triggered by the Watermark soil moisture sensors exceeding -200 (the maximum negative reading the sensors are capable of). Once triggered, 80mm of water would be applied.

The trial was established on a surface irrigated border check layout. The initial irrigation of the site post sowing was via surface irrigation, but subsequent irrigation was applied by Netafim Streamline X 16080 FL dripper tape to simulate flood irrigation. Emitters were on 25cm spacings, each delivering 1.6 l/min at 1 bar. Tape spacing was 35cm apart. This arrangement was capable of delivering the equivalent of 80mm of water in 4 hours and 30 minutes, adequately simulating flood irrigation. No issue with infiltration was noted.

60 kg P/ha as Superfect, and gypsum at a rate of 2 t/ha were applied pre-sowing during paddock preparation. 150 kg N/ha as urea was predrilled prior to sowing.
The trial was sown on November 18th and watered up on November 20th.

The sorghums plots were sown with a tyned seeder on 35cm row spacing. The 70cm row spacing for the ‘low’ treatments was achieved by removing every second row post emergence.
The maize plots were sown with a Mason precision planter.

Establishment was even and reached the target plant densities across all plots. The first irrigation began on 10 December with 50mm applied (assuming there was still moisture deeper in the profile).
Soil moisture monitoring equipment was installed in late November. Watermark sensors were installed in the white sorghum and Pac440 corn plots in each of the irrigation strategy block at 20cm and 40cm depth. These were connected to MEA GBug data loggers.

Treatments 1, 2 and 3 received a topdressing of 150 kg N/ha as urea, starting in late December, prior to an irrigation event. Treatment 4 received 100 kg N/ha as a topdressing, assuming lower yield potential, over a similar timeframe.

Bird damage was noted in the 2020/21 trial and so ‘Deter’ was applied to the sorghum plots in mid-February as the grain began to fill. This, along with all buffers being grain sorghum, minimised bird damage.

Crop types were harvested as they reached soft dough for the sorghums and milkline 4-4.5 for the maize. Some maturity differences were noted in the grain sorghums as a result of the irrigation strategies. The ‘low’ treatment delayed maturity by approximately 7 days.

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Table 4: Forage harvest dates

Crop	Treatment	Harvest Date
Red Grain Sorghum	high, 75%, Medium	28 February
	low	7 March
White Grain sorghum	high, 75%, medium	7 March
	low	15 March
Sweet sorghum	All treatments	15 March
Corn short season	All treatments	21 March
Corn mid season	All treatments	25 March

Table 5: Summary of water applied (pre-irrigation and in-crop) and rainfall in millimetres, reflecting different cutting dates and irrigation strategies

Crop	Low	Medium	75%	High
Red Grain Sorghum	467	527	607	777
White Grain Sorghum	493	553	633	803
Sweet Sorghum	493	553	633	803
Pac440 Maize	587	567	647	897
Pac606IT Maize	587	567	647	897

Although it was anticipated to be differences between the 'low' and 'medium' strategies, the timing of rainfall did play it's part in the total water applied – a timely and substantial rainfall event resulted in an irrigation scheduled for the 'medium' strategy to be cancelled. Hence the two strategies ended up with similar applied totals.

Experiment findings

For reporting, each irrigation strategy is regarded as separate trial as they were conducted in blocks based on the relevant irrigation strategy. The data is presented in tables that list both the crop type and irrigation strategy, but the statistical analysis is limited to comparing crop types under each specific irrigation strategy and cannot compare the results between the irrigation strategies.

Yield values with the same letter are not statistically different. Analysis is limited to crop type under each irrigation strategy and so the letters are only applicable to that strategy. Maximum yield was achieved with either maize or sweet (forage) sorghum under the 'high' irrigation strategy. Maize outyielded the grain sorghums in all but the 'medium' irrigation strategy.

Although not directly comparable, the trend in maize and sweet sorghum was for increased dry matter yield as more irrigation water was used. The grain sorghums saw a trend for an increase between the 'low' and 'medium' strategies but then saw little increase beyond the 'medium' strategy.

As the amount of irrigation water was similar between the 'low' and 'medium' strategies, it could be argued that reducing plant population resulted in reduced yield.

Table 6. Influence of Crop type and irrigation strategy on biomass (t DM/ha).

Crop	Low		Medium		75% ET		High
Red Sorghum	11.54	c	17.64	b	19.86	b	20.57 b
White Sorghum	15.43	b	17.89	b	18.81	b	17.99 b
Sweet Sorghum	16.39	ab	20.72	ab	24.98	a	29.66 a
Pac440 Maize	18.63	a	22.7	a	25.54	a	29.62 a
Pac606IT Maize	18.91	a	20.51	ab	24.33	a	28.29 a
Mean	16.18		19.89		22.7		25.23

Low LSD p=0.05	2.724 P val		0.002
Medium LSD p=0.05	3.232 P val		0.032
75% LSD p=0.05	3.985 P val		0.012
High LSD p=0.05	2.606 P val	<0.001	

Table 7. Influence of Crop type and irrigation strategy on biomass Water Use Efficiency (kg DM/mm).

