Irrigated Cropping Council

# IRRIGATION INSIGHTS

## IRRIGATED AG CONFERENCE

2022

Murray DAIRY

Dairy Australia

Ricegrowers' Association of Australia INC

CottonInfo

This premier one day irrigated agriculture conference is designed to meet industry needs, provide growers with the new information and showcase the latest in on farm innovations.

ICC is proudly collaborating with rice, cotton and dairy industries with the purpose of building connections and synergies across irrigated agriculture.

Conference Partners

Irrigated Cropping Council Partners

# CONFERENCE PROGRAM

**9:00am Welcome** MC Neil Butler, Untypical
Irrigated Cropping Council Executive Officer, Charlie Aves

## 9:10AM NAVIGATING THE MODERN WATER ENVIRONMENT

**Proudly suported by Agrifutures Australia**

**Navigating volatile water markets and allocations**
Matthew Bryant, General Manager Water, Kilter Rural

Matthew will provide a snapshot on the water season ahead, gain insights to help make decisions about navigating volatile water markets and allocations to manage risk and effectively utilise water in farm systems.

**Systems thinking - building resilient farm systems**
Irrigation farms are complex systems that often include a range of enterprises, that add value and opportunities for diversifying income. Whether it be grain, fodder or forage. Challenge your thinking about how to manage this effectively to maximise returns from water. Growers Michael Hughes and Bruce Macague will share their learnings and how they have adapted to the changing water environment.

**10:30am Morning tea** – networking in the trade area

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## 11:10AM IMPROVING AND ADAPTING IRRIGATION SYSTEMS

Lou Gall, Project Officer, Gwydir Valley Irrigators Association
Alex Schultz, Research Development Officer, NSW DPI
Dr. Amjed Hussain, Research Scientist, Agriculture Victoria

Discover the results from 10 year's worth of data about irrigation systems, what works in what situation? How can producers optimise the system they have to maximise their productivity? What are some of the aspects to consider when making system investments?

**Economic feasibility of growers investing in improved irrigation systems**
Tristan Wardley, Consultant, RMCG

Find out the key lessons from this economic study economic analysis of farm investments in irrigation systems with a focus on risk, looking specifically at where it lies and what are the impacts of risk in an investment.

**Design and monitoring of spray systems to improve efficiency**
Nick O'Halloran, Senior Irrigation Officer, Agriculture Victoria

Find out more about this local work aimed at improving energy efficiency and application uniformity of irrigation systems.

**12:45pm Lunch** – networking in the trade area

## 1:30PM IMPROVING AND ADAPTING IRRIGATION SYSTEMS

**Hyper yielding crops**
Kenton Porker, Research Director, FAR Australia

The Hyper yielding crops project aims to push the economically attainable yield boundaries of wheat, barley and canola. Gain an insight into the key principles that can help farmers achieve higher yields.

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## 2:30PM MANAGING COMPLEXITIES OF USING WATER ON FARM

**Proudly supported by Plan2Farm**

Growers Lachie Danckert, Andrew Murphy and Evan Ryan will share their learnings and how they have adapted to the changing water environment. Learn how they are integrating enterprises, making decisions, managing their water portfolios, mitigating risk, improving efficiencies and future proofing their businesses.

**2:50pm Afternoon tea** - networking in the trade area

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## 3:20PM FUTURE OPPORTUNITIES AND CHALLENGES

**Proudly supported by GRDC**

**Carbon - Upsides, offsides, blindsides: considerations for an ag offsets market**
Katie McRobert, General Manager, Australian Farm Institute

What does this mean for the agricultural sector? How will the potential benefits of providing offsets be realised, if indeed there are benefits available? What possible pitfalls should the industry consider?

**Leading Conversations**
Brett Hosking, Chair, GrainGrowers

In an increasing array of future challenges, how can we proactively contribute to positive conversations about irrigated agricultural industries. In a landscape where community attitudes influence regulatory change and new government policies could lead to disruptive change for business, how can we ensure we are positioned to respond and participate in important discussions?

**5:15pm Launch**

Southern NSW Drought Resilience Adoption and Innovation Hub

**5:30pm Networking Drinks**

Irrigated Cropping Council
*Promoting irrigated agriculture*

# About
# Irrigated Cropping Council

The Irrigated Cropping Council (ICC) is a not for profit farming systems group, committed to improving the profitability and long-term viability of mixed farmers and croppers through practical research, development and extension that leads to best practice. The ICC is a membership organisation providing members with access to our variety trial results within days from harvest, regular research updates and discounted entry to ICC run events.

**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.

**Our Trial Site**

Our irrigated research site situated just outside of Kerang Victoria provides the perfect base to conduct local research providing relevant information to growers across the region. Research trials conducted at the site focus on all aspects of irrigated grain production including agronomy, irrigation scheduling, plant nutrition, crop diseases, weed and pest management and risk management.

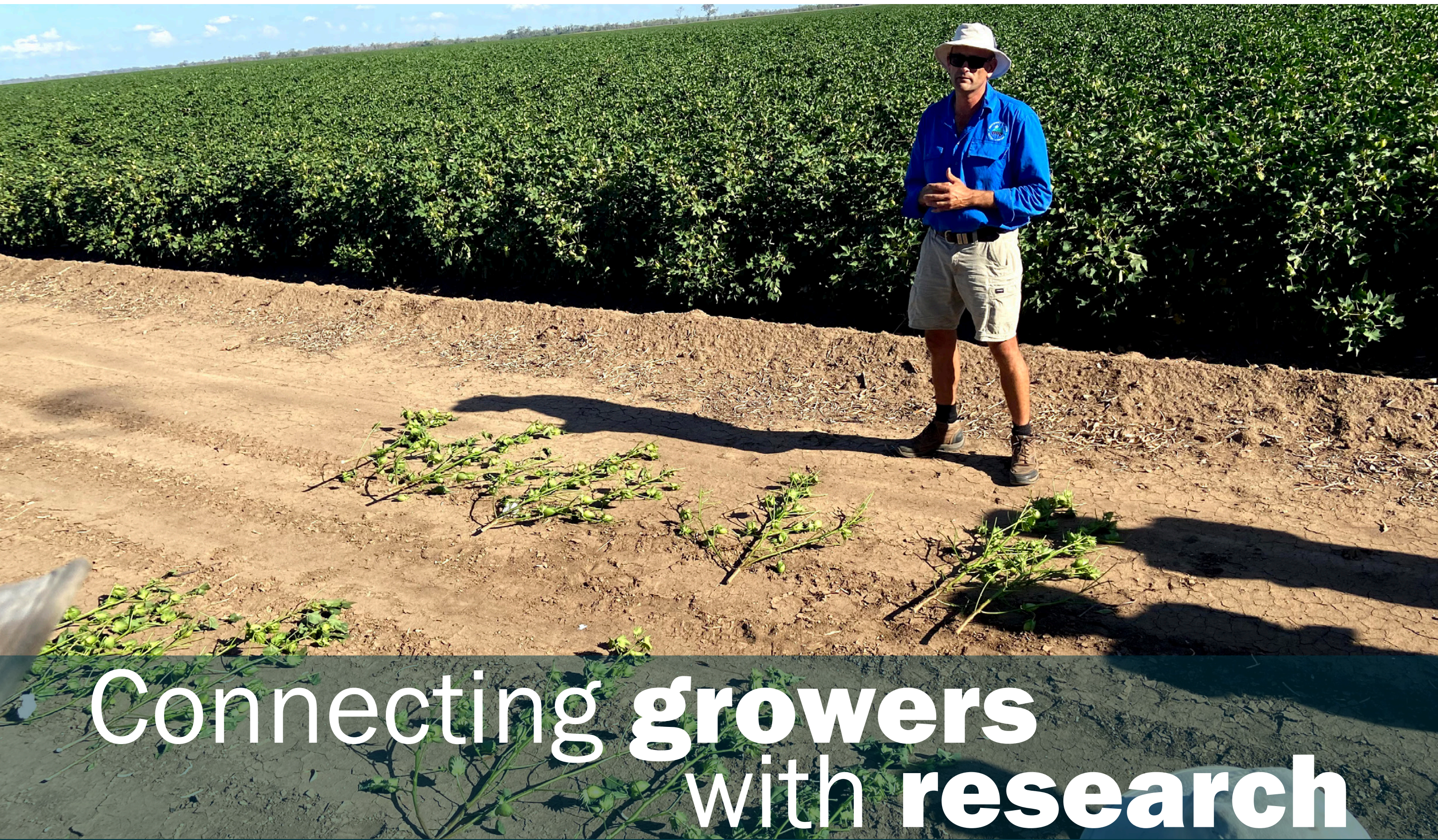
**Our Projects**

-Irrigated Variety Trials, some of the only fully irrigated wheat, canola, barley and faba bean variety trials nationally. Results of these are shared exclusively with ICC members with yield results coming out within days of harvest. Funded by ICC Memberships, Pioneer, Pacific Seeds, AGT, BASF, Nuseed, Seed Force, Seednet, Intergrain, University of Adelaide
-Optimising Irrigated Grains, small plot research investigating the agronomic levers to increase yields of maize, canola, durum, barley, faba beans and chickpeas. Delivered in collaboration with FAR Australia, funded by GRDC
-Irrigated Discussion Groups, meet 4 times a year to discuss topics of relevance to the members. The focus has been on farm visits to see how irrigators in our region are responding to the high opportunity cost of water and built in flexibility to their systems. Funded by GRDC
-Fodder for the Future, researching the balance between quantity and quality for winter cereal, winter pulse and summer fodder options. In collaboration with Marry Dairy this project is funded by Federal Government under the Murray–Darling Basin Economic Development Program.
-Increasing soil carbon to ameliorate compaction in irrigated soils - Goulburn Broken CMA and the Australian Government's National Landcare Program
-Plan2Farm – Irrigation Business Planning Program enabling farmers to develop their business plan with support from agribusiness consultants, funded by the Australian Government's Future Drought Fund.
-Southern NSW Drought Resilience Adoption and Innovation Hub, ICC are part of the knowledge broker network, giving you a say in the direction of projects delivered locally – Funded by the Australian Government's Future Drought Fund.
-Irrigated Ag Conference – a cross-industry event bringing together leaders from the grains, rice, cotton and dairy industries.
-Heat Stress in Canola, a pure research project screening large amounts of germ plasm to see how they are impacted by heat stress, delivered in partnership with UWA and funded by GRDC
-Smarter Irrigation for Profit - Phase 2 – Demonstrating different irrigation strategies aiming to get the best returns from water when prices are high, Funded by Rural Development Corporations (grains, rice, cotton, dairy and sugar), through funding from the Australian Government Department of Agriculture's Rural R&D for Profit program.

CottonInfo

CSD COTTON SEED DISTRIBUTORS

COTTON AUSTRALIA



# Connecting **growers** with **research**

**CottonInfo** is the industry's extension program.

We bring the industry the **latest research and development findings** to help boost productivity, profitability and best practice.

To learn more about what's happening with extension in the cotton industry, you can subscribe to our updates. Visit **cottoninfo.com.au/subscribe**

Visit our website to learn about what we do and meet the team of **extension officers, technical leads,** and **myBMP experts.**

We're supported by CRDC, Cotton Australia and CSD as part of a partnership that has been operating for 10 years.

Talk to us at the conference: **Kieran O'Keeffe (CottonInfo), Ella Arnold (CSD),** and **Harriet Brickhill (Cotton Australia)**.

*Best Practice*

# Farm Systems Panel Speakers

## Michael Hughes

**Farm location:**
40 Km's West of Deniliquin towards Moulamein. Right on the north weather edge of the Murray Irrigation service footprint.

**Farm size:**
1,800 Ha with a mix of owned and lease

**Enterprise(s):**
Irrigated summer and winter crop with a real focus on fodder production. Run a self replacing merino flock plus a small beef feedlot. Maize is base of summer production for silage with rice in the mix for good water seasons. Winter crops include grain and graze wheat and canola along with pastures and mixed species.
Cropping program is a barley lupin rotation.

**Irrigation system(s):**

All flood irrigation with a mix of boarder check and traditional rice layouts, based around soil types.

**Brief outline of farm system:**

Cut and carry fodder system with maize and whole crop barley the main two crops.

## Bruce Macague

**Farm location:**
Rochester

**Farm size:**
2000 ha

**Enterprise(s):**
Cropping, finishing lambs

**Irrigation system:**
Flood

**Brief outline of farm system:**

Farm system is about 95% cropping and 5% finishing lambs (no breeding stock). Mostly winter cropping (wheat, barley, canola) with a small area of summer crops (maize and lucerne).Irrigation footprint is only about 10% of the farm, but is an important part of the farm system.

Dual-purpose cropping fits well into the system by using the crop (canola, wheat) and high density legumes (Antas) in a pasture phase for lamb feed until it is time for market in June or July.  the farm is destocked by August to allow for hay and grain harvest.

## Andrew Murphy

**Farm location:**
Kyabram

**Farm size:**
345 ha

**Enterprise(s):**
Dairy

**Irrigation system(s):**
Flood and Sprinkler

**Brief outline of farm system:**

600 Milking cows
The combined property size is 345 hectares, located at Kyabram Victoria. Our main enterprise is Dairy, Milking 600 holstein cows on a Pasture Mixed Ration. We have 250 hectares of flood irrigation, 42 hectares under pivot and approximately 50 hectares of dry land crops.

We grow a mix of winter cereals for predominantly silage such as Wheat and Vetch, summer crops like corn, millet and annual pastures for grazing.

# Evan Ryan

**Farm location:**
Yarrawonga, Victoria

**Farm size:**
900ha total (600ha irrigated)

**Enterprise(s):**
Winter cropping
Wheat, Canola, Oat Hay, Lupins
Summer cropping
Adzuki Beans, Lucerne Hay, Corn

**Irrigation system(s):**
Centre Pivot/ Lateral Move 60%
High-flow flood 37%
Sub Surface drip 3%
All fed under pressure from a river pump station via underground HDPE pipelines

**Brief outline of farm system:**

Our farm system is kept flexible to adapt to issues and opportunities based on commodity prices, input prices, water markets, weed and disease issues. We plan on having a full area of winter crops on irrigation most years and then opportunistically growing summer crops when there is a reasonable chance of achieving a profitable outcome.

# Lachlan Danckert

**Farm location:**
Deniliquin and Hay

**Farm size:**
1200ha of irrigation

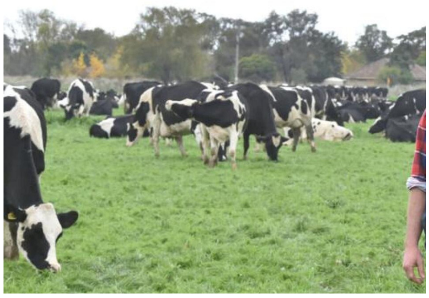
**Enterprise(s):**
Cotton, Wheat, Canola and Cattle

**Irrigation system (s):**
Bank less Channel, Pipe through the bank (Pontoon) and syphons

**Brief outline of farm system:**

Predominantly irrigated cotton through summer, and durum wheat and canola for winter. We also run a small number of Angus cattle and when the season and markets permit we run a small lamb feedlot.

