IREC

Irrigation Research & Extension Committee

Irrigation Research Update

Presentation Papers 2022

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Irrigation Research & Extension Committee

IREC Irrigation Research Update

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Precision Surface Irrigation

Rob Houghton
Chair, IREC
Irrigator, Gogeldrie

Key Points

- Soil Type / Layout
- Flow Rate
- Automation
- Recreation

Soil Type / Layout

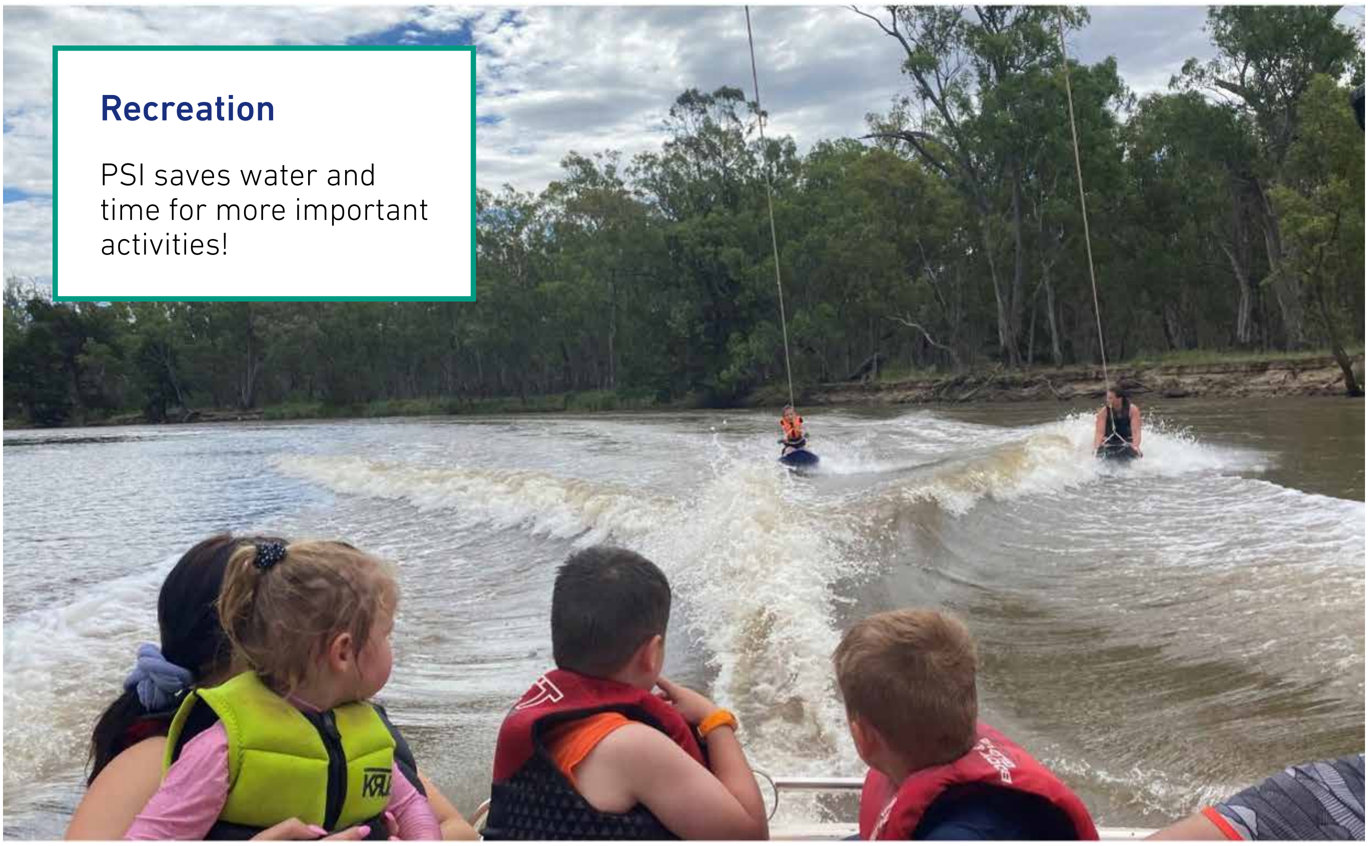
- Hard setting sandy clay loam or hard to sub – soils maybe better suited to stepped bankless flat layouts.
- Heavy black alluvial clays maybe suited to downwards slope as opposed to flat layouts to assist drainage.
- Some soil types may be prone to erosion with high flow down the slope systems. This may suit the roll over bankless system.

Flow rate

- Making sure that the supply and drainage system can adequately cater for maximum flow rate.
- The higher the flow rate you can command the bigger the layout you can design ultimately reducing per ha cost for concrete and automation.
- Consider pump capacity and on farm storage to supplement flow rate where needed and handle excess run off.

Automation

- Remote monitoring of channel heights and bay levels.
- Remote start and stop of diesel and electric lift pumps.
- Maintain channel height.
- Scheduled field changes and automatic bay triggering.
- Scheduling of multiple days of irrigation prior to the event.
- In field sensing initiating bay changes and predict irrigation intervals.



Recreation

PSI saves water and time for more important activities!

Preventing weed spread to neighbours: ways and reasons

Rick Llewellyn, Christina Ratcliff, Marta Monjardino, Tim Capon, CSIRO Iva Quarisa, Rachel Diversi, IREC
Chris Preston, University of Adelaide
James Hereward, University of Queensland
Sonia Graham, Gina Hawkes, University of Wollongong

General aim: Reduced impact of major mobile weeds of cropping

- Less impact on own farm
- Less impact on others
- Less impact from others

- Ryegrass: most costly weed
- Fleabane: top 3 costly fallow weeds

What we've done

- Consult to prioritise weed issues and threats
- Determine resistance status
- Test for genetic evidence of 'spread'
- Evaluate social aspects & costs
- Locally trial control options
- Promote new options
- Work towards identifying best bet opportunities

IREC Trials

Area-wide Weed Management

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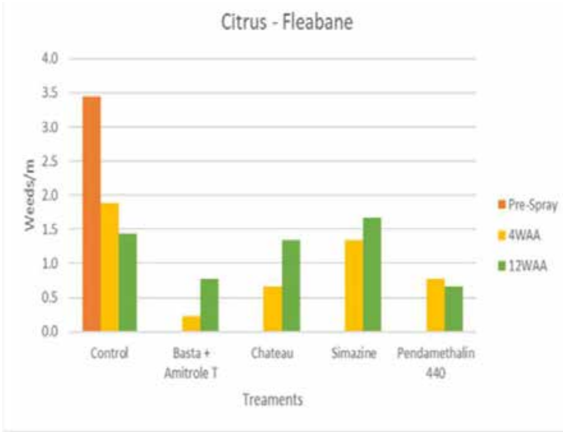
- Weed control in Citrus orchards
- Kikuyu on Channel Bank
- Kikuyu establishment
- Weeds in Vineyards

IREC/Summit Ag (Ayliffe et al 2021)

Identifying best herbicide options

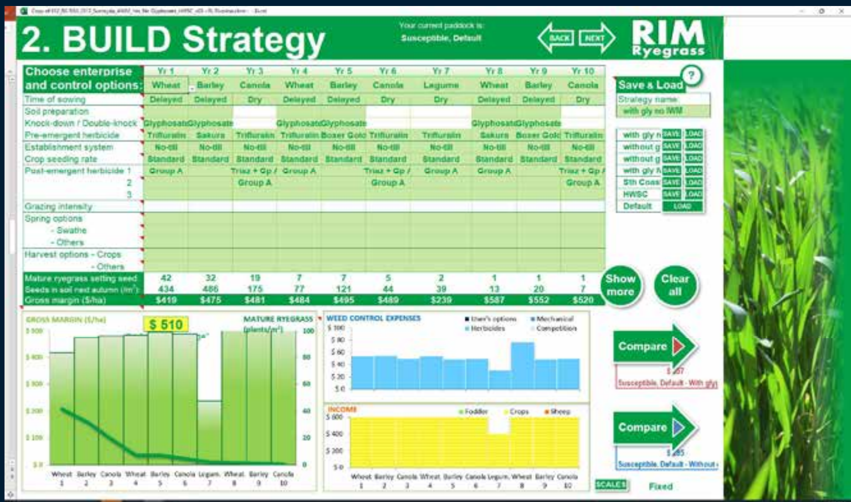
Treatment 5 - Pendimethalin – Left Pre-spray and Right Post-spray



IREC/Summit Ag (Ayliffe et al 2021)