Crop	Low		Medium	75% ET	High
Red Sorghum	24.72	b	33.49 -	32.73 bc	26.47 c
White Sorghum	31.31	a	32.35 -	29.71 c	22.41 d
Sweet Sorghum	33.25	a	37.46 -	39.45 a	36.93 a
Pac440 Maize	31.33	a	40.03 -	39.47 a	33.03 b
Pac606IT Maize	32.21	a	36.18 -	37.61 ab	31.54 b
Mean	**30.64**		**35.9**	**35.79 -**	**30.07**

Low LSD p=0.05		**5.009 P val**	**0.028**
Medium LSD p=0.05	**NS**	**P val**	**0.095**
75% LSD p=0.05		**6.3853 P val**	**0.025**
High LSD p=0.05		**3.174 P val**	**<0.001**

Looking from a water use efficiency basis:

Maize and sweet sorghum gave the best WUE when grown under the 'deficit' irrigation strategy such as the '75%' or the 'medium'. These two strategies were also the best WUE strategies for the white and red sorghum although they were lower than that achieved by the maize and sweet sorghum. The amount of water used in the 'low' and 'medium' strategies was very similar (thanks to a timely rainfall event saving one irrigation in the 'medium' strategy, but resulted in different WUE due to lower plant numbers leading to lower dry matter production.

Table 8. Influence of Crop type and irrigation strategy Metabolisable Energy (MJ/kg).

Crop	Low		Medium		75% ET		High	
Red Sorghum	10.2	a	10.2	a	10.1	a	9.8	a
White Sorghum	9.8	b	9.7	b	9.2	b	9.3	b
Sweet Sorghum	9.6	b	9.7	b	9.4	ab	9.5	ab
Pac440 Maize	9.5	b	9.4	b	9	b	8.8	c
Pac606IT Maize	9.5	b	9.2	b	9	b	8.7	c
Mean	9.7		9.6		9.3		9.2	

Low LSD p=0.05	0.3617 P val	0.006
Medium LSD p=0.05	0.5005 P val	0.019
75% LSD p=0.05	0.6951 P val	0.03
High LSD p=0.05	0.3562 P val	<0.001

Feed quality tended to decrease as water use increased as demonstrated in Tables 8 - 12. Another trend was for a higher quality forage from the grain sorghums.

The red grain sorghum consistently had higher ME when compared to the other crops across all irrigation strategies. Maize tended to have lower ME, although not always different to the sweet and white sorghums.

The mean ME for each irrigation treatment trended lower as irrigation increased.

Table 9. Influence of Crop type and irrigation strategy Crude Protein (%).

Crop	Low		Medium		75% ET		High	
Red Sorghum	10.2	a	9.7	a	9	a	8.1	a
White Sorghum	8.9	b	8.8	ab	7.8	ab	7.4	a
Sweet Sorghum	8.3	bc	9.1	a	8.6	a	6.6	b
Pac440 Maize	8.5	bc	7.8	b	6.9	b	5.9	bc
Pac606IT Maize	7.9	c	7.6	b	6.6	b	5.5	c
Mean	8.7		8.3		7.8		6.7	

Low LSD p=0.05	0.917 P val	0.003
Medium LSD p=0.05	1.17 P val	0.016
75% LSD p=0.05	1.206 P val	0.008
High LSD p=0.05	0.728 P val	<0.001

Red grain sorghum consistently had the highest crude protein for each irrigation treatment. The different irrigation strategies saw varying responses in crude protein, but maize tended to have lower figures.

Once again, the irrigation strategies followed a trend of declining crude protein as irrigation increased.

Table 10. Influence of Crop type and irrigation strategy on Acid Detergent Fibre (%).

Crop	Low		Medium		75% ET		High	
Red Sorghum	19.6	a	22.4	-	23.5	-	24.4	a
White Sorghum	24.9	b	23.3	-	27.7	-	28.1	b
Sweet Sorghum	25.3	b	24.4	-	25.5	-	24.1	a
Pac440 Maize	21.9	a	22.5	-	31.2	-	31	b
Pac606IT Maize	19.8	a	21.7	-	26.5	-	28.8	b
Mean	22.3		22.9		26.9		27.3	

Low LSD p=0.05	2.552 P val	0.002
Medium LSD p=0.05	NS P val	0.495
75% LSD p=0.05	NS P val	0.053
High LSD p=0.05	2.953 P val	0.003

ADF was not as responsive to irrigation strategies as some of the other quality components. There was no difference in ADF across the crop types in the 'medium' and '75%' strategies.

Once again, the ADF % saw a trend to higher figures when irrigation was increased.

Table 11. Influence of Crop type and irrigation strategy on Neutral Detergent Fibre (%).