We have integrated cotton into our system by developing a crop rotation plan which not only aims at utilising plant available water, but makes good agronomic sense for soil health as well.



#GRAINSTORMING

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# TOWARDS 2040

## CONTRIBUTE NOW TO HELP SHAPE THE 2023-28 RD&E PLAN

We want to understand what is challenging you, what excites you, the issues facing the grain industry and where you believe grains research and development should be focused to deliver greatest impact.

SCAN ME

### WHAT WILL WE SEE TOWARDS 2040...

**30.6m** people living in Australia[1]

**1.4 billion** extra mouths to feed globally[1]

**39%** global population growth in Asia[1]

Additional **13.7 million** tonnes of wheat demand across Indonesia, Philippines, Thailand and Vietnam[1] **by 2030**

Carbon intensity of ships to be cut by 40% by 2030[1]
(International Maritime Organisation)

More people will die prematurely from over-consumption than perish from starvation[13]

**India** will import between **6-11** million tonnes of pulses p.a.[1] **by 2030**

Electric vehicles to represent **32%** new passenger vehicle sales globally by 2030[2]

Additional **2.9** million tonnes stockfeed + **0.8** million tonnes grain for food required domestically[1]

### HOW TO CONTRIBUTE

Help shape the Plan by visiting:

rdeplan.grdc.com.au/consultation

You can also contact our staff directly or connect with us through:

rdeplanconsult@grdc.com.au

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https://www.facebook.com/theGRDC

1. Kingwell, R. (2021). Grains industry supply/demand drivers and trends: Considerations for Australian grains RD&E. Report to GRDC by the Australian Export Grains Innovation Centre (AEGIC)
2. Deloitte (2020). Deloitte Insights: Electric vehicles. Setting a course for 2030. Deloitte University EMEA CVBA, B-1831 Diegem, Berkenlaan 8b.

# SIP2 Optimising Irrigation Systems

Lou Gall, Project Officer, Gwydir Valley Irrigators Association

Alex Schultz, Research Development Officer, NSW DPI

Dr. Amjed Hussain, Research Scientist, Agriculture Victoria

## Key Messages

- No single system is suited to every situation. Selecting and optimising the system for your farm and water reliability is the most important priority.
- Enhanced irrigation performance can be achieved by.
- Design and drainage to minimise waterlogging and deep drainage,
- Irrigation scheduling to apply the right amount at the right time,
- Optimisation of system performance and
- Automation

### Background

GVIA in partnership with Sundown Pastoral Company has conducted system comparison field research since 2009-2010. The comparison included siphons, bankless channel, drip and lateral move. Throughout the trial, the site experienced climatic extremes including one of the longest periods of hot temperatures on record (2013-2014) and two seasons with significant flooding (2011-2012 and 2020-2021).

As the research progressed new tools and technologies were included. In 2017-2018 the traditional siphons were replaced by a small Pipe Through Bank (sPTB) fitted with an Islex 'Smart Siphon' elbow. While in 2020-2021 the trial was expanded to include a 500ha fully automated bankless field and the subsurface drip was replaced with the Netafim surface drip.

The introduction of the Smart Siphon provided the opportunity to automate or remotely control siphon irrigation. In 2017-2018, 150 siphons could be started at once, initially this was manually controlled. By the end of the season, the project tested remote control software. In 2020-2021 the EnviroNode IoT system was upgraded to enable complete remote control of siphons. It includes channel water level sensors providing real time information and weir controllers which enable remote control of channel weirs so head height can be maintained. Water advance sensors were tested to provide information for the Surface Irrigation Simulation Calibration and Optimisation (SISCO) system.

The transition from the sub surface to a surface drip utilised the existing pumping and filtering system at Keytah, but a temporary set up is available from Netafim. Remote scheduling was done based on ETo and GoannaAg soil moisture probes, aiming to keep soil moisture between 60-80% field capacity.

The large bankless channel field is controlled via the Padman Web management app, and includes 15 irrigation bays, fitted with 30 water level sensors fixed to auto winches. The water level sensors can be set to measure changes in water height in the supply drain to the mm to trigger transitions to the next bay. This field was able to be automated using the Smart Sensing technology to help streamline scheduling and irrigation efficiency.

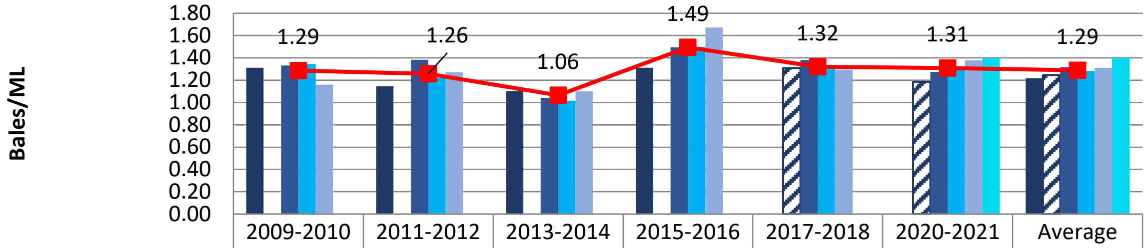
## What is the key finding from the research?

Yield and Gross Production Water Use Index (GPWUI) are influenced more by season than by system.

All systems can be optimised[1] to improve irrigation performance.

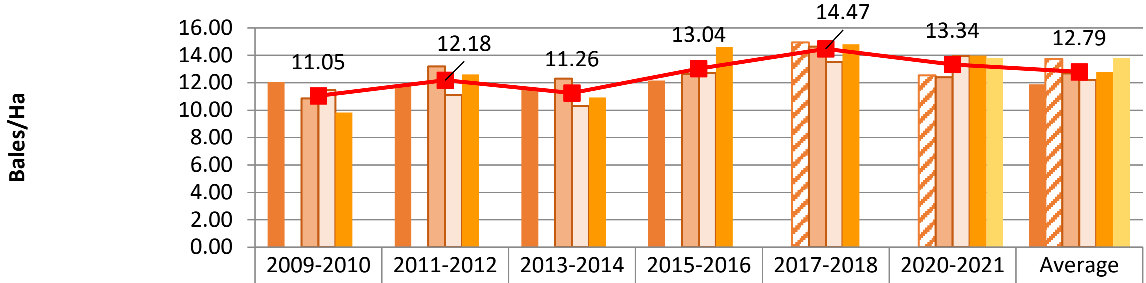
The trial has recorded yield and the Gross Product Water Use Index (GPWUI). The GPWUI enables comparison between fields and between years. It considers use soil moisture, effective rainfall, applied irrigation water and yield. The higher the GPWUI, the more efficient the field or system.

**Gross Production Water Use Index Comparison (effective)**




| | 2009-2010 | 2011-2012 | 2013-2014 | 2015-2016 | 2017-2018 | 2020-2021 | Average |
|---|---|---|---|---|---|---|---|
| Siphon | 1.31 | 1.15 | 1.10 | 1.31 | | | 1.22 |
| Smart Siphon | | | | | 1.31 | 1.18 | 1.25 |
| Lateral | 1.33 | 1.38 | 1.04 | 1.50 | 1.38 | 1.28 | 1.32 |
| Drip | 1.35 | 1.22 | 1.02 | 1.50 | 1.30 | 1.31 | 1.28 |
| Bankless | 1.16 | 1.27 | 1.10 | 1.67 | 1.29 | 1.38 | 1.31 |
| W567 Bankless | | | | | | 1.40 | 1.40 |
| Average | 1.29 | 1.26 | 1.06 | 1.49 | 1.32 | 1.31 | 1.29 |

**Yield Comparisons**




| | 2009-2010 | 2011-2012 | 2013-2014 | 2015-2016 | 2017-2018 | 2020-2021 | Average |
|---|---|---|---|---|---|---|---|
| Siphon | 12.06 | 11.80 | 11.46 | 12.17 | | | 11.87 |
| Smart Siphon | | | | | 14.94 | 12.55 | 13.74 |
| Lateral Move | 10.86 | 13.20 | 12.31 | 12.64 | 14.65 | 12.39 | 12.68 |
| Subsurface Drip | 11.45 | 11.11 | 10.32 | 12.72 | 13.51 | 13.95 | 12.18 |
| Bankless Channel | 9.82 | 12.60 | 10.93 | 14.62 | 14.80 | 13.98 | 12.79 |
| W567 bankless | | | | | | 13.82 | 13.82 |
| Average | 11.05 | 12.18 | 11.26 | 13.04 | 14.47 | 13.34 | 12.79 |

[1] Optimisation covers water application efficiency (keeping water in the root zone available to the crop), distribution uniformity (evenness of water application across the field) and requirement efficiency (meeting the soil moisture deficit), through water management practices (mostly flow rate and cut-off times, but scheduling, agronomy and whole farm water management will also affect WUE).

NB: Seasonal impact on systems: Bankless channel (poor establishment following late land preparation 2009-2010), Siphon (flooding in 2011-2012, poor establishment and disease 2020-2021), Lateral (disease 2020-2021) so results should be viewed with this understanding.

Both the yield and the GPWUI show that there is greater variation between seasons than there is between systems. This means irrigators should optimise the system they have before making significant investment in new systems.

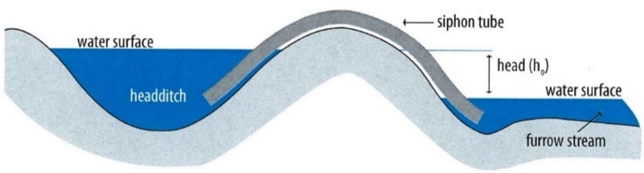
| *Data from 6 seasons (Large bankless not included)* | Yield (Bales/Ha) | GPWUI (Bales/ML) |
|---|---|---|
| *Variation between system* | 0.61 | 0.09 |
| *Variation between season* | 3.4 | 0.43 |

## How can this research help Irrigators?

Irrigators should evaluate their current system before changing to a new system. Often simple management changes are all that's required to optimise your irrigation system.

## Siphon irrigation and automation

Flow rates from traditional siphons are influenced by siphon placement, furrow entry conditions, and supply head height. Flow through siphons increases as head increases and decreases as head decreases. The use of siphon flow meters will help irrigators understand the impact placement can have on flow rates. More uniform application and better siphon placement can be a simple first step.




Source: J Purcell

Automation of siphons is possible where small Pipe Through Bank (sPTB) are installed either with smart siphons as at Keytah or with a double head ditch as at Waverley Ag near Wee Waa. With sPTB all siphons are positioned at a uniform level through the bank. Flow rates are then evenly influenced by channel head height which can be easily monitored with channel level sensors.

Siphon irrigation can be further optimised by a greater understanding of soil infiltration characteristics using models such as SISCO. These models use information on flow rates, furrow cross sectional profiles and water advance rates to examine irrigation performance in terms of application efficiency (keeping water in the root zone available to the crop), distribution uniformity (evenness of water application across the field) and requirement efficiency (meeting the soil moisture deficit). Flow rates and cut-off time need to suit the soils infiltration characteristic. SISCO will provide the optimum flow rate and irrigation time for your soil. A greater understanding of infiltration characteristics makes it possible to confidently stop each irrigation event without physically checking fields. SISCO can be applied to both manual siphons and sPTB siphon setups.

## Bankless Automation

Bankless channel designs also readily lead themselves to automation. The new bankless development at Keytah was fitted with water content and water potential sensors (tensiometers) to monitor soil moisture. Soil moisture tension has been identified as a key measurement which can be used for autonomous irrigation due to its 'absolute' measurement. This allows it to be used across multiple soil types without site specific calibration issues. This is important when using soil data for autonomous irrigation. To control irrigation during actual irrigation events (as opposed to scheduling timing of irrigation events), both pressure transducer and ultrasonic water height sensors are used to monitor water levels and triggering gate drops between irrigation bays. The IRRISENS cloud-based app can control watering events automatically using this data.

Automation of irrigation improves water use efficiency from better scheduling of irrigations. Information from weather stations, satellites, soil moisture probes and water advance sensors can be fed directly into various platforms to enable optimal starting times, and importantly finishing times.

## Why is this important research?

Each and every farm will have their own set of factors such as water reliability, labour resourcing, topography and soil type which will impact irrigation performance. For many irrigators improving what they have may be the most cost effective option to deliver enhanced irrigation performance.

This research provides more practical commercially relevant information for irrigators who are looking to improve the way they irrigate.

## Further information

The full Keytah Automation report is available on the GVIA and Smarter Irrigation websites.

Soil moisture deficits & plant available soil water (smarterirrigation.com.au)

Scaling irrigation management for whole farm operations with Agriculture Victoria (smarterirrigation.com.au)

Simple Approach to Managing Water on Farm (smarterirrigation.com.au)

Double Cropping in a Rice System (smarterirrigation.com.au)

Economic costs and benefits of winter cropping irrigation scenarios in Northern Victoria (smarterirrigation.com.au)

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.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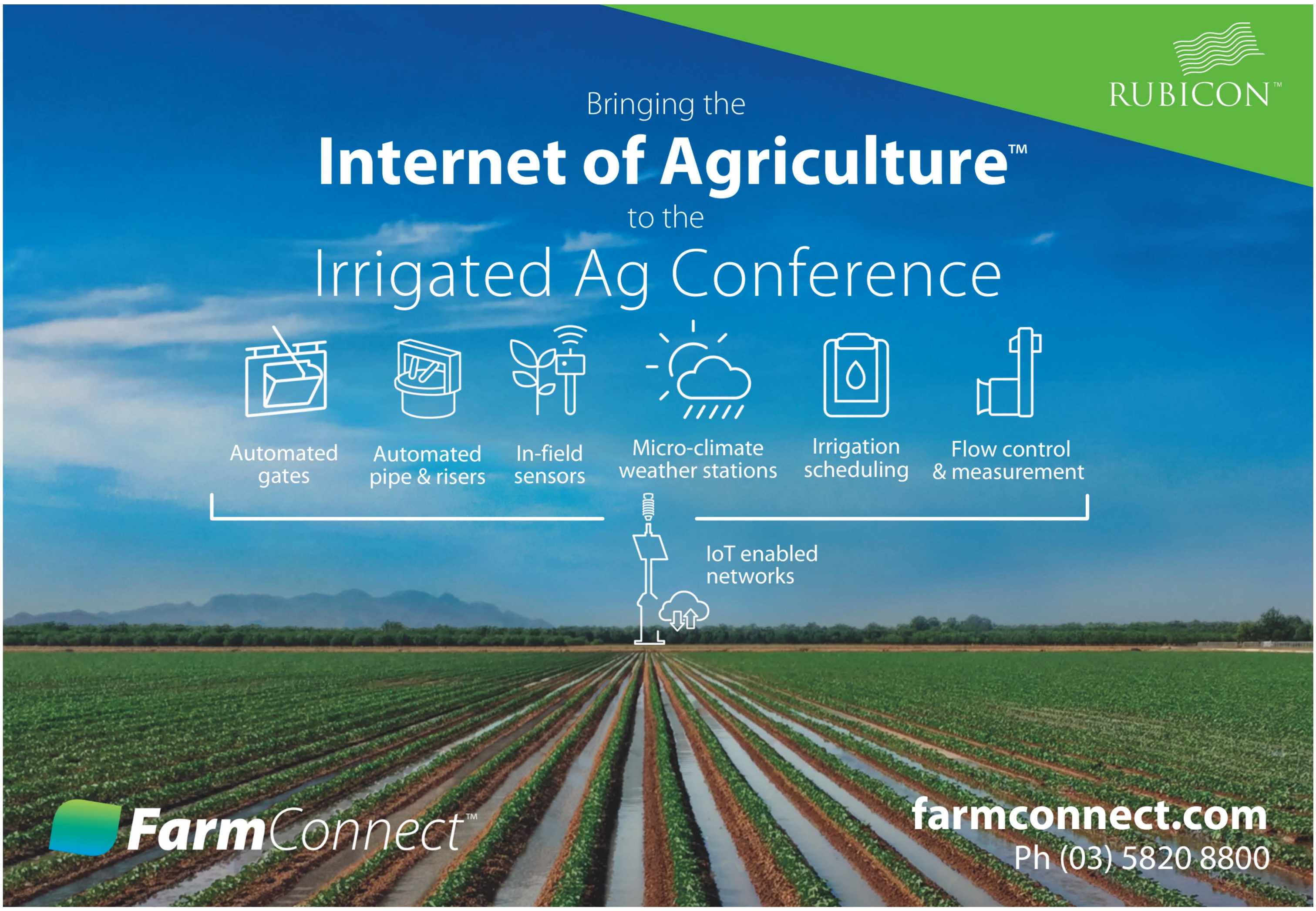
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# Design and monitoring of centre pivot and lateral move systems to improve efficiency

Nick O'Halloran, Senior Irrigation Officer, Agriculture Victoria

Good design and ongoing monitoring of centre pivot and lateral move irrigation systems is essential to achieving their potential.