Ryegrass control

Analysis of cost of gaining glyphosate resistant ryegrass in Riverina



Impact of glyphosate efficacy going from 95% to 40% in non-irrigated grains

+ 46 seeds

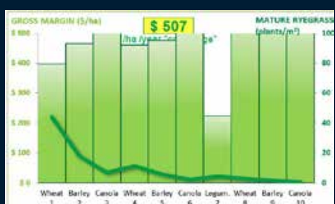
1 plant to 6/ m2

If glyphosate resistance gained without IWM

(IWM = 80% seed control)

-$14/ ha

$510 to $496



+ 16 seeds

<1 plant to 1/ m2

If glyphosate resistance gained with IWM

(IWM = 80% seed control)

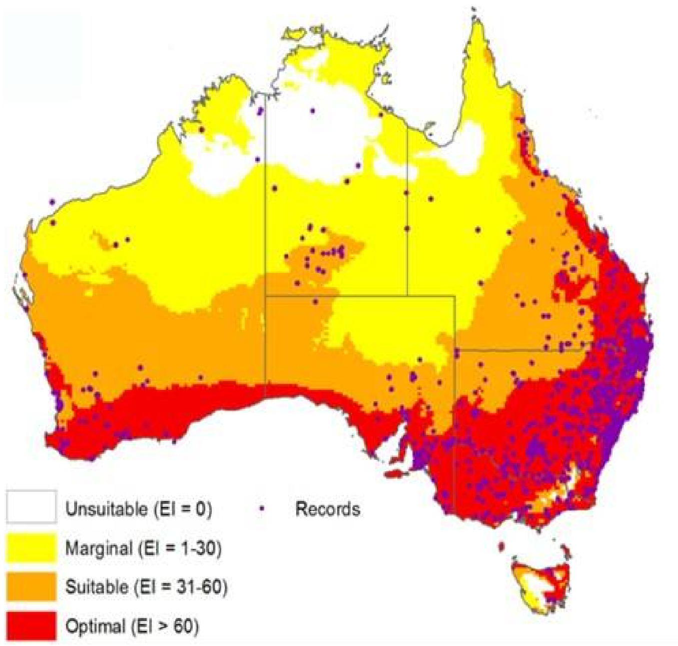
-$3/ ha

$510 to $507

IWM increases resilience to new RG resistance incursions (reduces resistance cost by 80%)

And not just on-farm...

Darling Downs



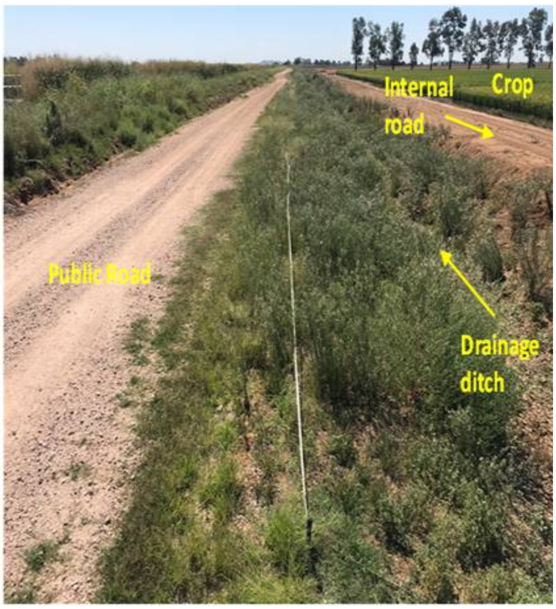
Flaxleaf fleabane; Scott et al 2016

Working together on the release and monitoring of the fleabane bio control agent

Flaxleaf fleabane Rust fungus
Puccinia cnici-oleracei (ex. *Conyza*)

Fleabane biocontrol agent — for 'area-wide' release

- Rust — completes development on fleabane only
- No alternate hosts



Roadside (e.g. Transect 7)

The Department of Agriculture, Water and the Environment (DAWE) approved the release of the rust fungus *Puccinia cnici-oleracei* (ex. *Conyza*) for the biological control of flaxleaf fleabane in June 2021.

Over to you ...

- Major weeds are highly mobile
- The spread of major weeds and resistance can be slowed
- The risk and potential cost of new weed incursions can be reduced

What actions in the MIA are worth taking?

Where would you start...........?

What would it take...?

AWM

Australian Government
Department of Agriculture, Water and the Environment

GRDC Grains Research & Development Corporation

CRDC Cotton Research and Development Corporation

CSIRO

Irrigation Research & Extension Committee

Landcare Millmerran

Mallee Sustainable Farming

Wine Australia

Toowoomba Regional Council

University of Wollongong Australia

The University of Adelaide

The University of Queensland Australia

https://research.csiro.au/weed-awm/

Herbicide resistant weed distribution in the Riverina

Christopher Preston
School of Agriculture, Food & Wine, University of Adelaide
Christina Ratcliff
CSIRO

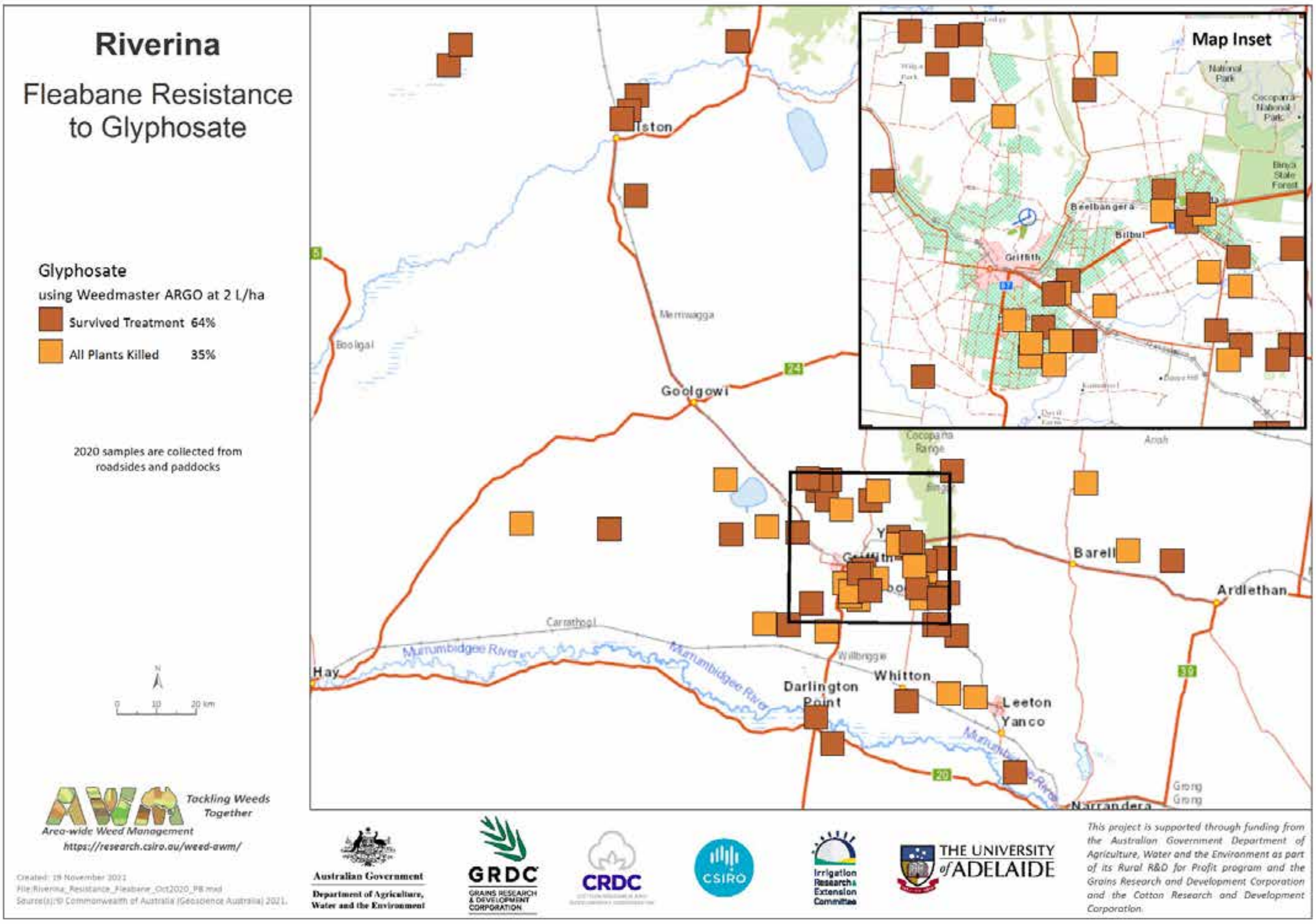
Weeds and Herbicides

Fleabane (121 samples)
Annual ryegrass (34 samples)
Silverleaf nightshade (11 samples)
Glyphosate (1080 or 540 g ha^{-1})
Paraquat + diquat (324 + 276 g ha^{-1})