Crop	Low		Medium		75% ET		High	
Red Sorghum	32.2	a	32	a	33.2	a	35.1	a
White Sorghum	41.2	b	38.2	b	45.2	bc	44.4	c
Sweet Sorghum	41.5	b	40.8	b	39.9	ab	38.8	b
Pac440 Maize	36.4	ab	37	b	48.4	c	46.9	c
Pac606IT Maize	33.3	a	36.9	b	43.8	bc	46.6	c
Mean	**36.9**	**-**	**37**	**-**	**42.1**	**-**	**42.4**	**-**
Low LSD p=0.05	**5.156**	**P val**		**0.008**				
Medium LSD p=0.05	**4.564**	**P val**		**0.024**				
75% LSD p=0.05	**7.33**	**P val**		**0.011**				
High LSD p=0.05	**3.649**	**P val**		**<0.001**				

The response in the level of NDF in crop type and irrigation strategy was mixed. Red grain sorghum had the lowest NDF%, but not necessarily different to the other crop types, and differences between crop types were not consistent between irrigation strategies.

However, the trend to higher NDF where more irrigation water was applied continued.

The trend across all irrigation treatments was for the grain sorghums to have the highest level of starch, followed by the maizes, with the sweet sorghum having the least, with some variations on this theme.

Overall, the red grain sorghum had the higher feed quality and irrigation tended to have a negative influence on feed quality based on the quality parameters presented.

Table 12. Influence of Crop type and irrigation strategy on starch (%).

Crop	Low		Medium		75% ET		High	
Red Sorghum	29.8	a	34.3	a	35.2	a	33.4	a
White Sorghum	29.3	a	34.2	a	30.3	ab	30.7	a
Sweet Sorghum	20.9	c	20.8	c	20.4	c	17.8	c
Pac440 Maize	23.7	b	26.8	b	22.3	c	24.5	b
Pac606IT Maize	24.8	b	23.9	bc	23.2	bc	23	b
Mean	**25.7**	**-**	**30**	**-**	**26.3**	**-**	**25.9**	
Low LSD p=0.05	**3.214**	**P val**	**<0.001**					
Medium LSD p=0.05	**5.183**	**P val**	**<0.001**					
75% LSD p=0.05	**7.41**	**P val**	**0.008**					
High LSD p=0.05	**4.285**	**P val**	**<0.001**					

Discussion

The assumption that less water is required by the grain sorghums was demonstrated to be correct, but the overall lower biomass produced did not compensate for the water saved on a kg DM/mm comparison.

Reducing the quantity of irrigation applied did result in reduced maize biomass. However, using less water (the '75%' treatment) on maize resulted in higher dry matter produced per volume of water and of slightly better quality.

The reduction in dry matter was expected as the amount of irrigation reduced, but countered by the better water productivity.

A higher quality feed was achieved with the grain sorghums, in particular the red sorghum.
The lower plant populations were assumed to be of benefit to achieving better water use efficiency (kg/mm) in the 'low' irrigation strategy, but due to the volume of irrigation water being similar between the 'low' and the 'medium' treatments, it could be argued that the lower population saw a reduction in efficiency.

Hyper Yielding Canola – more than just urea and fungicide

Rohan Brill, Agronomist Brill Ag

Key Points

- 2020 and 2021 Hyperyielding Canola trials have shown that yield potential can be raised through increased attention to nutrient manage ment and variety choice.
- At Hyperyielding Canola sites in four states in 2021, canola yield was improved where animal manure (chicken or pig) was applied.
- 2022 trials will provide a better understanding of the reasons for the manure response and if the response can be replicated with the application of inorganic nutrition alone.
- 45Y95 CL was the standout variety at Wallendbeen in 2021, it grew a high amount of biomass with a high conversion of that biomass to grain yield.
- The use of fungicide has limited yield loss from disease at Wallendbeen in both 2020 and 2021, with the best value application being the 20-30% bloom timing.

Importance of nutrition for Hyper Yielding Canola

The aim of the canola component of the Hyper Yielding Crops project is to determine management practices that achieve 5 t/ha canola grain yield in high yield potential environments. Nitrogen management has been prioritised as one management strategy that is important for canola yield. At Wallendbeen in 2021 there was no response to applied N (as urea) with rates applied up to 300 kg/ha. This was largely due to the very high fertility of the paddock following a pasture phase, with 340 kg/ha N stored in the top 90 cm soil plus 2% Organic Carbon. Over and above N application (at the 225 kg/ha N rate) there was a response to the application of chicken litter at 3 t/ha (dry basis). This supplied 110 kg/ha N, 30 kg/ha P and 105 kg/ha K and increased yield by 0.5 t/ha. Animal manure may not be readily available and/or the cost may be prohibitive, so 2022 trials are looking further into the reasons for the response to manure.