## Key Messages

- Centre pivot and lateral move irrigation system design, maintenance and operation are key to good application uniformity, minimising cost of operation and maximising crop production.
- Ongoing monitoring of pressure at the end of the system is the easiest check of performance and application uniformity.
- Agriculture Victoria system assessments have found low application depth and poor application uniformity to be common problems that make accurate irrigation scheduling difficult.
- Agriculture Victoria is offering free system assessments of application uniformity, energy efficiency and system design of irrigation systems in Northern Victoria.
- Centre Pivot and Lateral Move (CPLM) irrigation systems have rapidly increased in popularity in northern Victoria and southern NSW. The main reasons for the adoption of these systems are potential water savings, higher productivity and reduced labour requirements. However, system assessments completed by Agriculture Victoria have revealed that many of these systems are not achieving their production potential.
- Maintenance, monitoring and accurate irrigation scheduling is much more important with CPLM systems compared to traditional flood irrigation because these systems apply a precise amount of water. If the amount of water being applied is lower than plant needs, the paddock can progressively get drier without the farmer realising, resulting in greatly reduced productivity and water use efficiency.
- Knowing exactly how much water is being applied by the system is critical to good irrigation scheduling and maximising water productivity. Agriculture Victoria has undertaken over 40 system assessments across northern Victoria. These assessments have found that on average these irrigation systems are applying 20% less water than indicated on the system control panel. Over an entire season on average a farmer aiming to apply 8 ML/ha would actually only apply 6.4 ML/ha.

Agriculture Victoria's system assessments have also found that application uniformity is generally poor, ranging from 75% to 92%. A uniformity as low as 75% means that some areas of the paddock are receiving twice as much water as other areas. This makes irrigation scheduling extremely difficult because some areas of the paddock can be too wet at the same time as other areas are water stressed, both resulting in lost productivity and poor water use efficiency.

Common causes of low application depth and poor application uniformity include:

- Low system pressure caused by pump or pipe deterioration
- Low system pressure caused by undersized pumps or pumps operating at the wrong speed
- Control panels not calibrated correctly
- Variable travel speeds
- Perished regulators
- Blocked filters or nozzles or incorrect nozzles

Often the cause of these problems is lack of system maintenance and monitoring. You cannot tell if a system is evenly applying the right amount of water just by looking at it, measurements need to be taken.

### System assessment example 1.

The farmer had invested significantly in subsurface drainage and was investigating costly soil remediation. An Agriculture Victoria system assessment revealed that poor uniformity meant some areas of the paddock were receiving over 70mm of water, while other areas were receiving less than 40 mm per irrigation. Perished pressure regulators were identified as the problem and simply replacing the regulators fixed the problem, improving uniformity and making irrigation scheduling much easier. With new pressure regulators the system could also be run at much lower pressure at the pump, saving over $3000 per year in electricity costs.

### System assessment example 2.

The farmer was investigating soil solutions to poor water infiltration, however an Agriculture Victoria system assessment revealed that poor uniformity was actually the problem. The farmer was running the system at a very low pressure to save energy costs, but this meant most of the irrigated area was not receiving enough water. In this case simply increasing pump speed fixed the problem.

### System monitoring

Monitoring pressure is the easiest check of system performance and application uniformity. Low pressure at the outer end of the system is a good indication of a system fault or problem with the way the system is being operated. All systems should be fitted with a pressure gauge above the pressure regulator on a sprinkler close to the outer end of the system.

Pressure should be periodically checked when the system is in the highest point in the paddock and with the end-gun operating (if fitted). The pressure should be at least 35 kPa (5 psi) higher than the pressure regulator rating. If it is less, the application uniformity will be affected, particularly on high ground or when the end-gun is operating. However, the pressure should not be greater than required or pumping costs will be higher than necessary.

### System assessment

When your CPLM is first installed, system commissioning should include a system assessment to ensure your system performs as expected. You want to know:

- Does the system apply the designed volume of water?
- Is the application uniformity satisfactory?
- Are the rate of travel and the application depth correct?
- Is the operating pressure at the pump and the sprinklers as designed?
- Is the energy use / running cost as predicted?

If a system assessment was not undertaken at commissioning, get one done as soon as possible. While the checks are generally not complicated, you may prefer to use an independent consultant if you are not familiar with the technology. If you are in Northern Victoria and are interested in participating in the assessment program or would like to discuss the proposed design of your planned irrigation system, contact Agriculture Victoria Irrigation Services Nick O'Halloran on 03 5833 5222.

For more information on how to assess the performance of your irrigation system visit:

https://extensionaus.com.au/irrigatingag/centre-pivot-and-lateral-move-performance-check/

# Hyper Yielding Crops

Dr Kenton Porker, FAR Australia

**What is this project aiming to achieve and how did it originate?**

Hyper Yielding Crops (HYC) builds on the success of the GRDC's four-year Hyper Yielding Cereals Project in Tasmania which attracted a great deal of interest from mainland HRZ regions. The project demonstrated that increases in productivity could be achieved through sowing the right cultivars, at the right time and with effective implementation of appropriately tailored management strategies. The popularity of this project highlighted the need to advance a similar initiative nationally which would strive to push crop yield boundaries in high yield potential grain growing environments.

With input from national and international cereal breeders, growers, advisers and the wider industry, this project is working towards setting record yield targets as aspirational goals for growers of wheat, barley and canola.

In addition to the research centres, the project also includes a series of focus farms and innovative grower networks, which are geared to road-test the findings of experimental plot trials in paddock-scale trials. This is where in the extension phase of the project we are hoping to get you, the grower and adviser involved.

HYC project officers in each state are working with innovative grower networks to set up paddock strip trials on growers' properties with assistance from the national extension lead Jon Midwood.

Another component of the research project is the HYC awards program.

The awards aim to benchmark the yield performance of growers' wheat paddocks and, ultimately, identify the agronomic management practices that help achieve high yields in variable on-farm conditions across the country. This season, HYC project officers are seeking nominations for 50 wheat paddocks nationwide (about 10 paddocks per state) as part of the awards program.

## Key Messages

- Increased yield potential of feed winter wheats and barley is expressed in better seasons from earlier sowing. RGT Accroc, RGT Cesario and Annapurna achieved yields of ~ 11 t/ha, 3t/ha higher yielding than the best milling wheat in NSW. Winter barley exceeded 10 t/ha (10.4) dryland in SA for the first time while Planet achieved 8.0 t/ha
- To maximise returns in milling wheats in better seasons, sound disease management is essential. Beckom and Scepter with either two or four units of fungicide produced the highest economic returns due to higher price per tonne compared to feed wheats ($356/t AH grade v $236/t for SFW1).
- The winter feed wheats are more disease resistant than milling wheats and gave their most profitable returns with a single flag leaf fungicide. Genetic resistance was insufficient alone to maximise returns without fungicide application
- Fertile soils in the high rainfall zone (HRZ) limit the ability to manage yield and early biomass production with applied nitrogen in wetter environments. Mineralised N timing, and other canopy management factors such as plant growth regulators (PGR) and fungicide are equally or more important
- Principles of canopy management also apply to irrigated scenarios, however the nitrogen rates required to achieve irrigated canola yields of greater than 4 t/ha are not as high as dryland budgets would suggest. Minimum durum protein requirements of 13% to achieve DR1 can be met with attention to nitrogen management in irrigated scenarios
- Canopy management benefits of PGR and fungicides extend beyond the growing season and limit pre harvest yield losses (lodging, brackling, head-loss) and improve harvest logistics
- Waterlogging tolerance of barley compared to wheat is poor in wetter seasons, however earlier sowing and slow developing cultivars increases the chances of improved yield recovery.

For more details on this project visit www.farAustralia.com.au

Australian Government
Department of Agriculture, Water and the Environment

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# Fodder for the Future

## A collaboration between forage growers and dairy farmers

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Irrigated Cropping Council
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# Fodder for the Future

ICC Irrigated Cereals Trial - Dr Charlie Aves and Damian Jones, Irrigated cropping Council

## Summary

Two long season cereal varieties (an oat and a wheat) were sown at 4 sowing rates at two Time of Sowings to assess fodder production and feed quality.

### Some observations

- Sowing rates had little impact on fodder production.
- While higher sowing rates resulted in higher stems/m$^2$ and lower stem diameter, this failed to equate to improved feed quality.
- Oats produced higher fodder yields than wheat, but it also had higher rates of lodging due to the very tall nature of the plants.
- While appearances suggested that the oat quality would be lower than that of the wheat (higher stem diameter and taller plants), the feed quality results did not show much difference.
- Time of Sowing influence on cutting dates in RGT Cesario wheat were negated by the strong vernalisation response and so both sowing dates were cut at the same time.
- Vernalisation response in Forrester oats was not as strong and a 3-week later sowing date delayed the harvest by 11-15 days.

## Objectives

To evaluate the dry matter production of irrigated oats and wheat for fodder production:

1. Optimal sowing rate
2. Optimal sowing date
3. Assess the fodder production at two cutting dates
4. The influence of crop type and time of cutting on feed quality.

## Methodology

The following varieties, target populations and sowing dates were selected for the trial.

**Table 1:** Cereal varieties sown

| Crop | Variety |
|---|---|
| Wheat | RGT Cesario |
| Oats | Forrester |

**Table 2:** Crop target populations and time of sowing

| Crop | Target populations | Time of sowing |
|---|---|---|
| Wheat | 80, 120, 180 and 270 plants/m$^2$ | 31 March, 21 April |
| Oats | 80, 120, 180 and 270 plants/m2 | 31 March, 21 April |

The trial design was blocked by time of sowing, with the early and late sown plots grouped together within the same irrigation bay. Within each sowing block, the crop type and sowing rate treatments were randomised using a randomised complete block design generated by 'Digger' trial design software, with 4 replicates. Plot size was 12m by 1.8m.

The trial was established on a surface irrigated border check layout.

It was the intention to pre-irrigate prior to sowing and then sow into receding moisture. However, 80 mm of rainfall was recorded in late March, and so the decision was made to take this opportunity to sow the first Time of Sowing (ToS) on 31 March. Soil moisture declined quite quickly and so the decision was made to irrigate on 10 April as the plants began to emerge. This also served as a pre-irrigation for the second ToS, which occurred on 21 April.

All plots received 125 kg DAP/ha (25 kg P/ha and 22.5 kg N/ha) at sowing.

Sowing rates calculations were based on the target population, seed size and an assumed establishment rate of 70%.

Nitrogen was top-dressed at tillering (90 kg N/ha) and again at early stem elongation (90 kg N/ha). This, along with the sowing N, soil N and estimated mineralisation, supplied the trial with 240 kg N/ha.

The first spring irrigation was on 28 August (1.0 Ml/ha) and again on 29 September (0.9 Ml/ha).

**Table 3:** Forage cutting dates

| Cereal | | GS49 | GS71 |
|---|---|---|---|
| Oats | ToS1 | 9 September | 11 October |
| | ToS2 | 24 September | 22 October |
| Wheat | ToS1 | 27 September | 26 October |
| | ToS2 | 27 September | 26 October |

When taking the dry matter cuts, all oat samples were assessed using a cutting height of 150mm above the soil surface. Wheat GS49 assessments were cut at 75mm (due to the very short stature of the crop at the time) and the GS71 assessments at 150mm.

Two samples consisting of 3 rows by 1m were cut, weighed and a subsample of approximately 400g was selected and shredded. This was then dried at 60 degrees C to determine dry matter percentage.

Samples were taken from each plot for feed quality assessment. The number of stems in a subsample of known weight were counted and the diameter of approximately 90 tillers measured.

Statistical analysis of the data was conducted using 2-way ANOVA, with ToS and plant population as the factors. The wheat and oats were analysed separately.

## Results

**Table 4**: Plant Establishment

| | ToS1 | | ToS2 | |
|---|---|---|---|---|
| Target Population | Oats | Wheat | Oats | Wheat |
| 80 plants/m$^2$ | 89.8 | 76.5 | 83.2 | 85.5 |
| 120 plants/m$^2$ | 132.5 | 128.5 | 126.0 | 123.8 |
| 180 plants/m$^2$ | 212.2 | 207.0 | 190.5 | 180.0 |
| 270 plants/m$^2$ | 256.5 | 238.3 | 256.0 | 256.0 |

The mean establishment rate for the trial was 72%.