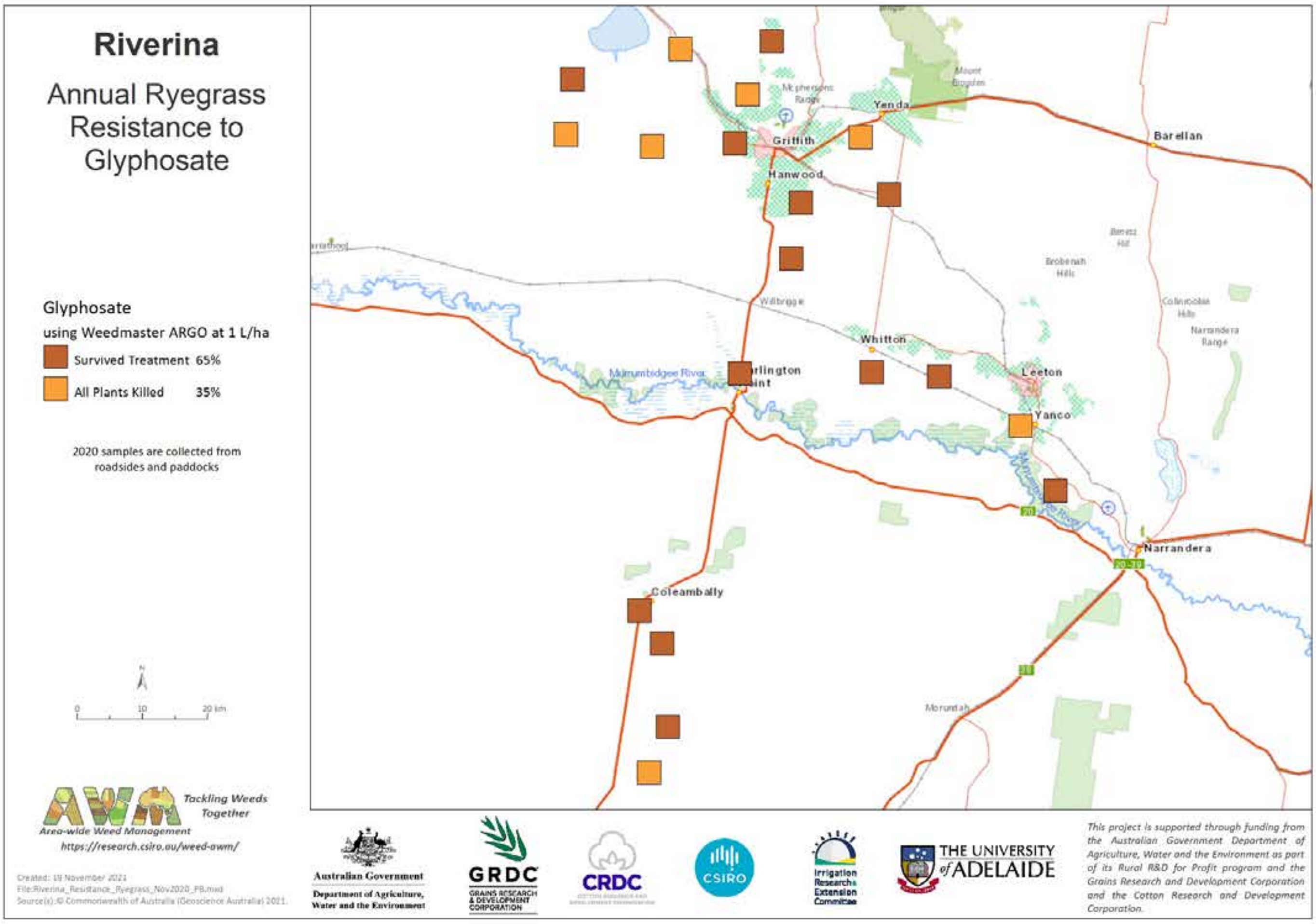
Results of herbicide resistance testing 2019/20 Riverina

2019/20			
Weed species	**Samples tested**	**Resistant to glyphosate**	**Resistant to paraquat + diquat**
Fleabane	64	41	0
Annual ryegrass	18	12	-

Distribution of fleabane resistant to glyphosate in 2019



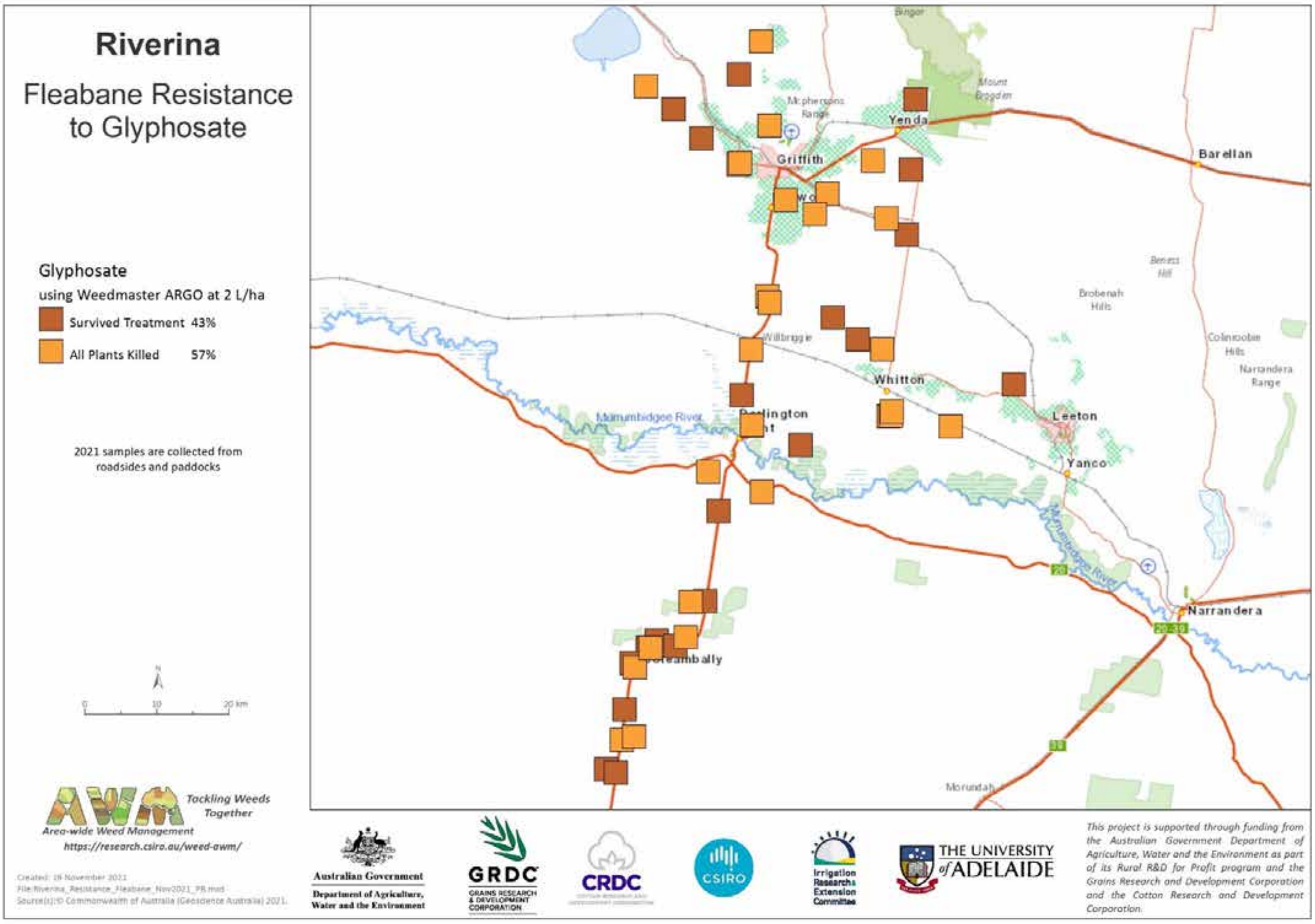
Distribution of annual ryegrass resistant to glyphosate in 2019



Results of herbicide resistance testing 2020/21 Riverina

2020/21			
Weed species	**Samples tested**	**Resistant to glyphosate**	**Resistant to paraquat + diquat**
Fleabane	57	21	0
Annual ryegrass	16	13	-
Silverleaf nightshade	11	1?	-

Distribution of fleabane resistant to glyphosate in 2020



Key findings

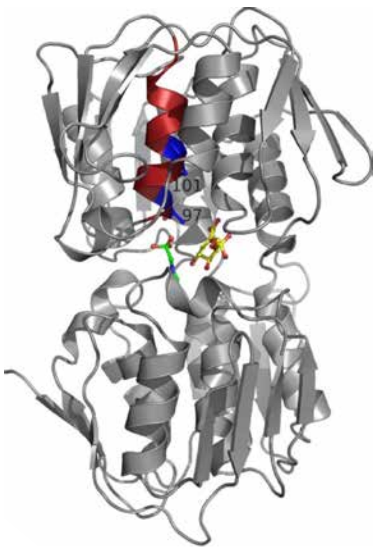
- Resistance to glyphosate is present in fleabane and annual ryegrass in the Riverina
- Glyphosate resistance is dispersed across the landscapes for fleabane and annual ryegrass
- Possible variation in tolerance of silverleaf nightshade to glyphosate

Using genetics to infer movement in Ryegrass and Fleabane in the Riverina region

At what scale should we co-ordinate weed management?
At what scale do weed individuals and herbicide resistance genes move?