The trials will determine if a similar response can be achieved by matching the nutrition supplied in manure with inorganic inputs. Is it a matter of simply increasing the NPK inputs to match or is there a benefit from manure beyond just the nutrient content? Does the manure increase nutrient supply when it is most required, i.e., through the crop critical period?
The positive response from manure application was mirrored at all four HYC Canola sites in 2021, including:

- Gnarwarre, Victoria (pig manure)
- Millicent, SA (pig manure)
- Kojonup, WA (chicken manure)

There was a range in yield response from 0.5 t/ha at Wallendbeen to 0.8 t/ha at Gnarwarre and Kojonup.

Variety Choice 2021

Once nutrition is optimised, a variety needs to be chosen that will capitalise on the investment in soil fertility. In a Genotype * Environment * Management (GEM) Trial at Wallendbeen in 2021 the standout for grain yield was 45Y95 CL, being at least 0.8 t/ha higher yielding than all other varieties (Table 1).

Table 1. Yield of spring canola varieties at four national HYC canola sites in 2021.

	Gnawarre Vic	Kojonup WA	Millicent SA	Wallendbeen NSW
ATR Wahoo	3.5	1.8	3.3	3.6
HyTTec Trifec-ta	3.9	2.7	4.4	5.2
45Y95 CL	*	*	6.4	6.4
45Y93 CL	*	*	5.7	5.6
45Y28 RR	4.5	2.9	5.1	4.9
Condor XT	3.9	3.4	5.1	5.2
l.s.d. (p<0.05)	0.21	0.13	0.34	0.36

Detailed assessment of 45Y95 CL at the Wallendbeen site showed that it had high biomass at maturity but also a high harvest index, with 36% of final biomass being grain (Figure 1). 45Y95 CL had a high number of seeds per pod (21) with a high number of pods/m² (8422) (Table 2), the only variety that was above average for both components. Experiments and measurements will be completed again in 2022 as subtle differences in final biomass and harvest index can magnify into large differences in crop profitability.

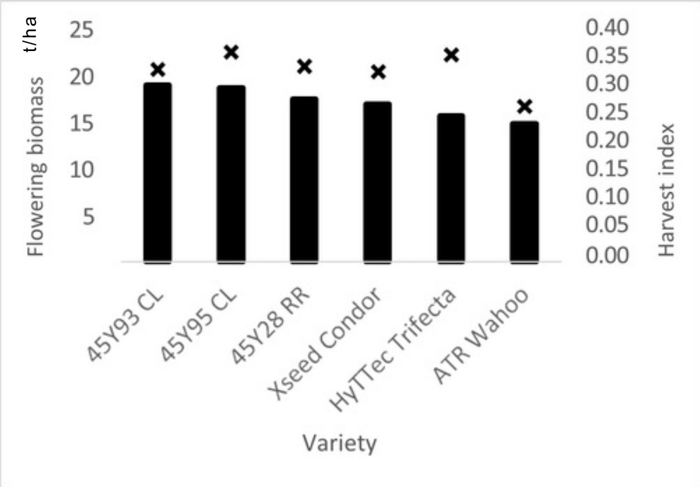

Figure 1: Maturity biomass (bars) and harvest index (X) of six canola cultivars in Wallendbeen GEM trial 2021.

Table 2. Seeds/pod and pods/m² of six spring canola varieties in Wallendbeen HYC GEM trial 2021.

	Seeds/pod	Pods/m²
ATR Wahoo	21	5240
HyTTec Trifecta	17	8003
45Y95 CL	21	8422
45Y93 CL	18	8692
45Y28 RR	18	7628
Condor TF	15	8263
Mean	18	7708

There was also a winter version of the Hyper Yielding Canola GEM site, where the highest yielding variety was Hyola Feast CL at 3.8 t/ha. The high fertility at the site led to very tall winter canola plots and which lodged badly by harvest time. Further grazing treatments have been included in 2022 to evaluate the response of new winter canola varieties to grazing and the value that may bring for forage and grain yield.

YieldMax Trial 2022

The YieldMax Trial was sown in 2022 which gives an opportunity to evaluate the best varieties with a strong nutrition package. The nutrition treatments include:

- High Input – 40 kg/ha P, 225 kg/ha N, 3 t/ha (dry basis) Chicken Manure
- Low Input – 15 kg/ha P, 150 kg/ha N.

Biomass samples were taken at flowering to determine the differences between varieties and treatments.