**Table 5a**: Oat Stem number (stems/m$^2$)

| Target Population | ToS1 | ToS2 | Mean |
|---|---|---|---|
| | Stems/m$^2$ | Stems/m$^2$ | Stems/m$^2$ |
| 80 plants/m$^2$ | 279 | 269 | 274 a |
| 120 plants/m$^2$ | 335 | 327 | 331 b |
| 180 plants/m$^2$ | 361 | 362 | 362 c |
| 270 plants/m$^2$ | 365 | 367 | 366 c |
| Mean | 335 - | 331 - | |
| | | | |
| LSD ToS p = 0.05 | ns | P val | 0.793 |
| LSD Population p=0.05 | 20.29 | P val | <0.001 |
| LSD ToSxPop'n. P=0.05 | 29.0 | P val | 0.987 |

Table 5b: Wheat Stem number (stems/m$^2$)

| Target Population | ToS1 | ToS2 | Mean |
|---|---|---|---|
| | Stems/m$^2$ | Stems/m$^2$ | Stems/m$^2$ |
| 80 plants/m$^2$ | 592 | 800 | **696 c** |
| 120 plants/m$^2$ | 676 | 794 | **735 bc** |
| 180 plants/m$^2$ | 736 | 867 | **802 ab** |
| 270 plants/m$^2$ | 692 | 990 | **841 a** |
| Mean | **674 b** | **863 a** | |
| | | | |
| LSD ToS p = 0.05 | 69 | P val | <0.001 |
| LSD Population p=0.05 | 97.6 | P val | 0.024 |
| LSD ToSxPop'n. P=0.05 | 138 | P val | 0.225 |

Stem counts were higher in wheat than the oats. The trend was also for higher stem counts as plant population increased.

ToS had little influence on oat stem counts, but a significant influence in wheat. Anecdotally, when plots were sampled for dry matter assessments, the first ToS samples in the wheat had much more dead material present at the bases of the plants suggesting higher tiller death.

Table 6a: Oat Stem Diameter (mm)

| Target Population | ToS1 | ToS2 | Mean |
|---|---|---|---|
| | mm | mm | mm |
| 80 plants/m$^2$ | 5.15 - | 5.93 - | **5.54 a** |
| 120 plants/m$^2$ | 5.15 - | 5.45 - | **5.30 a** |
| 180 plants/m$^2$ | 4.75 - | 5.25 - | **5.00 b** |
| 270 plants/m$^2$ | 4.60 - | 4.88 - | **4.74 c** |
| Mean | **4.91 a** | **5.38 b** | |
| | | | |
| LSD ToS p = 0.05 | 0.177 | P val | <0.001 |
| LSD Population p=0.05 | 0.251 | P val | <0.001 |
| LSD ToSxPop'n. P=0.05 | 0.354 | P val | 0.170 |

Table 6b: Wheat Stem Diameter (mm)

| Target Population | ToS1 | | ToS2 | | Mean | |
|---|---|---|---|---|---|---|
| | mm | | mm | | mm | |
| 80 plants/$m^2$ | 3.62 | - | 3.62 | - | **3.62** | a |
| 120 plants/$m^2$ | 3.52 | | 3.44 | | **3.48** | b |
| 180 plants/$m^2$ | 3.51 | | 3.45 | | **3.48** | b |
| 270 plants/$m^2$ | 3.35 | | 3.09 | | **3.22** | c |
| Mean | **3.50** | b | **3.40** | a | | |
| | | | | | | |
| LSD ToS p = 0.05 | 0.074 | | P val | | 0.01 | |
| LSD Population p=0.05 | 0.105 | | P val | | <0.001 | |
| LSD ToSxPop'n. P=0.05 | 0.148 | | P val | | 0.098 | |

The trend was for decreasing stem diameter as plant population increased. This trend occurred in both wheat and oats and at both times of sowing.

Wheat had thinner stems than oats, averaging 3.45mm compared to 5.15mm.

Table 7a: Oat Dry matter (t/ha) at GS 49 and GS71

| | Dry Matter (t/ha) GS49 (booting) and GS71 (watery ripe) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Target Population | GS49 | | | | | | GS71 | | | | |
| | ToS1 | | *ToS2* | | *Mean* | | *ToS1* | | *ToS2* | | *Mean* |
| 80 plants/$m^2$ | 9.34 | - | 10.30 | - | ***9.82-*** | | 16.99 | | 20.94 | - | ***18.97*** - |
| 120 plants/$m^2$ | 8.64 | - | 10.89 | - | ***9.77-*** | | 16.03 | | 18.03 | - | ***17.03*** - |
| 180 plants/$m^2$ | 8.74 | - | 11.23 | - | **9.98-** | | 15.64 | | 18.66 | - | **17.15** - |
| 270 plants/$m^2$ | 8.57 | - | 11.33 | - | **9.95-** | | 15.10 | | 17.94 | - | **16.52** - |
| Mean | **8.82** | b | **10.94** | a | | | **15.94** | b | **18.89** | a | |
| LSD ToS GS49 p = 0.05 | 0.597 | | | | P val | | <0.001 | | | | |
| LSD Pop'n GS49 p=0.05 | ns | | | | P val | | 0.942 | | | | |
| LSD N TxP GS49 p=0.05 | 1.194 | | | | P val | | 0.154 | | | | |
| LSD ToS GS71 p = 0.05 | 1.770 | | | | P val | | 0.002 | | | | |
| LSD Pop'n GS71 p=0.05 | Ns | | | | P val | | 0.224 | | | | |
| LSD N TxP GS71 p=0.05 | 3.541 | | | | P val | | 0.882 | | | | |

Plant population made no difference to yield of oats at either ToS.

There appears to be no dry matter/fodder advantage for earlier sowing. In fact, there were higher yields from the second ToS at both the early (1.9 t DM/ha) and late (3.0 t DM/ha) harvests.

Another aspect to note is the approximate doubling of dry matter produced between the GS49 and GS71 stages.

Table 7b: Wheat Dry matter (t/ha) at GS 49 and GS71

| | Dry Matter (t/ha) GS49 (booting) and GS71 (watery ripe) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Target Population | GS49 | | | | | | GS71 | | | | |
| | ToS1 | | *ToS2* | | *Mean* | | *ToS1* | | *ToS2* | *Mean* | |
| 80 plants/m² | 8.32 | - | 8.56 | - | *8.44* | - | 14.35 | | 15.23 | *14.79* | - |
| 120 plants/m² | 8.77 | - | 8.63 | - | *8.70* | - | 12.94 | | 14.35 | *13.64* | - |
| 180 plants/m² | 8.37 | - | 8.19 | - | 8.28 | - | 15.90 | | 15.55 | 15.73 | - |
| 270 plants/m² | 8.75 | - | 7.64 | - | 8.20 | - | 13.36 | | 14.88 | 14.12 | - |
| Mean | 8.55 | - | 8.23 | - a | | | 14.14 | - | 15.00 - | | |

| | | | |
|---|---|---|---|
| LSD ToS GS49 p = 0.05 | ns | P val | 0.143 |
| LSD Pop'n GS49 p=0.05 | ns | P val | 0.256 |
| LSD N TxP GS49 p=0.05 | 4.783 | P val | 0.227 |
| | | | |
| LSD ToS GS71 p = 0.05 | ns | P val | 0.113 |
| LSD Pop'n GS71 p=0.05 | ns | P val | 0.056 |
| LSD N TxP GS71 p=0.05 | 2.185 | P val | 0.584 |

Similar to the oats, plant population did not have any influence on the yield at either cutting stage. In contrast to the oats, the ToS did not influence the yield of wheat at either cutting stage.

Another similarity with the oats was the doubling of the yield of wheat between GS49 and GS71.

Overall, oats had higher yields than wheat at both the early (1.49 t DM/ha) and late (2.85 t DM/ha) harvests. Average plant height at GS72 was 150cm for oats compared to 87cm for the wheat. This translated to lodging in the oats and none in the wheat.

Part 2: Feed quality

Table 1: Effect of time of sowing and growth stage on the ME, CP, NDF and ADF contents of wheat and oats.

| Cereal | Cut Stage | Sowing | ME | CP | ADF | NDF |
|---|---|---|---|---|---|---|
| Oats | GS49 | ToS1 | 9.2 | 12.6 | 35.9 | 61.1 |
| Oats | GS49 | ToS2 | 8.8 | 12.8 | 39.2 | 63.6 |
| Oats | GS71 | ToS1 | 8.9 | 9.1 | 38.6 | 62.4 |
| Oats | GS71 | ToS2 | 8.9 | 10.4 | 39.9 | 64.4 |
| Wheat | GS49 | ToS1 | 9.6 | 14.4 | 33.4 | 58.8 |
| Wheat | GS49 | ToS2 | 9.4 | 17.3 | 33.9 | 60.9 |
| Wheat | GS71 | ToS1 | 9.6 | 10 | 34.1 | 57.4 |
| Wheat | GS71 | ToS2 | 9.6 | 11.4 | 35.1 | 59.6 |

Overall, wheat had a slight quality advantage over the oats. Trial average ME for wheat was 9.6 MJ/kg compared to 8.9 MJ/kg for oats. Crude protein was generally higher in wheat than in oats (15.9 Vs 12.7 %DM at GS49 and 10.7 Vs 9.7 %DM at GS72) while the ADF (38.4 Vs 34.1) and NDF (62.9 Vs 59.2) were lower when averaged across all treatments.

The ME, ADF and NDF contents remained reasonably consistent between GS49 and GS71 in both cereals. The CP content declined between GS49 and GS71 in both oats (12.7 Vs 9.7 %DM) and wheat (15.9 vs 10.7 %DM).

Plant population had no influence ($p<0.05$) on any of the feed quality variables that were analysed.

The second ToS did see an increase in CP in wheat when compared to ToS1 but this may be due to differing nitrate levels related to the time of N application.

## Conclusions

- Plant populations had little influence on yield or feed quality.
- The fodder yields in wheat were not affected by the sowing date but in oats sowing in late March compared to 21 April resulted in higher yields at both the early and late harvests.
- Oats had higher yields than wheat at both the early and late harvests but at a small quality penalty.
- Wheat would have been an easier crop to harvest due to no lodging and smaller stature.


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Optimising Irrigated Grains

# GRDC Optimising Irrigated Grains (OIG) Project

## Key Learnings – 2020 & 2021

The following key learnings have been derived from growing crops at two irrigated research centres at Finley, NSW on a red duplex soil under surface and overhead irrigation and Kerang, VIC on a grey clay with surface and sprinkler irrigation. The research was conducted in the 2020 and 2021 seasons.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Irrigated Cropping Council
*Promoting irrigated agriculture*

## Barley under irrigation

*i) Germplasm, Crop structure and Plant population*

### Key Points

- Irrigated barley has benefited from PGR application with greater yield benefits associated with crops that are irrigated earlier in the grain fill period.
- The spring barley RGT Planet (8.13t/ha) has been significantly higher yielding than Cassiopee winter barley (7.83t/ha) when averaged over 2 years (2020 & 2021) and 4 treatments in a plant growth regulator trial at the Finley Irrigated Research Centre (IRC).
- Applying a plant growth regulator (PGR), either as a split application (GS31 & GS33) or as a single application (GS31) resulted in a significantly higher yield (8.40t/ha) compared to the untreated plots (7.79t/ha), averaged over both varieties over two years.
- The winter barley Cassiopee experienced significantly more lodging than RGT Planet and was less suitable for irrigated systems. PGR application did reduce lodging, although in Planet differences in lodging were relatively small.
- PGR application and grazing both had a similar reduction (average 7cm) in crop height compared to the untreated plots when measured over both varieties and both years.
- Defoliation of RGT Planet at GS30-31 to simulate grazing generated 722kg DM/ha RGT and 1937 kg DM/ha in Cassiopee.
- Valued at 25 cents per kg/dry matter the dry matter was valued at $180/ha and $484/ha respectively which in both cases compensated for the loss of grain yield with defoliation.
- Grazing a late April sown Planet required a minimum 4 cents/kg return on dry matter (DM) to offset the grain loss associated with 722kg DM/ha removal at GS30, whilst with Cassiopee it was 8 cents/kg DM when 1937kg DM/ha was removed at GS30. To grow Cassiopee in place of Planet in order to take advantage of the extra forage required 19 cents/kg DM to counter the loss of $359/ha in grain.

Irrigated barley at the Finley IRC has consistently shown yield benefits to the application of Plant Growth Regulators (PGRs) in the OIG project, even though responses have not always been statistically significant (Figure 1).

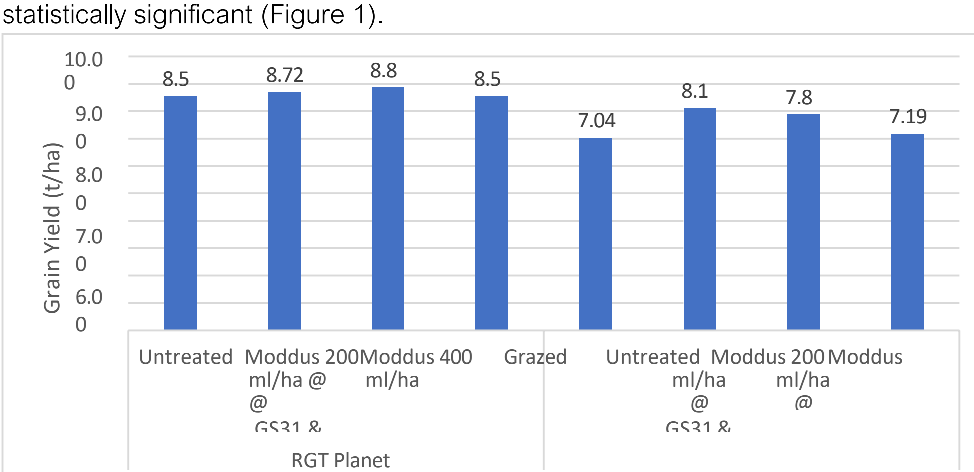

**Figure 1.** Influence of plant growth regulator on seed yield (t/ha) using RGT Planet spring barley and Cassiopee winter barley in 2 irrigated trials conducted at Finley – 2020 and 2021.

These PGRs, either single applications or splits of Moddus Evo (trinexapac ethyl) have been observed to reduce or delay the onset of crop lodging during grain fill. It is this reduction and delay and lodging that is thought to be related to the yield increases that have been observed (Figure 2).