James Hereward, UQ
University of Queensland

Glyphosate Resistance

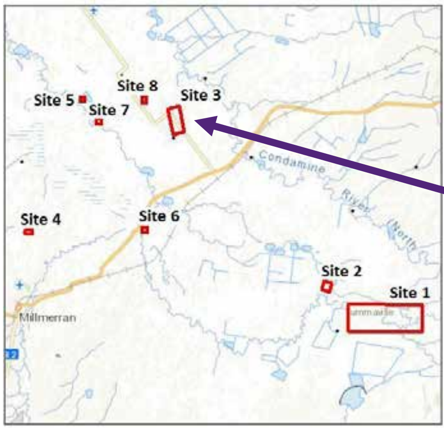


EPSPS

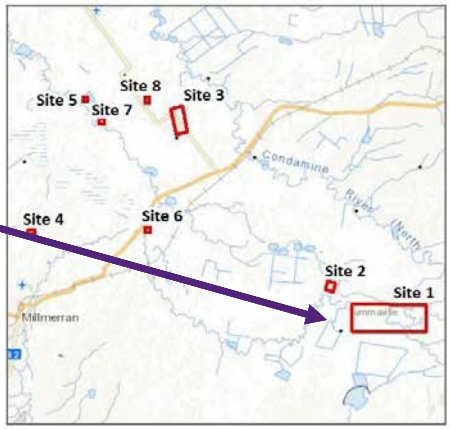
Feathertop Rhodes Grass	Fleabane	Annual Ryegrass
		
Chloris virgata	*Conyza bonariensis*	*Lolium rigidum*
Evolved glyphosate resistance at least 12 times	Glyphosate resistant across QLD by 2018 (first detected 2006)	

Feathertop Rhodes Grass	Fleabane	Annual Ryegrass
		
Chloris virgata	*Conyza bonariensis*	*Lolium rigidum*
Almost no outcrossing	V. low rates of outcrossing	Obligate outcrossing

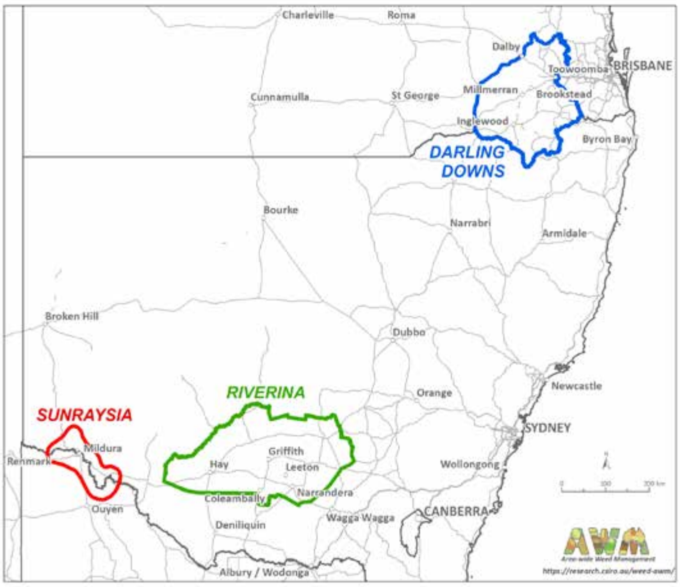
2020



2021



2020 sampling

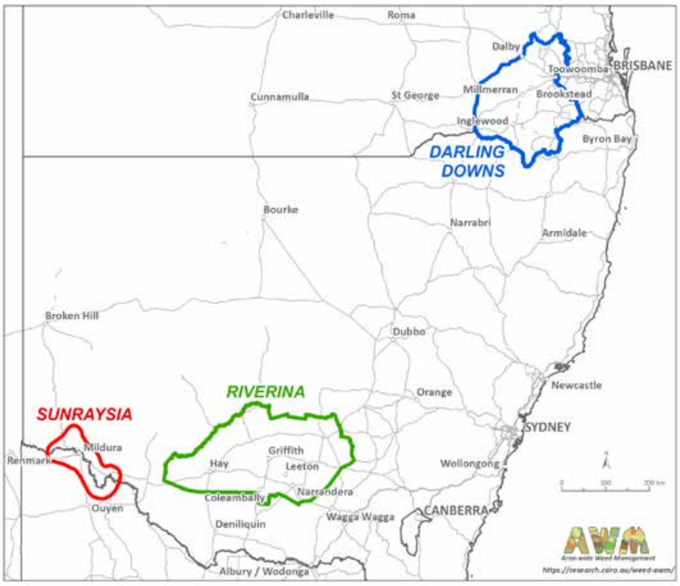


Darling Downs

Sunraysia

Riverina

2021 sampling



Darling Downs

Sunraysia

Riverina

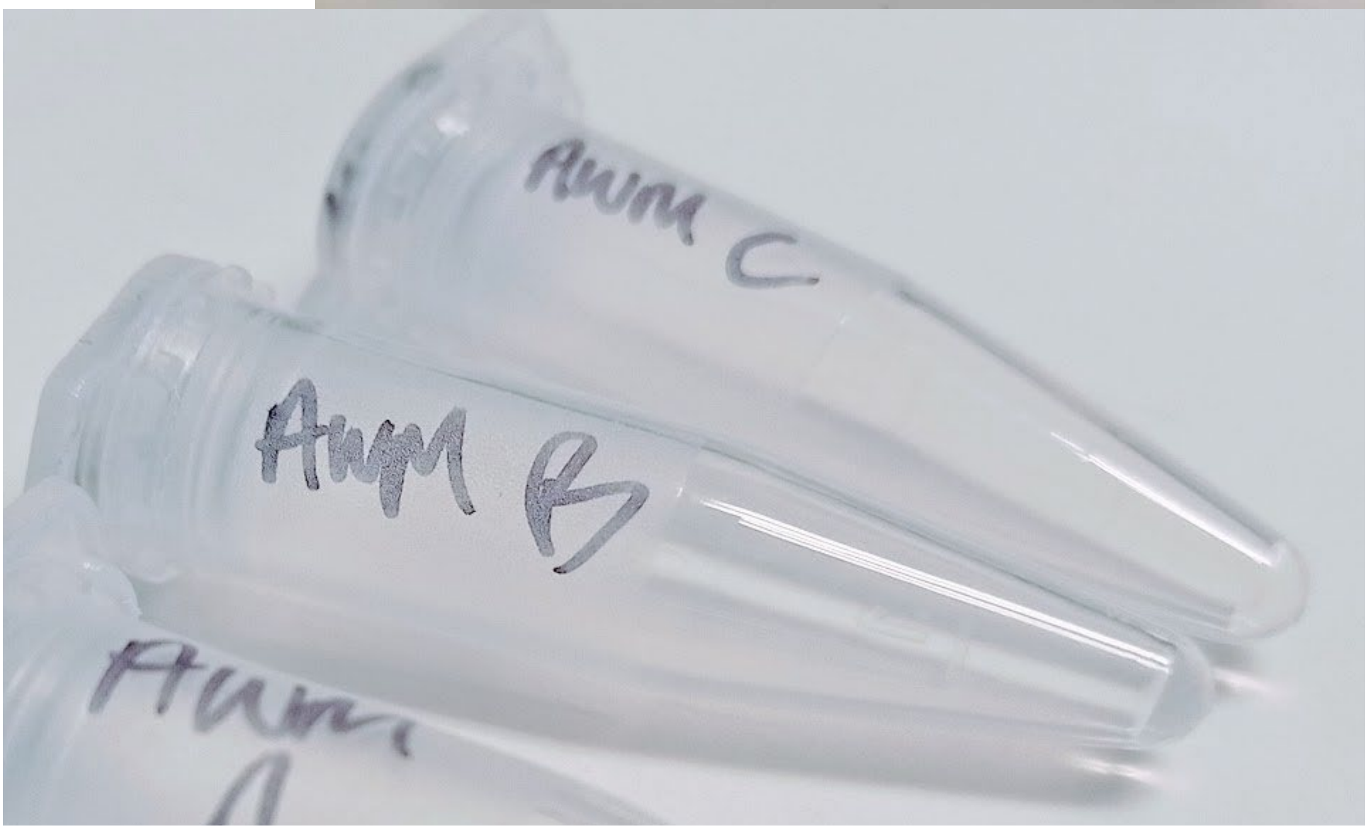

SITE: 8A
DATE: 8-5-2020
LAT: 34.33606
LONG: 146.09279
WP: 168
Weed: FB
SITE: 6A
DATE: 22-5-2020
LAT: 34.26349
LONG: 146.16058
WP: 201
Weed: FB