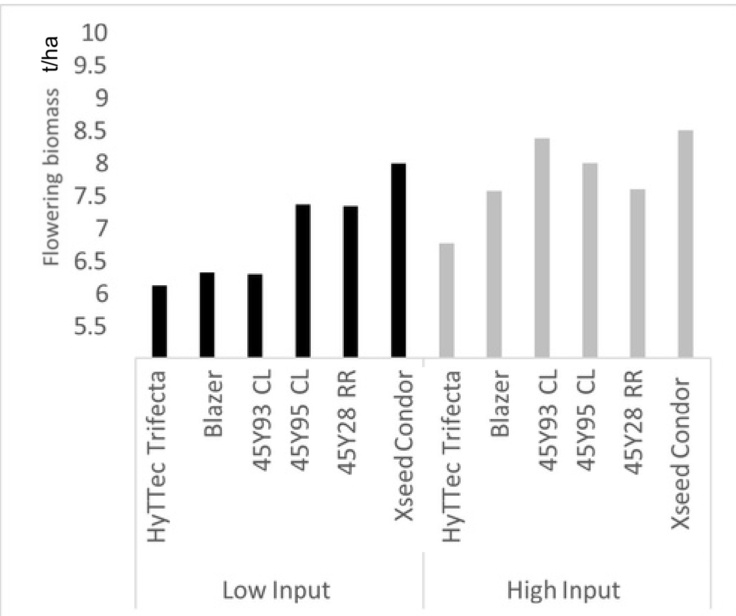

Figure 2: Effect of nutrient management on flowering biomass of six canola varieties at Wallendbeen 2022

The difference between varieties was generally greater than the difference between nutrition treatments (Figure 2). TT varieties had the least biomass and Xseed Condor (Truflex) had the most biomass. Biomass samples will be taken again at crop maturity as growth between the start of flowering and maturity has a much stronger correlation with grain yield than growth pre-flowering. Will the high input treatment increase growth during the crop critical period and which varieties will use this high nutrition the most efficiently?

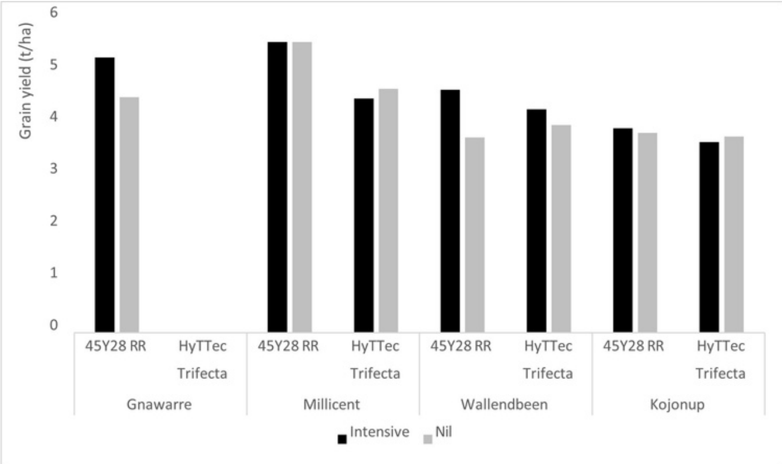

Figure 3: Effect of fungicide program (Intensive versus Nil) on grain yield of 45Y28 RR at Gnarwarre, Millicent and Wallendbeen and on HyTTec Trifecta at Millicent and Wallendbeen in 2021

HYC Canola Disease Management
With large biomass canola crops in high yield potential environments, it might be expected that growers would need to increase fungicide inputs to protect crops from disease. However, across the project in 2021 the yield response to fungicide (difference between Intensive and Nil fungicide program) ranged from nil in four (of seven) trials to 0.9 t/ha in a trial at Wallendbeen in 45Y28 RR canola (Figure 3). Intensive fungicide program included Saltro Duo on seed, Prosaro at 4-leaf stage, Aviator Xpro at 20% bloom stage and a follow up Prosaro at 50% bloom stage. The single best value fungicide application in 2021 was the use of an SDHI product (e.g. Aviator Xpro, Miravis Star) at 20-30% bloom stage

Hyper Yielding canola results Full results from 2021 are available at https://faraustralia.com.au
Results from 2022 will also be made available through the FAR Australia website and various other channels such as through social media and GRDC Updates.

FAR AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

A Systems Approach to Sustainable Soils

Dr Cassandra Schefe, Soil Scientist - Co owner AgriSci

Key Points

- Farmers should not have to chose between growing food/fibre and growing soil carbon. A focus on best-practice agronomy, efficient water and nutrient use, while managing soil constraints, will also provide the optimum environment for soil carbon.
- The high rate of organic matter turnover in irrigated systems means that there is high loss of carbon from the system due to microbial breakdown of organic matter and loss of CO2. This means that maintaining soil carbon levels is actually an active process. So, if you are a highly productive irrigation farmer, exporting high tonnages of product (grain/milk/cotton/meat), and you are maintaining soil carbon values, that is amazing!

While the presentation will go into this topic in greater detail, the following provides a general summary of the information to be covered.

What is a sustainable soil?

All agricultural systems have a complex interplay of inputs and outputs with the objective of growing (and exporting) food and fibre. Irrigated farming systems shift it up a notch as the availability of water increases the potential productivity of that land, with inputs and outputs increasing accordingly.

Therefore, rather than thinking of our soils, and the organic matter in our soils, as a static black box, we really should be thinking of our soils as a highly tuned dynamic engine room. As such, our ability to continue to generating food and fibre is completely dependent upon how we maintain our soils, which means that a sustainable soil requires constant support.

What about organic matter vs soil carbon?