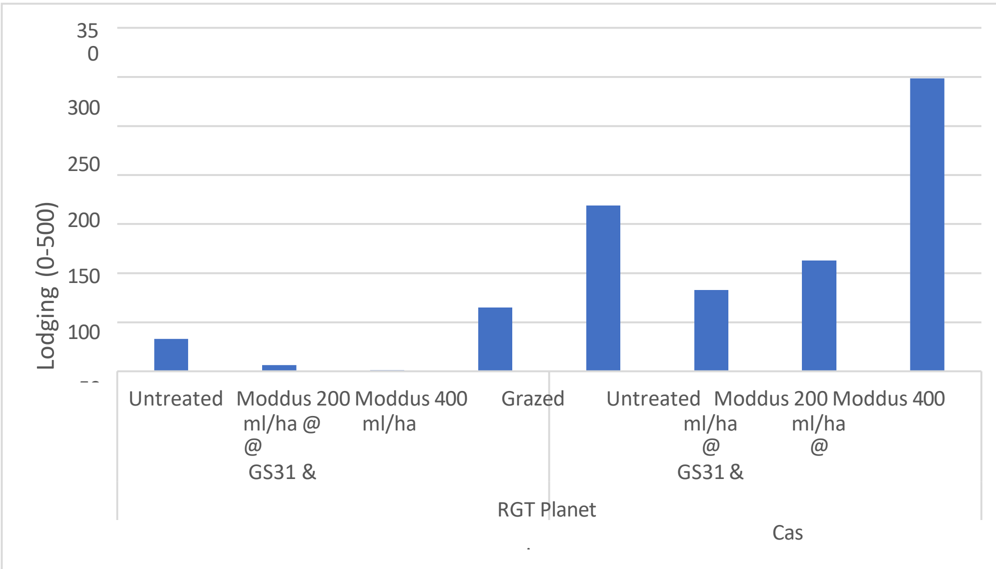


**Figure 2.** Influence of plant growth regulator on crop lodging using RGT Planet spring barley and Cassiopee winter barley in 2 irrigated trials conducted at Finley – 2020 and 2021.

Defoliation of the crop at GS30-31 (start of stem elongation) to mimic the effect of grazing produced significantly more dry matter with the winter barley that reached stem elongation later than the spring cultivar Planet (Figure 3).

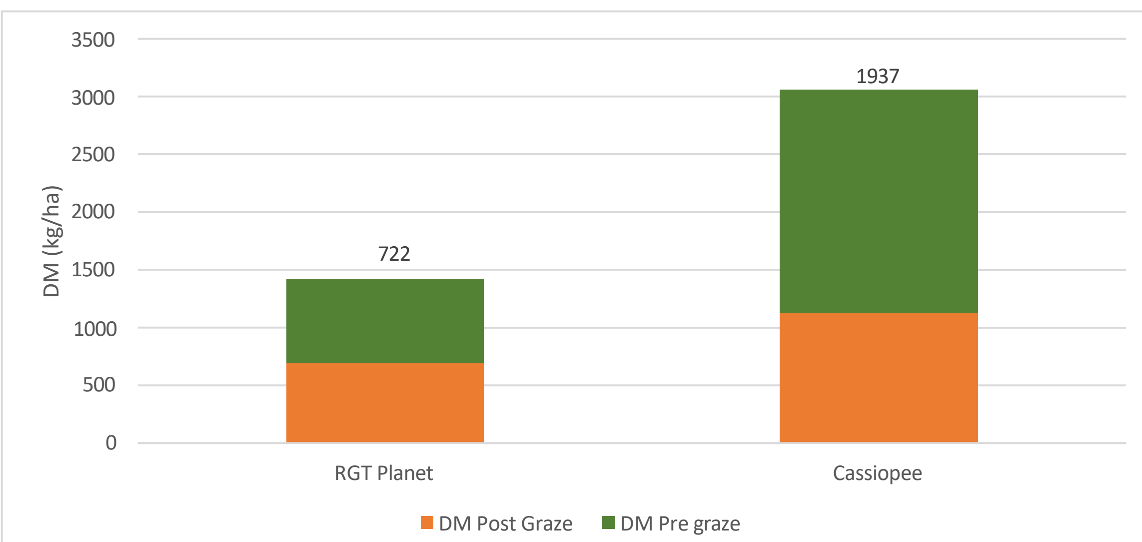


**Figure 3.** Influence of cultivar on dry matter (DM) kg/ha harvested by simulated grazing using a lawn mower to remove biomass at GS30-31 in two years of trials at Finley – 2020 and 2021. Figures above bars show the amount of biomass removed by simulated grazing.

The return in $/ha from PGR application with Planet was marginal, since the split application of Moddus (GS31 and GS33) was less cost effective than the untreated, whilst the single application (GS31) was slightly more cost effective. With the weaker strawed winter barley Cassiopee both single and split applications were very cost-effective applications (Table 1).

**Table 1.** Net income after PGR treatment, exclusive of grazing income.

| Cultivar | Treatment | Yield (t/ha) | Gross Income[1] ($/ha) | PGR cost[2] ($/ha) | Net Income[3] after PGR ($/ha) |
|---|---|---|---|---|---|
| RGT Planet | Untreated | 8.55 | 2052 | - | $ 2,052 |
| | Moddus Split GS31 & GS33 | 8.72 | 2092 | 61.72 | $ 2,030 |
| | Moddus @ GS31 | 8.88 | 2130 | 46.72 | $ 2,083 |
| | Grazed | 8.55 | 2052 | - | $ 2,052 |
| | | | | | |
| Cassiopee | Untreated | 7.04 | 1688 | - | $ 1,688 |
| | Moddus Split GS31 & GS33 | 8.13 | 1950 | 61.72 | $ 1,888 |
| | Moddus @ GS31 | 7.88 | 1890 | 46.72 | $ 1,843 |
| | Grazed | 7.19 | 1724 | - | $ 1,724 |

*[1]Gross income based on $240/t for feed barley delivered Finley, (protein was above 12% for all treatments in these trials and therefore unable to achieve malt quality). [2]PGR cost based on Moddus Evo at $79.30/L and application cost of $15/ha. [3]Net income has no other costs of production included only the PGR costs and its application cost.*

Table 1 does not include the value of dry matter grazed at GS30-31. In Table 2 the value of the reduction in grain yield is equated to a value for DM to justify grazing. In RGT Planet only 4 cents/kg DM was required to offset grain loss associated with removal of 722kg DM at GS30. With Cassiopee where defoliation produced nearly 2 t/ha DM the grain loss at harvest was greater (0.94t/ha compared to PGR treated) and 8 cents/kg DM was required to offset grain loss compared to the most effective PGR treatment or to warrant growing Cassiopee instead of RGT Planet 19 cents/kg DM.

**Table 2.** Grazing value required to ensure same income as ungrazed, PGR treated plots grain yields

| | | | Penalty for grazing cf. highest net income ($/ha) | | c/kg required from GS30 DM to offset grain loss | |
|---|---|---|---|---|---|---|
| Cultivar (Grazed) | Net Income ($/ha) | Grazed DM (kg/ha) | cf. Planet ($2083/ha)[1] | cf. Cassiopee ($1888/ha)[2] | $2083/ha | $1888/ha |
| RGT Planet | $ 2,052 | 722 | -31 | | $ 0.04 | |
| Cassiopee | $ 1,724 | 1937 | - 359 | -164 | $ 0.19 | $ 0.08 |

[1]Gross income achieved with RGT Planet and single PGR application. [2]Gross income achieved with Cassiopee and split PGR application.

cf. Compared to

# Canola under irrigation

## i) Crop structure and Plant population

### Key Points

- The penalty for growing canola crops that are too thin is significant under irrigation.
- At $700/t the influence of thinner canola populations can result in productivity losses of $448-$532/ha.
- Under irrigation it's better to have hybrid canola populations that are too thick than too thin when assessing seedbed conditions and establishment.
- 80 seeds/m$^2$ resulting in plant populations averaging 43-45 plants/m$^2$ were the most profitable populations tested under surface and overhead irrigations systems.
- If autumn surface irrigation 80-100mm (0.8-1.0 Mega litre) was followed by heavy winter rainfall on poorly drained red duplex soil, canola establishment could be severely reduced (2-9 plants/m$^2$) and productivity reduced to yields of 1-2.5t/ha.
- Under irrigation at Finley on a red duplex soil the yield advantage of RR hybrid over TT hybrid has been 17% (0.64t/ha) resulting in a $488/ha increase in productivity at $700/t.
- In the warmer irrigation region of Kerang on grey clay the advantage of the RR hybrid has been approximately half that observed at Finley with a yield advantage valued at $231/ha.
- Higher plant populations resulted in test weights that achieved the minimum standard (62kg/hL) which was not the case with the lowest TT plant populations tested

### Crop structure and Plant population

Growing canola under irrigation with the aim of producing 5t/ha has illustrated significant penalties in yields and margins from growing crops that are too thin. With higher yield potential under irrigation small differences in plant population have a "magnifying" effect in terms of yield. With plant populations below the optimum there are significant yield penalties, whilst in the same varieties' populations that might be regarded as above the optimum have been either equal or higher yielding than the optimum. As a result, dropping to populations between 10-20 plants/m$^2$ can produce a significant drop in productivity compared to plant populations that are above 40 plants/m$^2$ when canola has been grown under irrigation.  In the research looking at optimum crop canopy performance for irrigated canola the following key learnings have emerged over the last two years.

Influence of hybrid RR vs. TT

- Higher yields under irrigation magnify differences relative to dryland. Roundup Ready hybrid 45Y28 has been consistently higher yielding than the hybrid TT HyTTec. A mean 17% advantage (range 15-18% mean 0.64t/ha) advantage has been observed at Finley Irrigated Research Centre worth $448/ha at $700/t.
- The advantage of 45Y28 over HyTTec Trophy in the warmer region of Kerang on grey clay was approximately half that observed at Finley (9%-0.33t/ha) worth $231/ha.

of 14 plants/m$^2$ (based on 20 seeds/m$^2$) (Figure 1). Thicker canopies based on 45 plants/m$^2$ under irrigation generated a $448/ha return for an investment of approximately $110/ha in extra hybrid seed planted (additional 3kg/ha seed). Approximately $4 return for each $ spent on additional seed.

- The differences in hybrid TT populations under irrigation produced even greater differences in productivity and again illustrated that growing crops with higher plant populations was important to secure the additional productivity offered by irrigation. Hybrid TT HyTTec Trophy has shown 23% higher productivity (mean of 0.76t/ha) from a mean population of 43 plants/m$^2$ with this thicker crop generating an additional $532/ha return from a similar
$110/ha investment in additional seed. Approximately $5 return for each $ spent.

Influence of irrigation system (relative to winter rainfall)

- The poorest yield results so far observed in the project resulted from autumn irrigation immediately post sowing in early May following sowing in late April. Poor drainage and flow of surface irrigation at the Finley site led to early winter water logging and very low plant establishment. Crop establishment that fell to between 2-9 plants/m$^2$ yielded 0.83-2.67t/ha with 45Y28 and 3-7 plants/m$^2$ with HyTTec Trophy yielding 1.14-1.71t/ha.

The results illustrate that under irrigation the penalty of growing crops too thinly is increased with very large losses of income if population falls to 10-15 plants/m$^2$. Although hybrid plant populations of 25-30 plants/m$^2$ removes much of this penalty, productivity and profitability has been increased further with populations at 40-50 plants/m$^2$, despite the additional cost of seed.

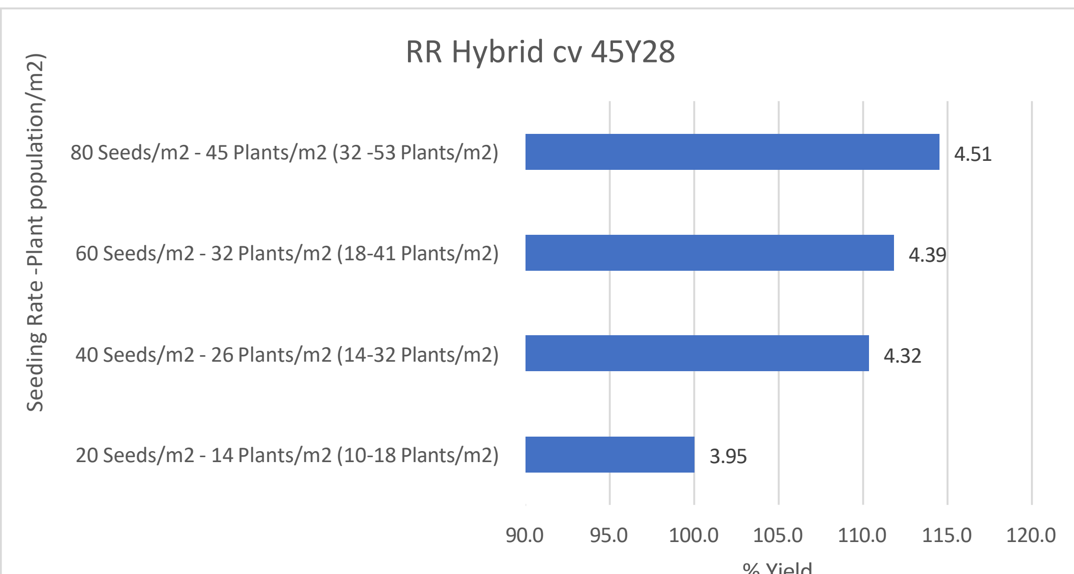


**Figure 1.** Influence of plant population on seed yield (t/ha) using the RR hybrid 45Y28 in 6 irrigated trials conducted at Finley and Kerang – 2020 and 2021.

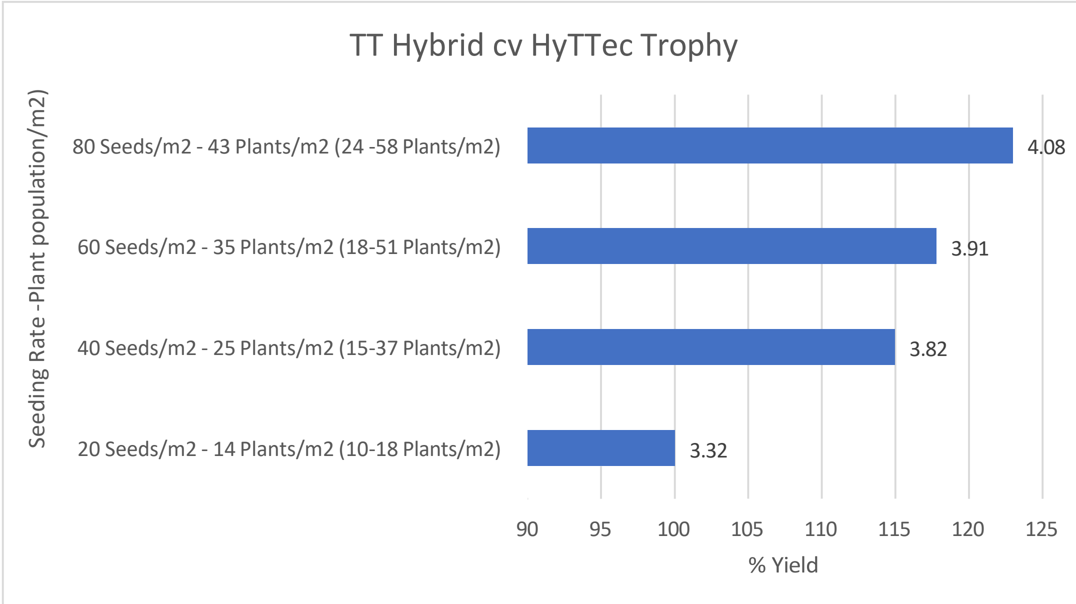


Figure 2. Influence of plant population on seed yield (t/ha) using the TT hybrid HyTTec Trophy in 6 irrigated trials conducted at Finley and Kerang – 2020 and 2021.