Fleabane 2020

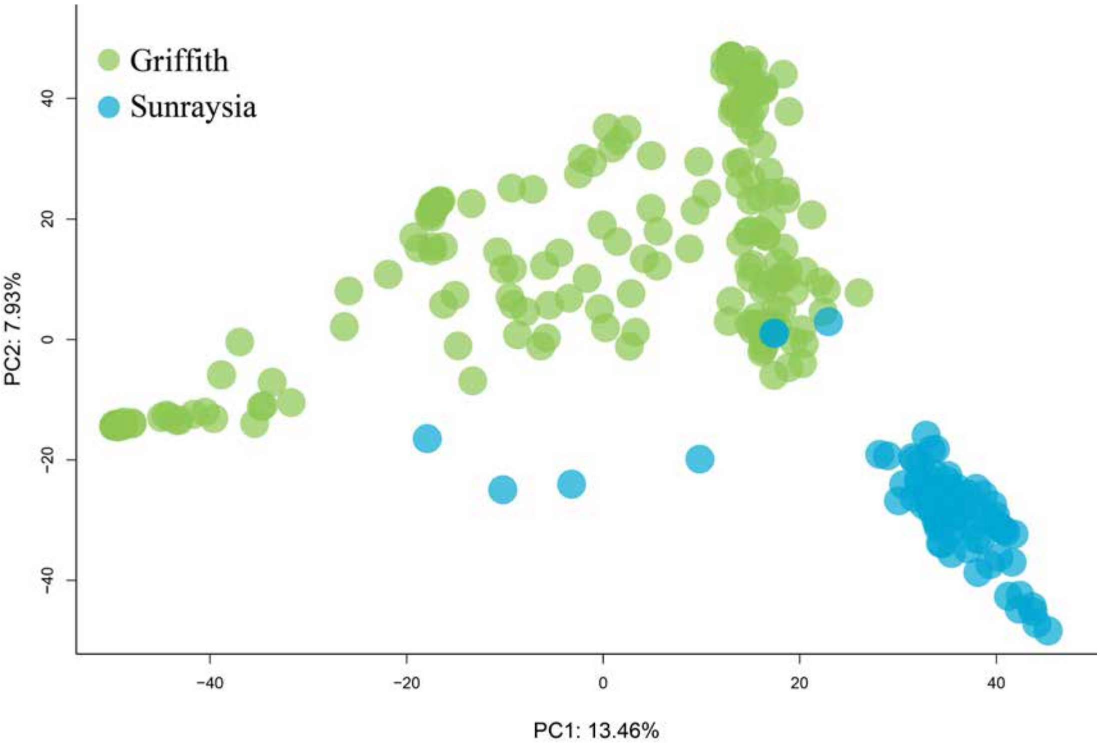
Fleabane 2021

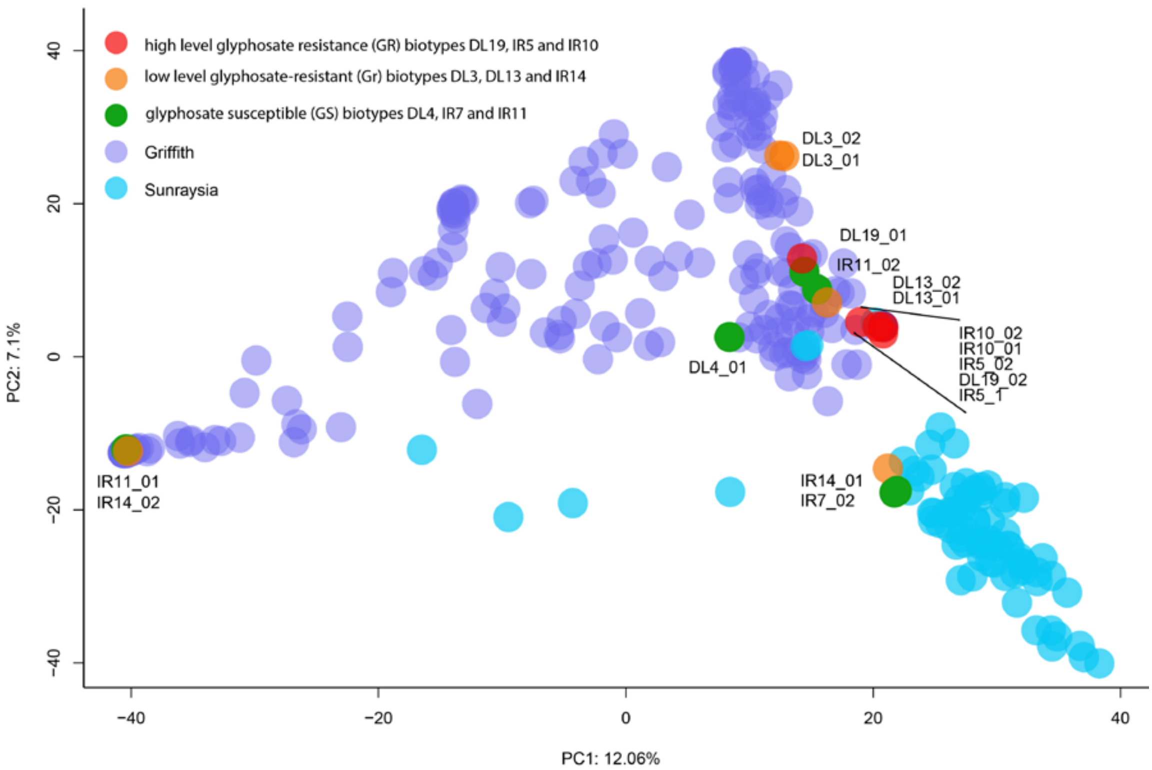
Ryegrass 2020

Ryegrass 2021

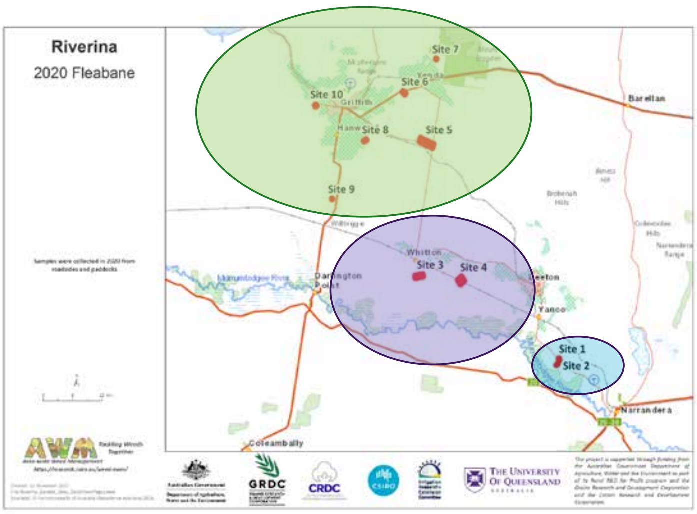


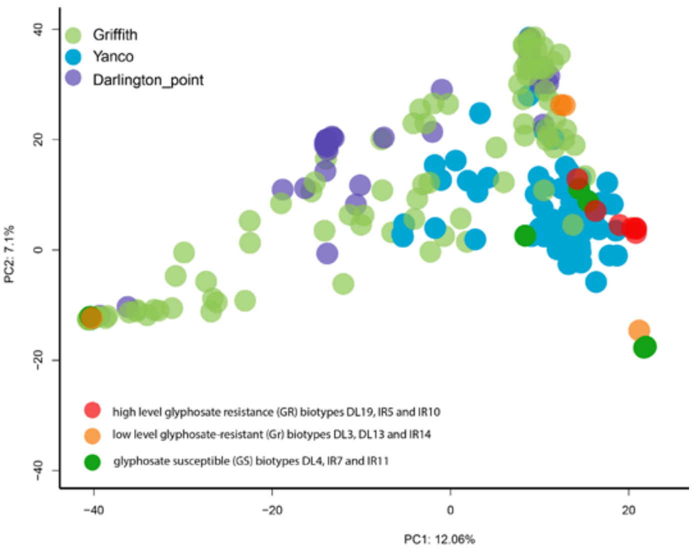
Fleabane 2020



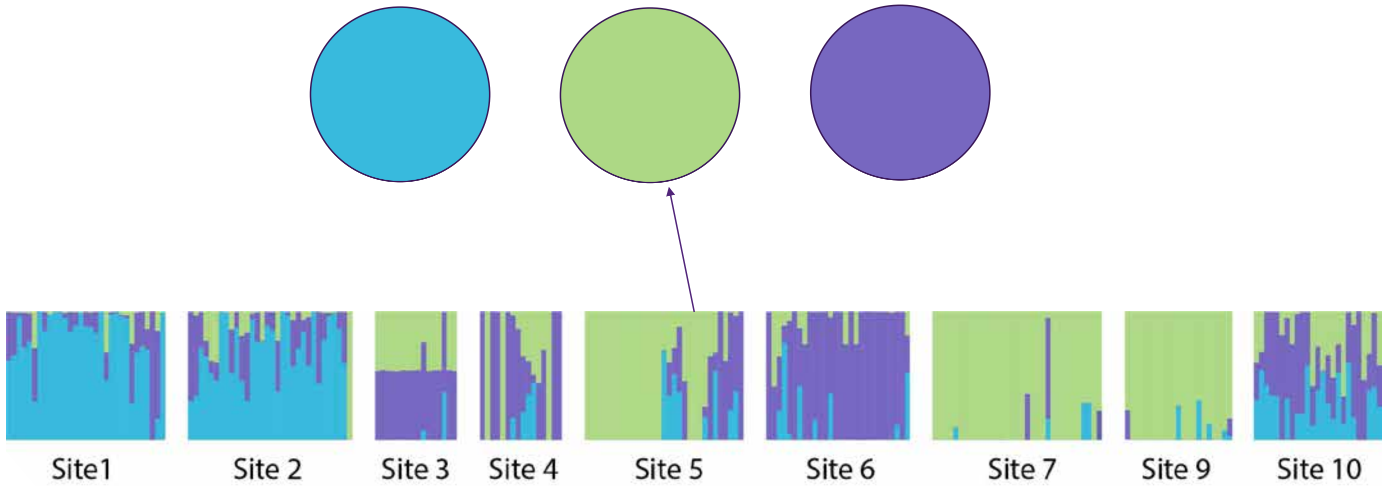


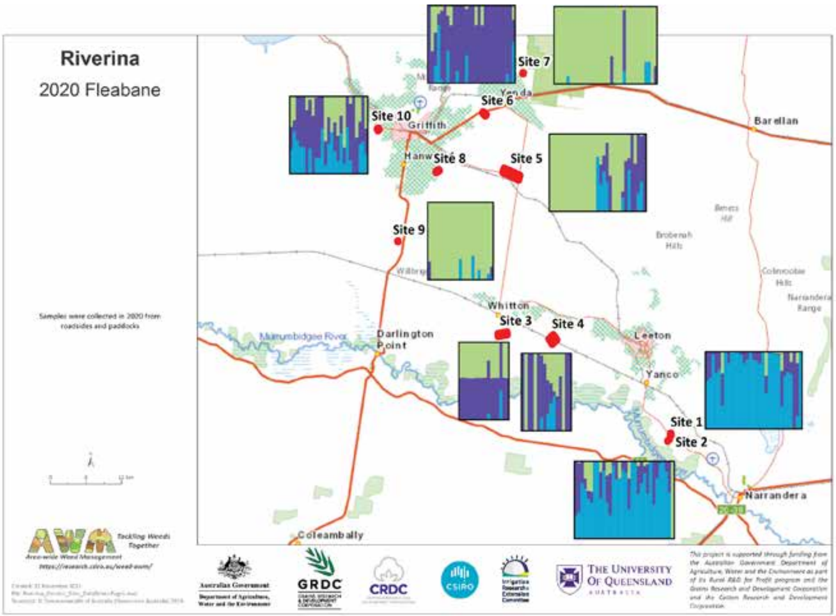
Fleabane Griffith 2020



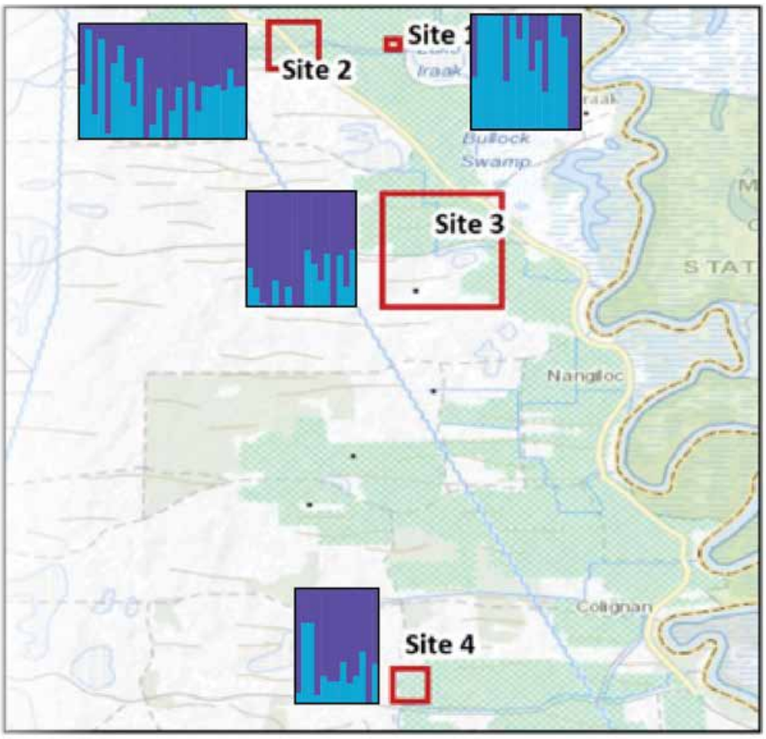


Fleabane Griffith 2020





Fleabane Sunraysia 2020



Seventeenth Australasian Weeds Conference