Soil organic matter (SOM) in its broadest sense, encompasses all of the organic materials found in soils regardless of origin and state of decomposition. This includes plant litter and roots, decomposing manures and dead micro-organisms, and added organic amendments.
When soil samples are analysed for soil carbon, the focus is on that portion which has been decomposed to the degree that it cannot be recognised as coming from a specific source, with the soil sieved to < 2mm fraction.

Within this <2mm fraction, the chemical composition of soil organic matter is relatively stable. Carbon is a large component of soil organic matter and is comprises about 58% of the total mass. It is from this measure that the conversion factor of organic carbon x 1.72 = soil organic matter is derived.

In addition to carbon, there are other nutrients are also present in well-established ratios to carbon. These nutrients include N, S, P, K etc. So, while we talk about soil carbon, we only do so because we can measure carbon as a discrete element, while organic matter is a broader aggregation of elements in material that is undergoing decomposition.

Why is it so hard to increase soil carbon in agricultural systems?

There are three challenges in increasing soil carbon in food and fibre production systems.
1. High turnover and cycling –The organic matter, and so the carbon in our soils is cycling rapidly. Every time plant residues are decomposed by microbes, most of those microbes breathe in O2 and breath out CO2, which means that conversion of residues into 'stable/sequestered' soil C is a very inefficient process.

Fertility limitations – As organic matter is comprised of carbon and other nutrients in defined ratios, if those other nutrients are not present, the carbon cannot be retained. This brings in 1.the Law of the Minimum, whereby, whichever nutrient is most limiting, is the level of organic matter (and so soil carbon) to which the whole system is constrained to.

2. Soil constraints – The maintenance and increase of soil carbon is constrained by the plant production system. If plant growth is limited due to other physical or chemical constraints (acidity, waterlogging, compaction etc), that will also constrain microbial function, thus limiting residue decomposition and soil organic matter levels.

Engaging with AgTech

Mark Sloan, AgTech Project Lead, Regional Innovation Network | Agriculture Sector Development, Department of Energy, Environment and Climate Action

AgTech

AgTech is any innovation in the agriculture sector (farm to consumer) designed to improve efficiency, profitability and or sustainability. It includes devices, sensors, virtual reality, robotics, automation and artificial intelligence.

AgTech can work by itself or be part of a network of devices such as the Internet of Things (IoT), where devices can connect to and interact with each other and the internet (see below).

On farms, AgTech can:
- Make decision-making easier and quicker.
- Provide more reliable and accessible information.
- Provide evidence of sustainability, improved efficiency, and increased profitability.
-

Examples of AgTech used on farms includes:
- Water sensors for tanks, troughs and irrigation.
- Weather stations and soil moisture monitoring.
- Gate and fence sensors.
- Electronic identification tags.
- Autonomous vehicles

Things To Consider

So, you're thinking of getting into ag tech, but want to know where to start? Often one of the starting points is the price – how much will this cost me upfront, and what's the ongoing cost, or how much will this save me in the long run? While these are fundamental questions and will impact your decision to invest or not, here are six points to consider. These should help you make a more informed decision and get the most out of your ag tech.

1. The why – what do you want to achieve from your AgTech?

How are you planning to use it? Simple applications such as remote management to monitor electric fences or water points to save travel time? Or more complex, such as accurately predicting where in your electric fence the fault is occurring. Clearly defining your aim will help you identify what technologies you need.

2. Do your research

What type of device best suits the job at hand? Research various products, such as the difference between ultrasonic sensors and pressure probes. For example, if using these for monitoring the water level in a tank, the ultrasonic sensor measures the distance to the water level but, in a closed top tank in summer, the humidity in the tank can give you a false reading, so a pressure probe might be a better option. Accurately mapping the number of devices or sensors is important, as this may change depending on your farm terrain or the information required.

You need to be prepared to invest in your own network to make the system work, depending on your farm terrain or service providers in your area.

The other consideration is how accessible is your data? What is the dashboard like, is it in a user-friendly format and can you integrate it to meet your needs? Can you share your data with third parties, your agronomist for example?

3. Installation

When setting up your networks or devices, you need to consider:
- network coverage
- protecting devices from damage (livestock, wildlife and machinery)
- location (wind direction, orientation, height)
- manufacturer recommendations such as depth, positioning and maintenance.

4. Established or emerging company or product?

One critical consideration is the after-sales service. How much does this support cost, where is the support located, is it online or are company representatives available to come to your farm? While established companies might have years of experience and have solutions and procedures to solve issues in place, emerging companies are often motivated to find solutions, to improve their service or product.

Source: agriculture.vic.gov.au/farm-management/agtech/introduction-to-agtech

More Information

AgTech - What you need to know

Video collection: Dirty Tech Talks - Connectivity, dashboards, weather stations and soil moisture probes.

Podcast: AgTech/Energy Podcast Series AgVic Talk Season 5

AgTech Finder

eLearn series: Getting into AgTech

Video collection: What has the On Farm Internet of Things trial achieved?