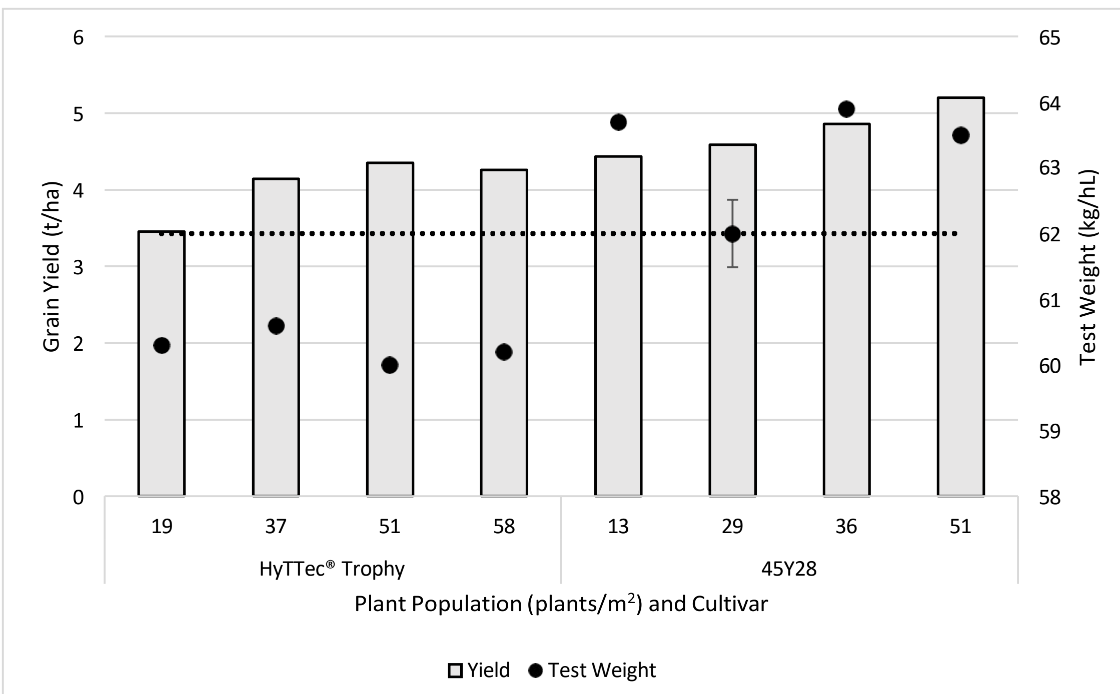


Figure 3. Influence of plant population and cultivar on seed yield (t/ha) and test weight (kg/hL) using the TT hybrid HyTTec Trophy - Finley 2021.

***ii)*** Nitrogen applications for 5t/ha irrigated canola

## Key Points

- Growing 5t/ha canola crops under irrigation does not require very large quantities of artificial nitrogen, it requires a fertile farming system that enables large crop canopies to draw down from a high soil N reserve in order to satisfy crop demand.
- Optimum N rates in OIG project trials required to grow 4-5t/ha canola crops have not exceeded 240kg N/ha applied as N fertiliser (urea 46% N).
- At Finley 200kg N/ha would be an appropriate target with a range of 160-240kg N/ha (upper end of range with low soil fertility or lower rate of range with high fertility).
- In trials conducted so far there have been few, if any differences in seed yield due to N timing with N rate being the most important. Timings of 6 leaf, green bud and yellow bud using split applications have had little difference to yield or oil content so far.
- When crops respond to higher levels of N input (above 240kg N/ha) it is often where crops cannot efficiently access the N fertiliser applied, a common occurrence in dryland scenarios. With irrigated crops the efficiency of N applied is improved considerably.
- The highest yielding irrigated canola crops in the project have been produced in paddocks where inherent fertility is high with applied artificial N rates typically no more than 160- 240kg N/ha at Finley and 80-120kg N/ha at Kerang.
- These fertile irrigated paddocks can often produce reasonable crops with little or no artificial N as soil N mineralisation provides a greater proportion of the N supply e.g. Finley and Kerang 2020 yields were in excess of 3t/ha achieved with only MAP at sowing.

During 2020 at Kerang on grey clay canola yields varied from 3.00-3.63 t/ha based on 0 to 320kg N/ha applied with an optimum of 80kg N/ha. In 2021 from the same N range the canola yields were 2.74-4.36t/ha with an optimum of 120kg N/ha. In Finley during 2020 yields ranged from 3.91-4.71t/ha (Figure 4) with an optimum of 160-200kg N/ha and in 2021 from 2.21-4.22 t/ha with an optimum of 240kg N/ha from the same yield range.

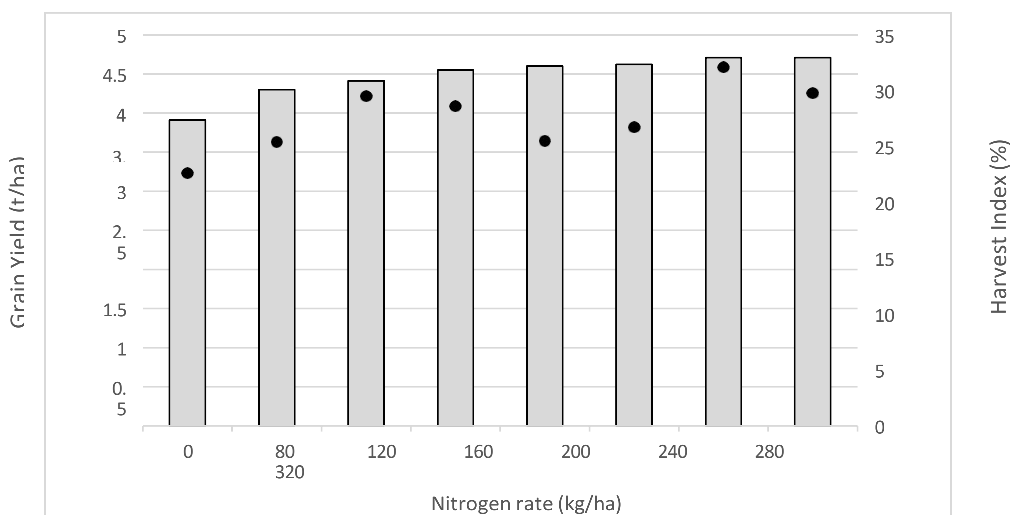


**Figure 4.** Influence of applied N rate on seed yield (t/ha) and harvest index (%) – cv RR Hybrid 45Y28, Finley, NSW 2020

### *iii)* Disease management in irrigated canola

**Key Points**

- To date in the project trials at Finley in 2020 and 2021 the maximum responses to disease management strategies have been relatively small (0.13t/ha and 0.28t/ha) in irrigated canola crops of ATR Bonito.
- The research work conducted on canola has been subject to upper canopy blackleg and crown canker but not sclerotinia.
- In these cases, flutriafol in furrow followed by Miravis at 4-6 leaf has been one of the most effective treatments, although the yield increases have been small and only statistically significant in 2021.

### *iv)* PGR management – controlling crop height and lodging

Experimental PGR applications (based on a gibberellin inhibitors) have been successfully employed to reduce crop height in irrigated canola, however the effects of the PGR which have been manifest at flowering have largely worn off by harvest. So far, these transient reductions in crop height have not been associated with any improvement in seed yield.

## Chickpeas under irrigation

### *i)* Crop structure and Plant population

**Key Points**

- Chickpea yields under irrigation have reached yields over 4.0t/ha.
- 35 seeds/m$^2$ resulting in plant populations averaging 21-25 plants/m$^2$ were the most profitable populations tested under surface and overhead irrigations systems from a late April sowing.
- The influence of lower chickpea populations can result in productivity losses of 1.0t/ha.
- Higher yields have come from April sowing compared to May sowing. Where sowing is delayed, populations need to be increased to 35 plants/m$^2$.
- Yields have not been stable between the two years of trials. Yields from the Finley site were approximately half in 2021 compared to 2020, with the overhead irrigation suffering the higher yield reduction. Kerang 2021 yields were similar between seasons.
- Lodging has been observed in higher plant populations, but this is also influenced by cultivar choice.

*Crop structure and Plant population*

Growing chickpeas under irrigation has demonstrated that there are yield penalties for crops that have reduced biomass. With early pod set determined by temperature (>15 degree C) and grain fill impacted by high temperatures later in spring, there is a window of opportunity for maximising yield by taking advantage of higher biomass promoted by higher seeding rates or earlier sowing (Figure 1).

### *ii)* Inoculation of Chickpeas

## Key Points

- As chickpeas require a specific inoculum (Group N), it is highly recommended that seed be inoculated before sowing.
- Using higher rates of Alosca granules resulted in increased nodulation in 2020 but there was no advantage to higher rates over 10kg/ha in 2021. Untreated plants had few root nodules.
- While yields were lower in the untreated plots, there was no statistically significant difference between inoculated and uninoculated crops in the trials.
- Applying artificial nitrogen (40kg N/ha) has not influenced nodulation in research conducted so far, but equally it hasn't been associated with yield increase.
- High soil N at sowing may have the effect of removing some of the reliance on nitrogen fixed by the crop.

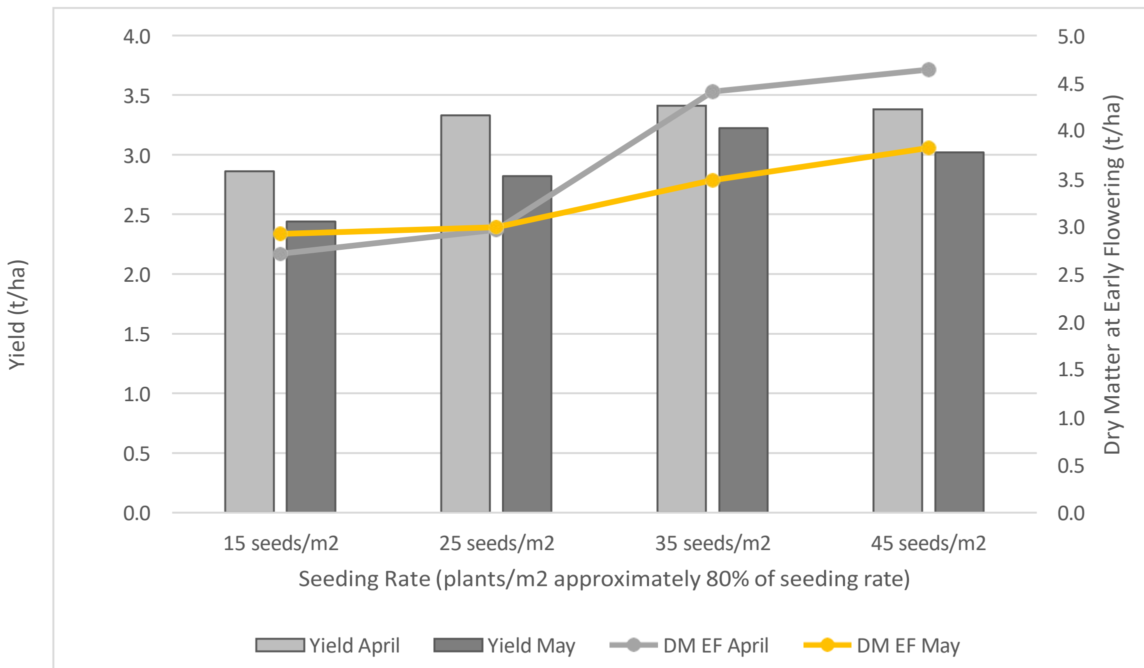


**Figure 1**: Chickpea yield (t/ha) and dry matter (t/ha) at early flower (EF) averaged from two cultivars – Finley, NSW cv Genesis 090 and PBA Royal.

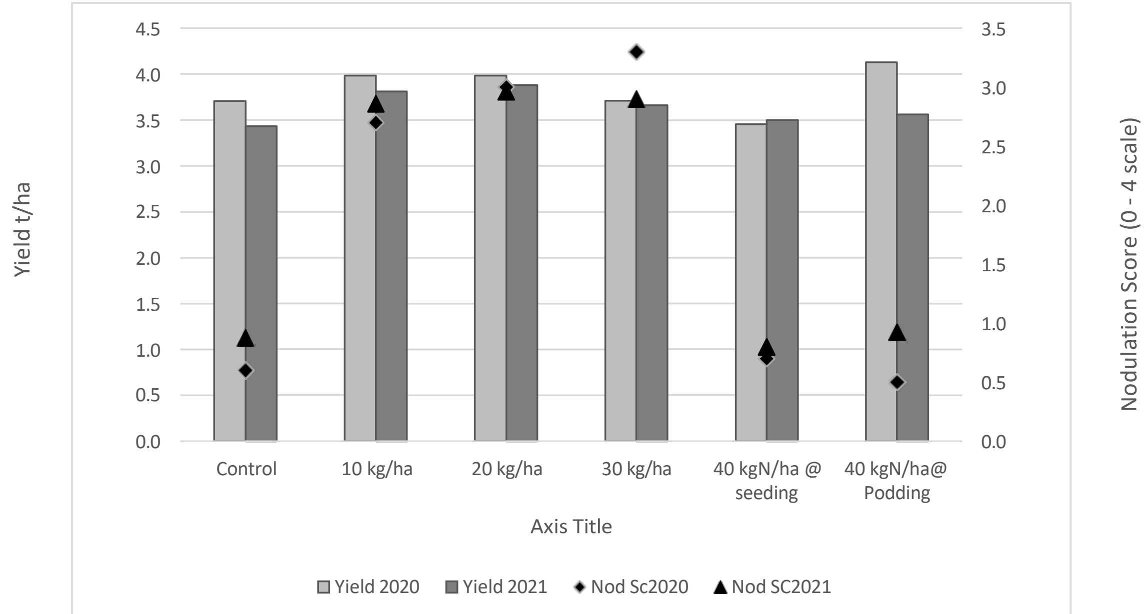


**Figure 2**: Influence of inoculant (ALOSCA granules) rate (kg/ha) and applied nitrogen kg N/ha on chickpea yield (t/ha) and Nodulation Score (NodSc) from the Kerang, Vic 2020 and 2021 trials – cv PBA Royal.

Inoculation has resulted in a significant improvement in nodulation scores assessed 9 weeks after sowing. However, the grain yields have not followed a similar trend, with yields regarded as statistically similar.

### *iii)* Disease management in irrigated chickpeas

## Key Points

- Chickpeas have been more susceptible to foliar disease, specifically ascochyta, than faba beans at both research sites.
- The disease rating of the cultivar was an important indicator of cultivar yield performance.
- The benefit of an 'Expensive' strategy using a combination of SDHI (group 7) and QoI (Group 11) chemistry gave significantly better disease control and significantly higher yields than 'Cheap' strategy based on chlorothalonil and tebuconazole, but only with PBA Monarch at both sites.
- Genesis 090 showed good response to fungicide but there was far less advantage to the more expensive fungicide strategy.
- While the untreated yields at Kerang were approximately 50% of the yields where disease was controlled, the actual grain produced in the untreated was unlikely to have any commercial value due to the number of small and discoloured chickpeas in the sample.