Colonisation of agricultural regions in Western Australia by *Conyza bonariensis*

Catherine P.D. Borger[1], Greg Doncon[1] and Abul Hashem[2]
[1] Department of Agriculture and Food WA, PO Box 432, Merredin, WA 6415, Australia
[2] Department of Agriculture and Food WA, PO Box 483, Northam, WA 6401, Australia
Corresponding author: cborger@agric.wa.gov.au

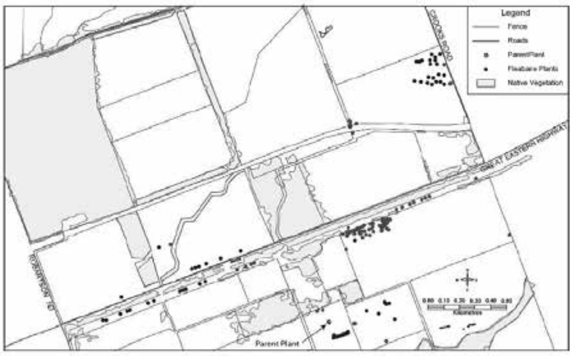
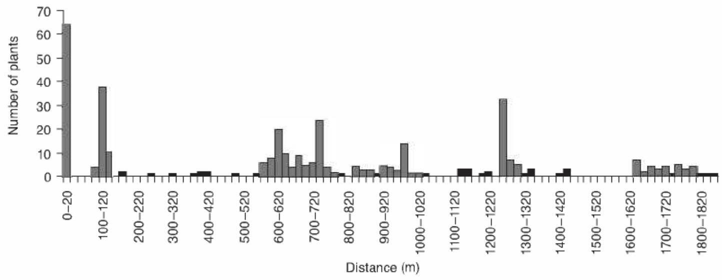
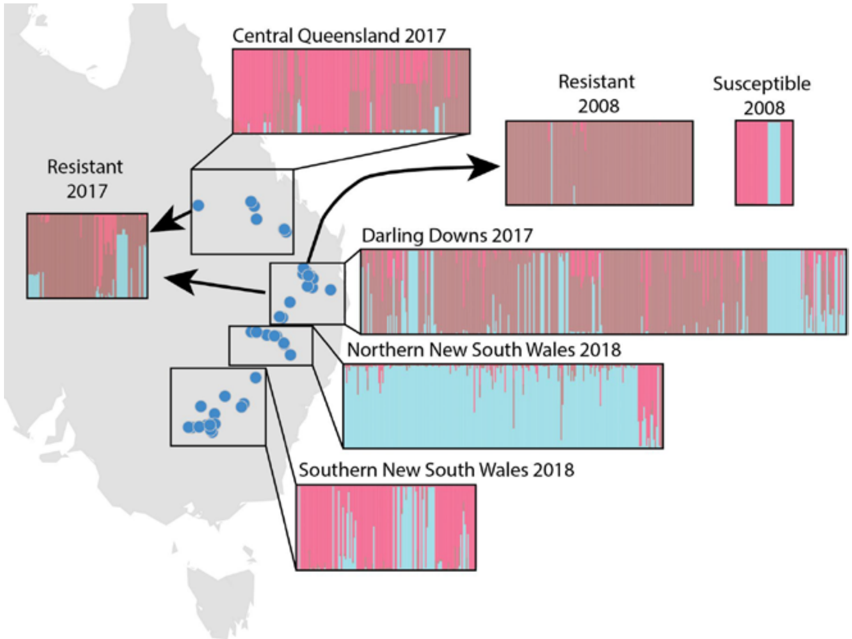