ICC Future Drought Fund Projects

Belinda Lambert, Extension Officer, Irrigation Farmers Network

This year we delivered the first half of our 'Saving Our Soils During Drought' Soils project, with demonstration and workshops for Stock Management (Containment) Areas (SMA)'s. Many irrigators have mixed businesses and SMA's are found to be successful in maintaining animal health and preserving pasture during periods of extreme climate conditions, as well as being a versatile management tool to be considered as part of your overall (livestock) business strategy.

Feedback from our first 2 workshops was very positive with over ***90% of the attendees saying that as a result of the activity they are more likely to make a practice change or consider doing so.***

The workshop provided a.. "new way of looking at planning - feeding strategy, and trigger points in regards to containment feeding".

Two new Future Drought Fund programs the Irrigation Farmers Network (formerly ICC) have successfully bid for, and will be delivering are:

1. Flexible Irrigation Farming Systems responsive to drought & seasonal climate volatility.

This project aims to enable you to create a flexible irrigated farming system that can either react to climate volatility in-season by adjusting inputs or plan for drought by using practices that reduce the risk of failed crops and maximise profitability. A combination of large-scale demonstrations and small plots will address issues such as setting yield targets, matching nitrogen nutrition to yields, irrigation strategies to maximise water use efficiency and switching from grain to fodder crops. This project is led by the Irrigation Farmers Network and supported by Irrigation Research & extension Committee (IREC) and Southern Growers.

So far, crops of wheat, barley, canola and faba beans have been established and the demonstrations will focus on:

- Nitrogen budgeting (soil, in-crop mineralisation, topdressing and crop demand) and matching inputs to crop yield.
- Nitrogen timing decisions based on seasonal forecasting – decreasing the risk of under/over-fertilising from lack of topdressing opportunities in a dry season.
- Nitrogen timing decisions based on seasonal forecasting and the flexibility of converting grain crops to fodder crops and the potential benefits from an early nitrogen application strategy in fodder production.
- Irrigation and variety selection decisions based on seasonal allocations and outlook e.g., whether to pre-irrigate or hold water until spring; canopy development for wateruse efficiency and sowing of long / short season varieties to match predicted allocations.

2. De-risking the seeding program. Adoption of key management practices for the success of dry and early sown crops.

This project aims to increase awareness and understanding of the strategic use of dry and early sowing to improve sowing efficiency and production levels of cereals in drought years. This project led by AgExcellence is being delivered by Farming Systems Groups across SA, Vic and NSW. All groups are tailoring activities to their members and regional specific needs. The Irrigation Farmers Network will be focusing on:

- Variety selection
- Opportunities for long coleoptile wheats

This year we have our early-sown variety trial and we will be expanding the work early next year to demonstrate the opportunities for early sowing under our conditions, including irrigation strategies.

Productivity Commission review

(On the effectiveness, efficiency and appropriateness of Part 3 of the Future Drought Fund Act.)

As we near the end of the first funding round for the Australian Government's Future Drought Fund (FDF); which makes $100 million available each year for drought resilience programs, arrangements and grants, we consider the interim findings of the Productivity Commission's (PC) review which will inform the next 4-year funding strategy (2024-2028).

Our Southern NSW Drought Hub's Farming Systems Group Alliance (FSGA) welcomed the opportunity to provide feedback and submitted a joint paper. Our submission highlighted some of the findings which were included in this first interim report, namely

- The constraints associated to short term projects of 1 year. Building resilience across the triple bottom line requires long-term, iterative participatory programs with stakeholders and these can't be tested, demonstrated and adopted on short-term funding.
- Knowledge sharing of learnings from the other FDF projects with the status, findings and methods for extension. The FSGA recommended that this data be available and easily accessible to encourage ongoing engagement.
- Broadening the scope of the FDF focus from 'Drought' to a broader climate impact.
- The PC found that overall the Hubs are a valuable regional presence for the FDF and funding for Hubs should be extended beyond the end of this Funding Plan.
- The Southern NSW Drought Resilience Innovation and Adoption Hub is planning for its potential continuation beyond the current funding period. In defining the scope and activities for a next stage there will be extensive consultation across southern NSW and we will be seeking input from as many stakeholders as possible.

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

SOUTHERN NSW Innovation Hub
SUSTAINABLE AGRICULTURE, LANDSCAPES AND COMMUNITIES

This project received funding from the Australian Government's Future Drought Fund

Irrigated Cropping Council

Long Term Irrigated Variety Trials

Irrigation Farmers Network (formerly Irrigated Cropping Council) have been doing independent irrigated variety trials since 2002. Harvest summaries are published for members at harvest and full results are published early in the new year to enable farmers to make key variety decisions. Below is a summary of the long-term averages of wheat, barley, canola and faba beans. If you are not a member you can join anytime online and visit the members area of our website for the latest variety results.