The OIG project has been looking at the influence of newer fungicide chemistry in chickpeas grown under either surface or overhead irrigation compared to historic standards using chlorothalonil (Table1).

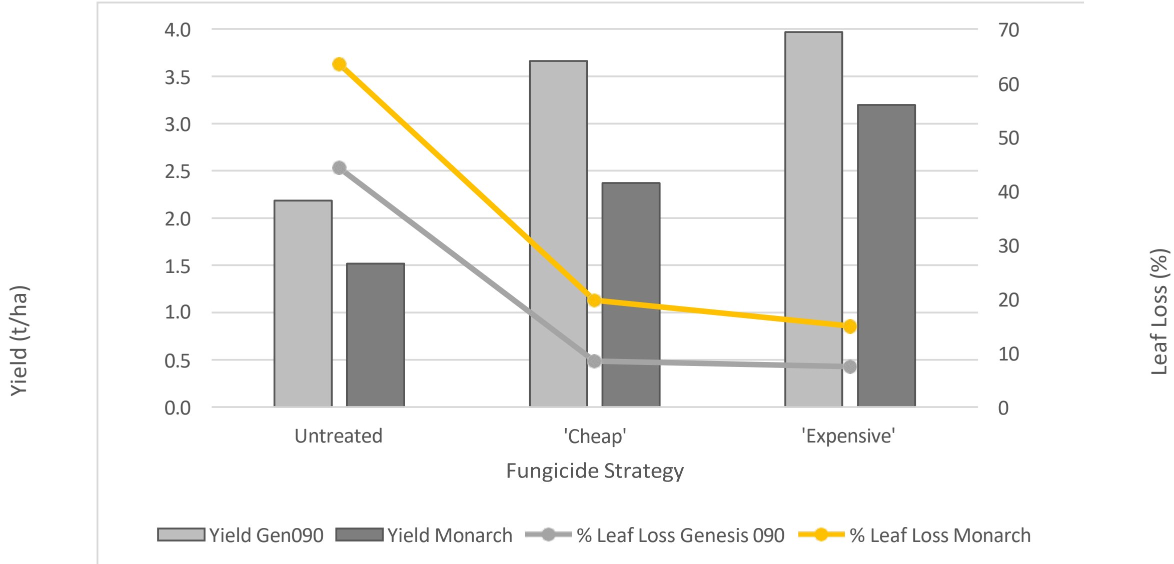


Figure 3: Influence of cultivar and fungicide strategy (based on three applications) on yield (t/ha) and % leaf loss – Kerang, VIC, cv Genesis 090 and Monarch.

Table 1. Trial treatment summary.

| TRT | Variety | Management Strategy | 4-5 weeks post emergence | Pre-Flower | Late Flower |
|---|---|---|---|---|---|
| 1 | | Untreated* | - | - | - |
| 2 | | Cheap | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha | Chlorothalonil 720 1 l/ha |
| 3 | | Expensive | Veritas 1l/ha | Aviator Xpro 600ml/ha | Veritas 1l/ha |

# Durum under irrigation

## *i)* Nitrogen (N) strategy for yield and quality

### Key Points

- The ability to use irrigation to improve the efficiency of later N timings is ideal for producing a crop that requires high protein levels to achieve the grade required.
- Provisional results illustrate that later N timings of main N doses in durum maintain yield potential whilst at the same time giving high proteins.
- The ability to delay all the N until GS32 (second node) and GS37 (flag leaf just visible) will need to be considered in the light of available soil N in the profile at late tillering and GS30.
- Very low levels of soil N available at GS30 may require a small late tillering dose in order to feed the crop (40N). With high levels of available of soil N this can be delayed until GS32.
- In 2020 at Finley high soil fertility (232kg N/ha in the 0-90cm soil profile at sowing) resulted in no response to applied N fertiliser with no significant difference in grain yield between 28-378kg N/ha applied.
- In a scenario of lower soil fertility in 2021 (measured 47kg N/ha in the soil, 0-90cm, 23rd August) increasing applied N rates (Urea 46% N) from 0-350kg N/ha had no significant effect on grain yield above 100kg N/ha, but to be certain of having 13% grain protein for DR1, N levels had to be increased to 200kg N/ha since 150kg N/ha achieved only 12.5% grain protein.
- A separate adjacent nitrogen timing trial demonstrated that protein above 13% could be achieved with 100kg N/ha by delaying the timing to GS32 and GS37 (Table 1).
- The same trials at Kerang (2020 & 2021), with starting soil N 77-130 kg N/ha, showed that maximum yield was achieved with N rates of 100-200kg N/ha and 13% protein could be achieved with no more than 200kg N/ha if timing was delayed to GS32 & GS37.

Durum has been an important crop in the OIG research programme over the last two years. The research has covered all aspects of agronomy, but nutrition has been a key component of the work. How can we reliably achieve 7t/ha plus with protein levels that meet the 13% level? Work has been centred on N rates and N timing. In 2020 high residual soil N (232N-0-90cm profile) built up from the drier previous seasons resulted in no yield response for N applied above starter N (28N). In 2021 soil available N was much lower at the start of spring (47N-0-90cm) and there were yield responses up to 100kg N/ha with 13% grain protein achieved at 200kg N/ha applied (Figure 1). A separate adjacent nitrogen timing trial demonstrated that protein above 13% could be achieved with 100kg N/ha by delaying the timing to GS32 and GS37 without sacrificing yield. (Table 1). At both Kerang and Finley similar findings have been identified with regards to later N timings under surface and overhead irrigation whereby later N timings give the optimum combinations of yield and grain protein.

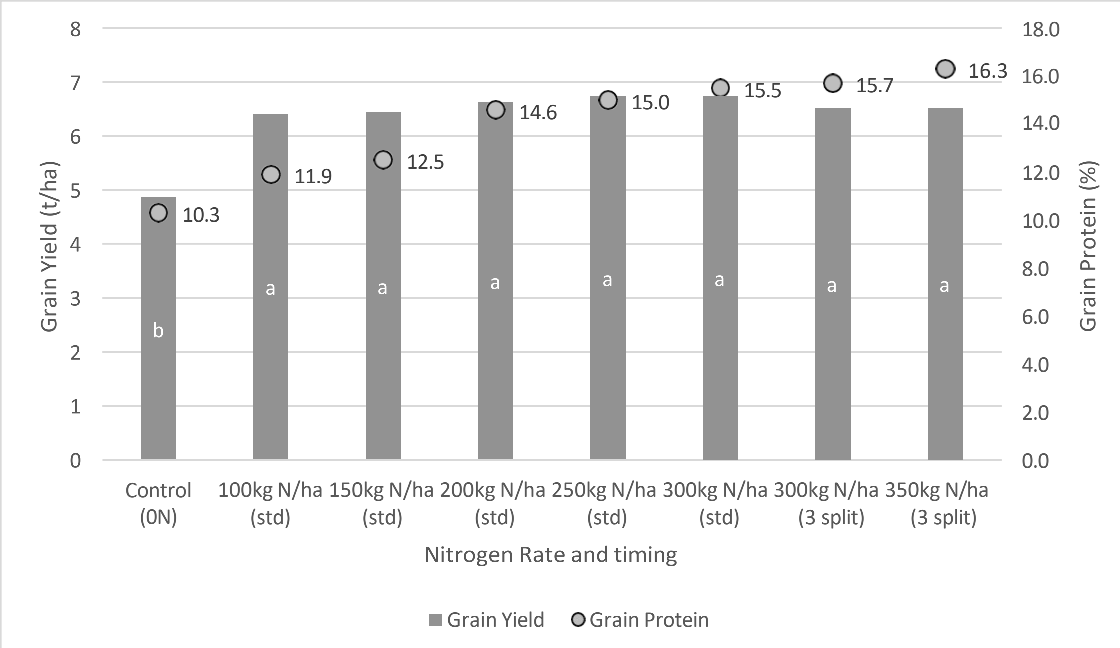


**Figure 1.** Influence of applied nitrogen at stem elongation on grain yield (t/ha) and protein content (%). – Finley 2021 Notes. Std – nitrogen split 50:50 between GS30 and GS32. 3 split – 100kg of nitrogen withheld until GS39 with the remainder split 50:50 between GS30 and GS32. *Yield bars with different letters are considered statistically different*

**Table 1.** Influence of N rate and timing strategies on grain protein (%) based on split application rates (0-300kg N/ha).

| | Nitrogen Application Rate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0kg/ha N | | 100kg/ha N | | 200kg/ha N | | 300kg/ha N | | Mean | |
| Nitrogen Timing | Protein % | | Protein % | | Protein % | | Protein% | | Protein% | |
| PSPE & GS30 | 10.9 | - | 12.4 | - | 13.8 | - | 15.0 | - | **13.0** | **b** |
| GS30 & GS32 | 10.6 | - | 12.5 | - | 13.7 | - | 15.0 | - | **13.0** | **b** |
| GS32 & GS37 | 10.9 | - | 13.4 | - | 15.3 | - | 16.4 | - | **14.0** | **a** |
| Mean | **10.8** | **d** | **12.8** | **c** | **14.3** | **b** | **15.5** | **a** | | |
| | | | | | | | | | | |
| N Timing | | | LSD | 0.4 | | | P val | | <0.001 | |
| N Rate | | | LSD | 0.5 | | | P val | | <0.001 | |
| N Timing x N | | | LSD | ns | | | P val | | **0.235** | |

Soil N available – 47kg N/ha 0-90cm

### *ii)* Crop lodging control and use of PGRs

## Key Points

- Aurora durum is prone to greater lodging problems during grain fill than Vittaroi.
- PGR applications at Finley and Kerang in 2020 and 2021 in Aurora have consistently resulted in a reduction in both crop height and lodging during grain fill.
- At Kerang in 2021, treatments where Moddus at 200ml/ha and Errex at 1.3l/ha were applied at various timings gave an average yield increase of 1.97t/ha over the untreated control plots (Table 1).

Four trials were conducted at 2 sites (Finley and Kerang) over 2 years (2020 and 2021). Moddus Evo mixed with Errex and an unregistered experimental product were used at various rates and timings. A grazing treatment was added where plots were mowed twice (GS22 and GS30) to simulate grazing. Responses to plant growth regulator (PGR) chemicals have resulted in a reduction in crop height and reduced lodging. The yield results have varied from 0-2.04t/ha. In most cases grazing has led to a reduction in lodging, however it almost always led to reduction in yield compared to the highest yielding plots in each trial. Table 1 illustrates the trial where the biggest penalty to not using a PGR occurred.

**Table 1.** Influence of PGR strategy on Grain yield (t/ha) and Screening (%) - Kerang 2020 cv Aurora.

| PGR Treatment | | | Grain yield and quality | | | |
|---|---|---|---|---|---|---|
| | | | Yield | | Plant Height | |
| No. | Product and Rate | Timing | t/ha | | cm | |
| 1. | Untreated | | 7.61 | d | 100 | a |
| 2. | Moddus Evo 200mL/ha + Errex 1.3L/ha | GS31-32 | 9.49 | ab | 83 | ef |
| 3. | Moddus Evo 100mL/ha + Errex 0.65L/ha<br>Moddus Evo 100mL/ha + Errex 0.65L/ha | GS30<br>GS32 | 9.59 | ab | 81 | f |
| 4. | Errex 1.3L/ha<br>Moddus Evo 200mL/ha | GS30<br>GS32 | 9.65 | a | 86 | de |
| 5. | Errex 0.65L/ha<br>Moddus Evo 100mL/ha | GS30<br>GS32 | 8.17 | cd | 98 | ab |
| 6. | Moddus Evo 200mL/ha + Errex 1.3L/ha<br>FAR PGR 20/01 0.75 L/ha | GS31-32<br>GS39 | 9.64 | a | 81 | f |
| 7. | Moddus Evo 100mL/ha + Errex 0.65L/ha Moddus Evo 100mL/ha + Errex 0.65L/ha<br>FAR PGR 20/01 0.75 L/ha | GS30<br>GS32<br>GS37 | 8.95 | abc | 84 | ef |
| 8. | FAR PGR 20/01 0.75 L/ha | GS39 | 7.81 | d | 98 | ab |
| 9. | Grazing (twice GS22 & GS30) | GS22 & GS30 | 8.61 | abcd | 91 | cd |
| 10. L/ha | FAR PGR 20/01 0.75 L/ha + Errex 1.3 | GS32 | 8.53 | bcd | 95 | bc |
| | **Mean** | | **8.81** | | **89.7** | |
| | **LSD** | | 1.08 | | 4.52 | |
| | **P val** | | 0.001 | | <0.001 | |

# Faba Beans under irrigation

## *i)* Crop structure and Plant population

### Key Points

- High yielding faba bean crops greater than 7t/ha are achievable under both overhead and surface irrigation systems.
- The penalty for growing faba bean crops that are too thin is significant under irrigation.
- Aiming for populations above the optimum is less risky, with little to no penalty for canopies that are above optimum.
- With plot yields varying from 2.5t/ha to 8t/ha, the older variety Fiesta VF consistently out yielded the newer variety PBA Amberley by 8%.
- Surface irrigation combined with growing season rainfall at both Finley and Kerang was at least 500mm in order to achieve 7t/ha plus. Overhead irrigation systems in 2020 associated with 400mm of GSR and irrigation combined produced only 4-5t/ha with lower pod numbers/$m^2$ and harvest dry matter.

*Cultivar and Population*

Fiesta out yielded PBA Amberley by 8% across the two years of research trials under irrigation. This increased yield is consistent over plant populations that vary from low to high density, however at the high populations (plus 40 plants/$m^2$) PBA Amberley appears to drop in yield slightly.

Irrigated grain yield plateaus at around 30 plants/$m^2$ and there is little gained going above 25 plants/$m^2$. However, when plant populations start dropping below 20 plants/$m^2$ the yield loss can be significant. With higher yield potentials under irrigated cropping systems, the small drops in plant populations have a "magnifying" effect on grain yield loss (loss of approx. 1.5t/ha when dropping from 20 to 10 plants/$m^2$). In contrast, moving from 20-30 plants/$m^2$ increased yield by 0.5t/ha and whilst higher populations were rarely higher yielding, the risk of poorer performance was very slight in comparison to populations dropping below the optimum.