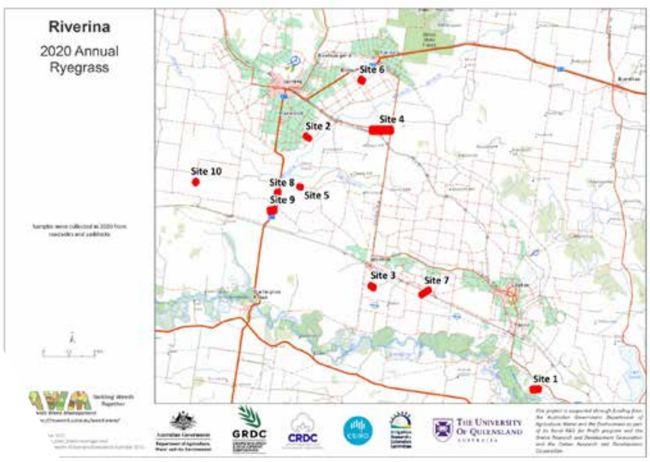
Figure 2. Location of *C. bonariensis* (fleabane) rosettes (dark grey dots) collected on the Research Station, from May 2008 to February 2009. Robartson and Crooks Road border the Research Station to the west and east. The legend indicates the location of Parent Plant, roads, fences and areas of native vegetation.

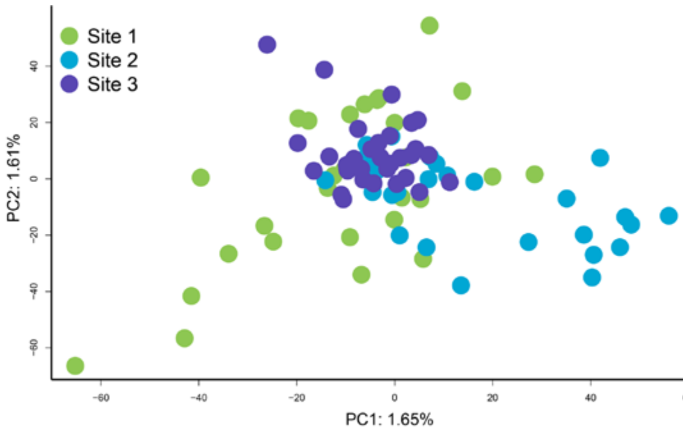


Fleabane CRDC Project UQ1501

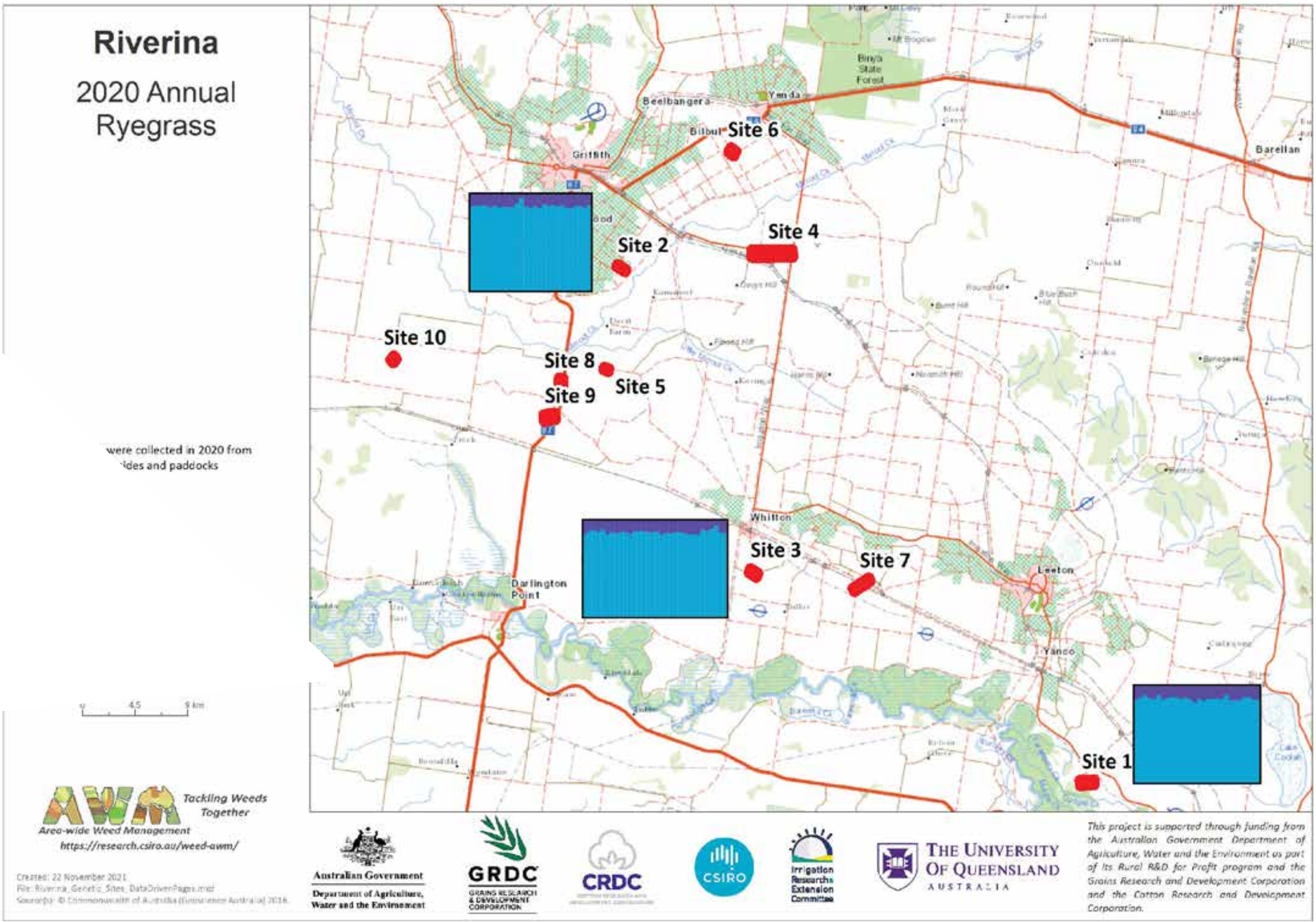


Ryegrass Riverina 2020





Ryegrass Riverina 2020



Concerted efforts to control herbicide survivors are likely to reduce the spread of resistance and have benefits at the regional scale.

Growers'attitudes and practices towards area-wide management of weeds in the Riverina

Findings from the intensive interviews and survey

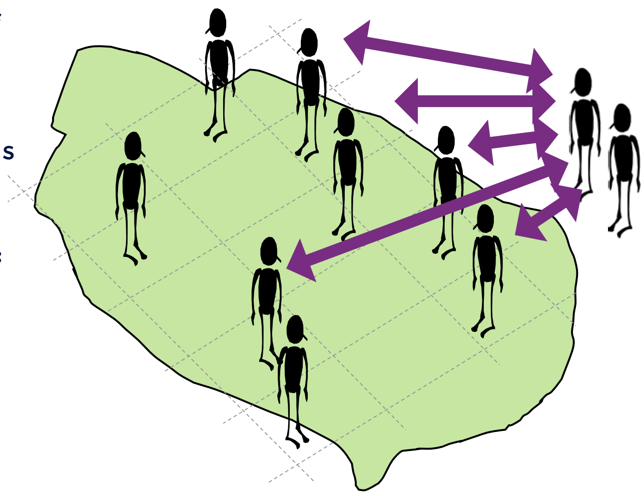
Gina Hawkes, Sonia Graham, Kaitlyn Height, Rebecca Campbell, SiljaSchrader, Louise Blessington, Scott McKinnon
University of Wollongong

Introduction

In 2020-2021 growers, agronomists, consultants, contractors, extension officers, biosecurity officers and public land managers were interviewed and surveyed as part of this social research project.