Wheat	2015	2016	2017	2018	2019	2020	2021	Average
RGT Zanzibar						134%	119%	127%
Sherriff CL+						118%	107%	113%
Rockstar					105%	123%	106%	111%
DS Pascal			103%	110%	110%	120%		111%
Sunblade CL+						114%	108%	111%
Illabo				118%	107%		102%	109%
Coota						111%	105%	108%
Beckom	96%	117%	100%	112%	101%	118%	97%	106%
Cobra	98%	109%	109%	84%	120%	118%		106%
Scout	100%	100%	100%	100%	100%	100%	100%	100%
Coolah				111%	96%		91%	99%
Scepter	92%	122%	106%	84%	85%	90%	105%	98%
Ballista						89%	105%	97%
Trojan	98%	125%	99%	108%	76%	83%	80%	96%
Hammer CL+						81%	90%	86%
Scout t/ha	8.7	8.2	10.6	7.1	7.8	7.7	9.1	8.5

Canola	2018	2019	2020	2021	Average
Site Average t/ha	2.93	3.85	4.27	3.90	3.74
Quartz	134%	125%	115%		124%
Nuseed Raptor			115%	116%	115%
InVigor R 4520P				112%	112%
InVigor R 4022P		113%	112%	109%	111%
Nuseed Condor TF			112%	108%	110%
Hyola Garrison XC				105%	105%
HyTTec Trifecta			107%	102%	104%
45Y95				102%	102%
45Y28			100%	103%	102%
HyTTec Trident	115%	85%	112%	93%	101%
HyTTec Trophy	102%	97%	90%	99%	97%
Hyola Equinox CL				95%	95%
44Y94				94%	94%
InVigor T 4510	102%	80%		97%	93%
SF Dynatron TT			90%	95%	93%
Hyola Blazer TT				92%	92%
Hyola Enforcer CT			90%	90%	90%
InVigor LT4530P			96%	83%	89%
InVigor T 6010			82%	93%	88%
SF Ignite TT				87%	87%

Growing season rainfall (mm)	121.6	154.6	251.9	160.4	
Irrigation Applied (ML) - Autumn	1.5	1.8	1.3	1.5	
Irrigation Applied (ML) - Spring	1.8	2.0	1.7	1.9	

Faba Beans	2014	2015	2016	2017	2018	2019	2020	2021	Ave
AF14092							117%	106%	111%
PBA Marne	99%	94%	89%	103%	98%	106%	108%	98%	103%
Samira	100%	100%	100%	100%	100%	100%	100%	100%	100%
PBA Bendoc				95%	97%	99%	107%	99%	99%
PBA Amberley		99%	107%	107%	98%	95%	105%	92%	99%
Fiesta	88%	93%	101%	93%				99%	95%
Farah	82%	96%	81%	93%	97%	105%	102%		94%
Zahra	103%	92%	87%	91%	89%	86%	105%		93%
Nura	94%	93%	76%		93%	101%	101%		93%
Samira t/ha	5.5	5.9	6.7	7.2	6.2	5.0	5.4	7.4	6.2

Growing Season Rainfall (mm)	232.2	170.8	340.3	220.2	121.6	154.6	251.9	160.4	
Irrigation Applied (ML) - Autumn	1.5	1.5	1.5	1.75	1.50	1.75	1.70	1.50	
Irrigation Applied (ML) - Spring	2.5	3.6	1.0	3.80	3.80	2.90	1.80	2.60	

Barley	2015	2016	2017	2018	2019	2020	2021	Average
Laperouse						120%	105%	113%
RGT Planet			126%	113%	69%	141%	110%	112%
Spartacus CL	104%	138%	110%	84%	95%	118%	108%	108%
Rosalind		129%	117%	76%	105%		107%	107%
LaTrobe	99%	132%	111%	84%	103%	109%	108%	107%
Oxford	107%	110%	121%	107%	53%	123%		104%
Maximus CL						107%	97%	102%
Commander	100%	100%	100%	100%	100%	100%	100%	100%
Westminster	98%	106%	112%	100%	48%	109%	100%	96%
Alestar					70%	109%	107%	95%
Commander t/ha	8.2	5.5	8.4	8.1	5.5	5.7	7.8	7.0

Growing Season Rainfall (mm)	170.8	340.3	220.2	121.6	154.6	251.9	160.4	
Irrigation applied (ML) Autumn	1.5	1.9	1.8	1.5	1.75	1.5	1.5	
Irrigation applied (ML) Spring	1.9	0	2.8	1.8	2	1.8	1.8	

Note: This is only one trial in one location/environment. It is advised to consult other trial results over multiple sites and seasons before making annual variety decisions. Please note that InVigor, Hyola, HyTTec, Monola are all "registered" trademarks and Xseed is trademarked.

Thank you to Pioneer Seeds, Pacific Seeds, BAS-F, Intergrain, AGT, NuSeed, University of Adelaide, Longreach Plant Breeders, Seed Force and Seednet for their contributions to our annual variety trials.

www.irrigationfn.com.au