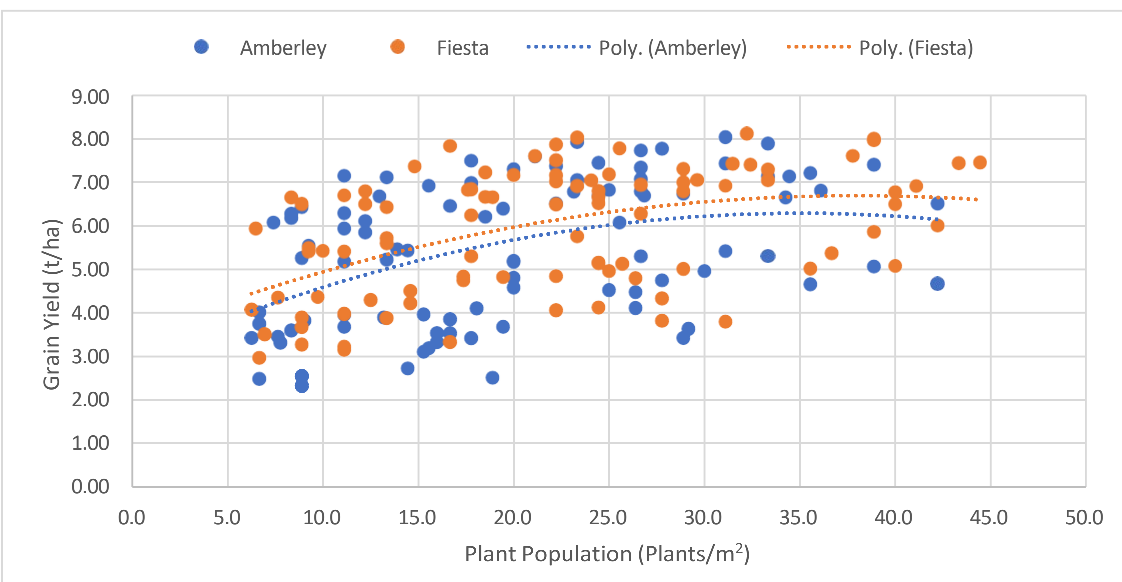


**Figure 1.** The influence of faba bean plant populations on grain yield (t/ha). Data points from 6

trials across 2 years and 2 sites.

If aiming for 20 plants/m$^2$, there are greater negative consequences if populations fall below that target than where populations are higher than the target, even up to 35-40 plants/m$^2$. Therefore, there is less risk of losing yield if aiming for higher populations (25-30 plants/m$^2$) than falling short.

### What makes a 7-tonne crop?

When growing faba beans under irrigation plant populations is one of many components making up the yield achieved at the end of the season. Other yield drivers include biomass production, stem numbers, pod numbers, seeds per pod and thousand weight (TSW).

Two years of achieving high yielding irrigated faba beans has allowed us to estimate some matrix figures around what makes up a 7+ t/ha faba bean crop. When achieving 7t/ha at our Finley irrigated research site a minimum established population of 20 plants/m$^2$ was the establishment foundation required. From this point, at least 60 stems are required and approximately 8 pods per stem to reach the target of 7t/ha.

**Table 1.** Yield components of a high yielding (+7t/ha) irrigated faba bean crop.

| | Population (plants/m$^2$) | Harvest Dry Matter (t/ha) | Stems/m$^2$ | Pods/m$^2$ | Grain Yield (t/ha) |
|---|---|---|---|---|---|
| Amberly 2020 | 20 | 13.59 | 60 | 453 | 7.45 |
| Amberley 2021 | 21 | 11.66 | 60 | 490 | 7.18 |
| Fiesta 2020 | 27 | 15.15 | 70 | 557 | 7.06 |
| Fiesta 2021 | 23 | 13.68 | 60 | 624 | 7.23 |
| Amberley 2020 | 32 | 9.05 | 61 | 351 | 5.17 |

Despite achieving +20 plants and +60 stems/m$^2$ in one trial in 2020, a yield of only 5t/ha was achieved due to lower biomass and pod numbers. In this example irrigation was provided by overhead and the GSR and irrigation combined fell below 400mm, whilst in 2020 the only crops to achieve 7t/ha plus had surface irrigation of approximately 500mm at Finley (Red Duplex) and 580mm at Kerang (Grey Clay).

### *i) Nitrogen Fixation*

Key Points:

- ***Using current estimates, high yielding faba bean crops are removing more nitrogen in the grain than they are supplying in nitrogen fixation.***

Current rules of thumb (for dryland bean crops) for nitrogen fixation are 20kg of N fixed per tonne of dry matter biomass at flowering and estimates of nitrogen removal are 40kg of N per tonne of grain.

Using these estimates, our irrigated faba bean crops are removing up to 300kg N/ha while only supplying 110-190kg N through fixation leaving a large N deficit.

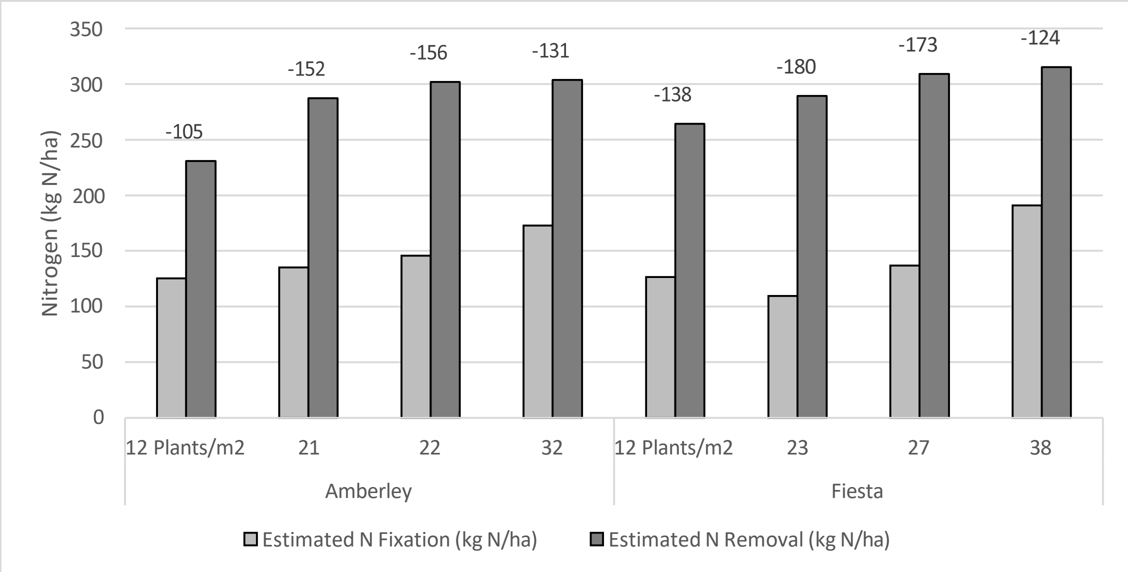

Figure 2. Estimates of nitrogen fixation and removal from high yielding irrigated faba bean crops. Data labels show the nitrogen deficit.

## Pre irrigation – it's not just 'add water' and enjoy the high yields

### Key Learnings

- Water savings can be made with improved irrigation infrastructure such as overhead sprays.
- Irrigation districts have varying access to water during the winter season, with some irrigators having no access from mid-May to mid-August.
- Not having sufficient soil moisture going into winter may leave the crop susceptible to 'winter drought', that can have a negative impact on yield.
- Similarly, having a full soil profile at the beginning of winter may increase the risk of waterlogging, particularly with surface irrigation in systems that don't drain well.
- Soil type, location and appetite for risk all play a part in irrigators' decisions regarding pre- irrigation.

Two years of GRDC's Optimising Irrigated Grains (OIG), on top of research conducted under the 'Smarter Irrigation for Profit' project, have highlighted the irrigation decisions that need to be made by irrigators on how and when to use their irrigation water to set up their irrigated crops to be the most profitable.

The changing irrigation environment has seen irrigation water become an input where the price can be highly variable based on seasonal conditions and allocations. Efforts to make irrigation more efficient has seen investment in improved layouts and infrastructure such as overhead sprinklers or fast flow surface irrigation, giving irrigators flexibility in the amount of water applied and the choice of crops.

Pre-irrigation (where fallow paddocks are irrigated prior to the sowing of a crop) has always been a judgment call by irrigators, based on timing to enable timely sowing and adequate moisture for the crop to develop over winter. Using surface irrigation, this could mean using anywhere between 0.75 to 2.0 Mega litres/ha (75-200mm/ha) to wet up the soil profile. The timing of pre-irrigation must be considered in order to allow the paddock to dry sufficiently to enable sowing on time, but not to dry too much and then be at the mercy of 'the autumn break' for sowing similar to a dryland grower. Many irrigators have a story about the pre-irrigation that went badly – where it rained, and sowing couldn't proceed or winter waterlogging was detrimental to the crop as the soil profile was full going into winter. However, pre-irrigation does provide soil moisture over winter as some irrigation regions do not have access to water between 15 May and 15 August to allow the water authorities to service and repair the water delivery network.

Irrigators have installed overhead irrigation as a means to be able to have more control over the amount of water applied. Instead of the large volume of water applied via surface irrigation as a pre- irrigation, irrigators can apply enough water to ensure timely establishment of their crop. This can be a considerable saving of water but does then run the risk of a 'winter drought' if the winter period is dry and winter rainfall is inadequate to meet the needs of the crop. In these cases, yield potential is lost before the irrigation water becomes available in the spring. In shorter season crops or in warmer regions where spring growth occurs earlier (before mid-August) yield potential starts to be reduced since crops are stem elongating but without the water reserve to sustain this period of rapid development.

The OIG project, with its geographically diverse project partners, has illustrated the different thinking that drives irrigators decision making on irrigation. Higher rainfall regions are unlikely to pre-irrigate due to the risk of autumn irrigating leading to waterlogging if they go into winter with a full profile.

Similarly, those in the east of the Murray and Murrumbidgee valleys are more confident of a timely break for sowing and follow-up winter rainfall to get the crop through to the spring when irrigation can commence. Those to the west who have soils (e.g. grey clays) that require more water to fill the profile, are less confident of the break being in late April/early May and have lower winter rainfall to tide them over until the irrigation season opens in the spring. Depending on the crop type, restoration of yield potential with spring irrigation following a winter drought can be more limited with early maturing wheat, since it has already started developing rapidly whilst the crop is under spring drought conditions. In some cases, the restoration of yield potential is adequate (e.g. faba beans) but this does depend on whether heat stress was additional to the lack of soil moisture and becomes part of the yield equation. These geographical differences also manifest themselves in the responses to disease management where irrigation does not appear to favour conditions that promote the fungal diseases compared to the naturally more disease prone high rainfall zones.

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SUSTAINABLE AGRICULTURE,
LANDSCAPES AND COMMUNITIES

Southern NSW Drought Resilience, Adoption and Innovation Hub is one of eight around Australia established by the federal Department of Agriculture, Water and Environment through a grant from the Future Drought Fund. Hubs support farmers and communities to get ready for drought including:

- Adopting innovative tools and technologies
- Improving productivity and profitability
- Preserving natural capital
- Reducing financial exposure to future droughts.

Now their activities are expanding beyond drought to include the National Agricultural Innovation Agenda 2030 priorities which will see Australia become a:

1. Trusted exporter of premium food and agricultural products
2. Champion of climate resilience to increase the productivity, profitability and sustainability of the agricultural sector
3. World leader in preventing and rapidly responding to significant pests and diseases through future-proofing our biosecurity system
4. Mature adopter, developer and exporter of digital agriculture

## Southern NSW Drought Resilience Adoption and Innovation Hub

### Our Vision

**Creating connected and adaptable people and places, prepared to respond to future challenges and capitalise on opportunities.**

### Our Partners

Our Hub is a partnership led by Charles Sturt University including University of Wollongong, University of Canberra, Australian National University, NSW DPI, NSW Local Land Services, First Nations Governance Circle, RuralAid and Farming Systems Group Alliance.

The Hub's Board provides leadership of skills and diversity, each nominated by our partners and led by Independent Chair, Barry Irvin AM, Executive Chair of Bega Cheese.

Board members include – Lorrae van Kerkhoff (Australian National University), Rene Wood (First Nations Governance Circle), Ron Heinrich (Farming Systems Group Alliance), Pascal Perez (Wollongong University), Kate Lorimer-Ward (NSW Department Primary Industries), Barney Hyams (Local Land Services), Niall Blair (Charles Sturt University), Ross Thompson (University of Canberra) and John Warlters (RuralAid).

### Where?

Southern NSW Innovation Hub covers the majority of NSW, over 41 million hectares, from Broken Hill in the west, across to Quambone, and down the East coast from just north of Sydney. The Victorian border is the Southern boundary for the Hub.

You can come and visit the Hub office at Charles Sturt University in Wagga and we have shopfronts established across Southern NSW in our five nodes of Western Rangelands, Central, Orange, Monaro and Capital and Coastal.

This is where you will find our network of 22 Knowledge Brokers and can access our Concierge Service. They're embedded with our partners, established organisations who you already know and are ready to work with farmers and communities to find out what they need to increase resilience, and connect them to the resources, training or researchers who can help.

## What are we doing?

### Our Activities

Talk to our communities to:

- Describe the impact of drought on communities, landscapes and agricultural systems and identify where improved resilience can be built
- Identify the extension, adoption and commercialisation capacity (people & resources) to support adoption of existing ideas, technologies and systems
- Identify gaps in extension, adoption and commercialisation capacity and work with partners to fill gaps and enhance existing capabilities

Create a values-based, people-focussed agricultural innovation system by working with our partners to:

- provide tools, training, and resources to create a network of skilled people able to engage in communities, provide information and access to tools and support the RD&E program
- Establish and support community-based teams to identify their needs and design solutions together Innovation support services to help individuals prioritise and adopt ideas and technologies for their farm/community/landscape OR creators of new technologies to connect with end users
- Create a forum to introduce ideas from different industries and countries to stimulate creative problem solving

Leverage investment for RDEA&C programs to address the innovation needs of agriculture and regional communities:

- Influence investment strategies of existing investors
- Create and/or facilitate new investment opportunities

**"The Southern NSW Hub will identify how we can speed up the adoption of innovations on farms to modernise our approaches for improved community, landscape and production outcomes. This will see us reimagining how we develop and deliver activities that foster innovation and better address the needs of the current farming environment."**

***- Cindy Cassidy, Director, Southern NSW Drought Resilience Adoption and Innovation Hub***

**Find out more and connect with us:** southernNSWhub@csu.edu.au

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research.csu.edu.au/engage-with-us/research-impact/southern-nsw-drought-resilience-hub

Australian Government
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Future Drought Fund

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**Supporting Partners**

Australian National University · Charles Sturt University · CWFS · NSW Department of Primary Industries · FarmLink · MFS Monaro Farming Systems · Southern Growers · Holbrook Landcare Network · Irrigation Research & Extension Committee · Irrigated Cropping Council · NSW Local Land Services · RiverinePlains · Rural Aid · University of Canberra Centre for Applied Water Science · University of Wollongong Australia · TFS Tablelands Farming Systems

Notes...

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Dairy Australia

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AgriFutures Australia

Smarter Irrigation for Profit

GRDC Grains Research & Development Corporation

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