The aim of the interviews was to:

- learn about the diverse attitudes towards AWM of weeds
- identify factors that explain participation in individual and AWM of weeds
- identify social costs and benefits of AWM of weeds and related practices



The aim of the survey was to collect information on:

- socio-economic characteristics
- the nature of farming operations
- weed management concerns and beliefs
- individual and collective weed management practices

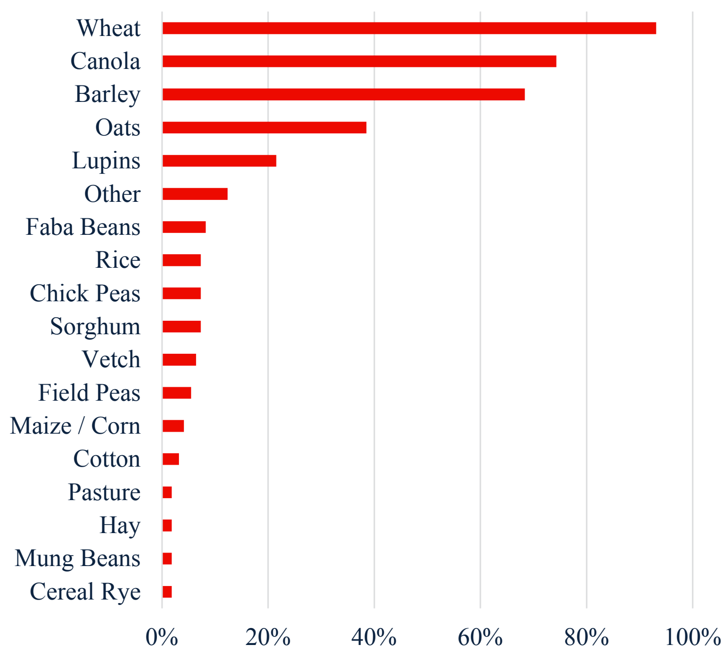
Method

Intensive interviews: 30 from the Riverina (84 total)

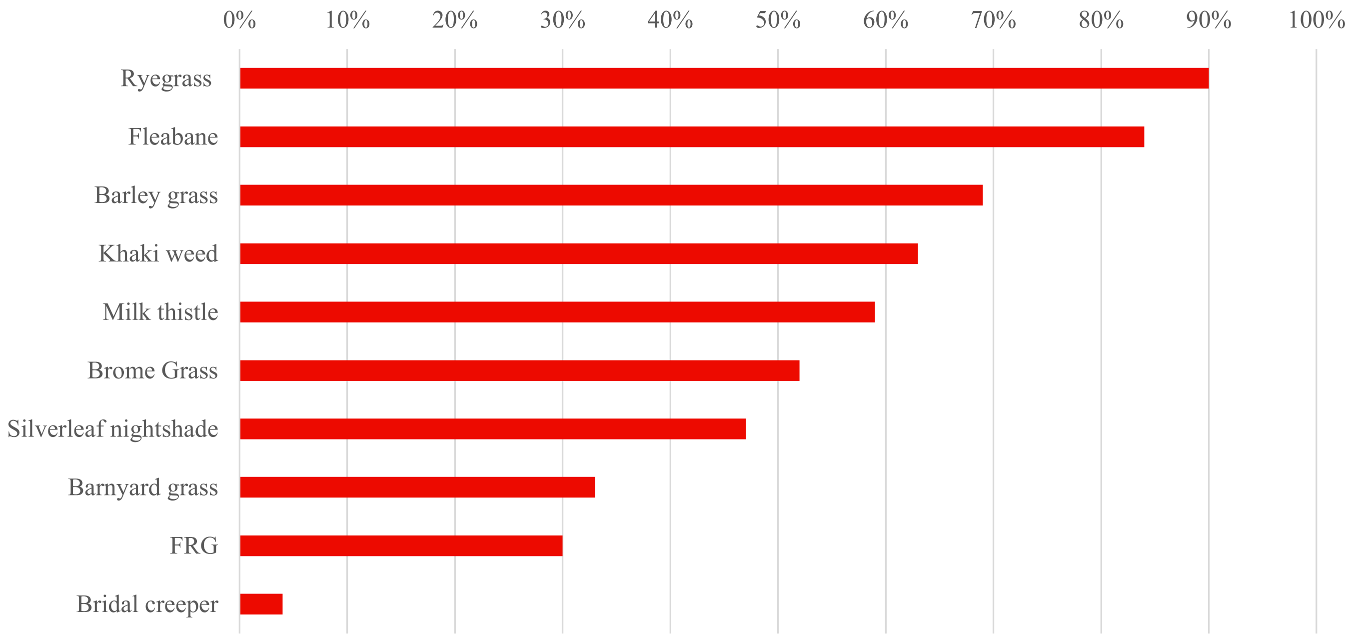
Growers	14 participants
Information provision	10 participants
Government	6 participants

Survey: 218 growers from the Riverina (604 total)

Crops grown by at least 2% of Riverina survey respondents



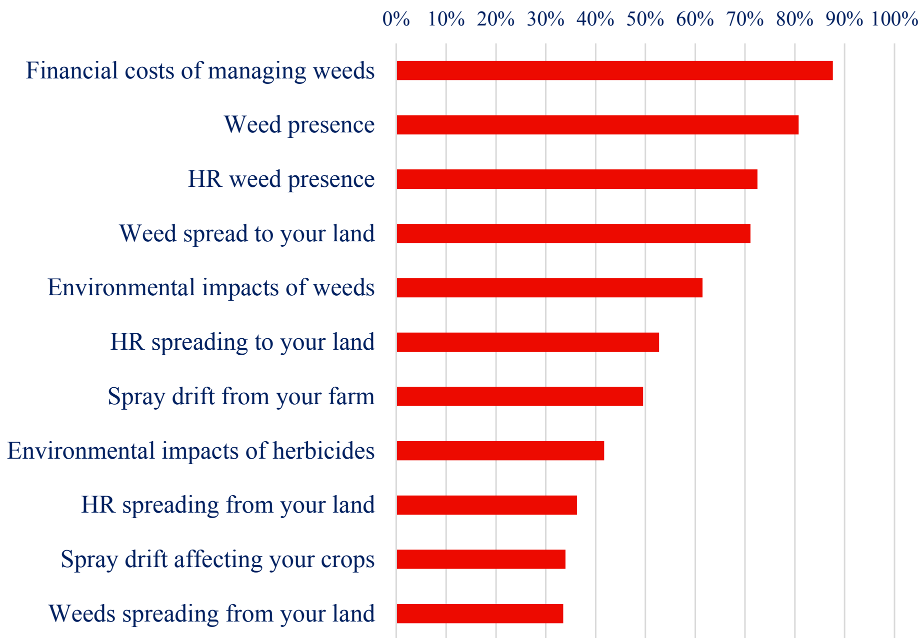
Weeds of most concern in survey



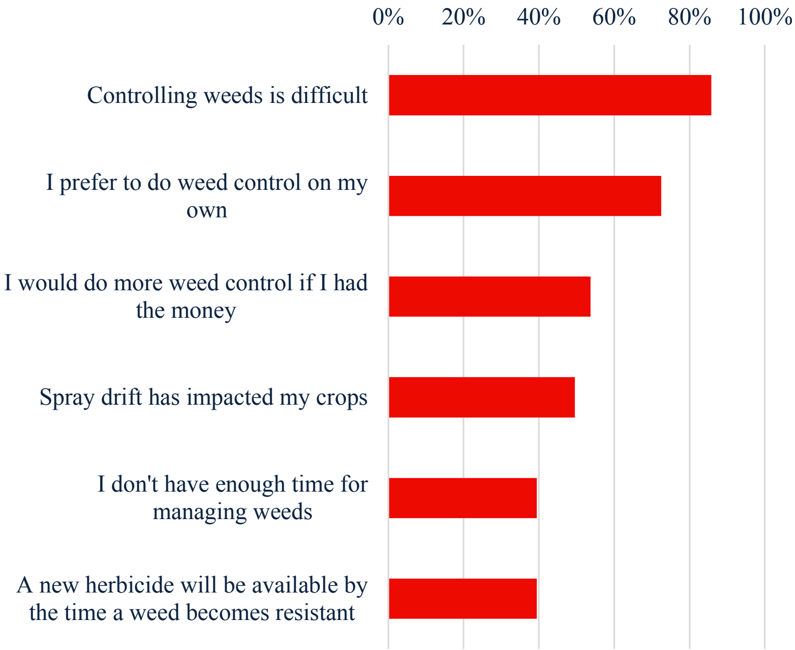
Proportion of Riverina growers who were concerned about each of the 10 weeds.

Proportion of growers who were concerned or very concerned about 11 weed management issues

"The main issue is resistance to chemicals. We're relying on chemicals more and more now, and if they become resistant… [it] makes everything harder than it should be… More expensive chemicals for one, because you're putting bigger rates, and you're putting more expensive chemicals to try and pull down the weeds. And also it takes more time, so that's at a cost. It takes – and if you cultivate, it's more time again, fuel, machinery, wear and tear, so it's just a flow-on effect."



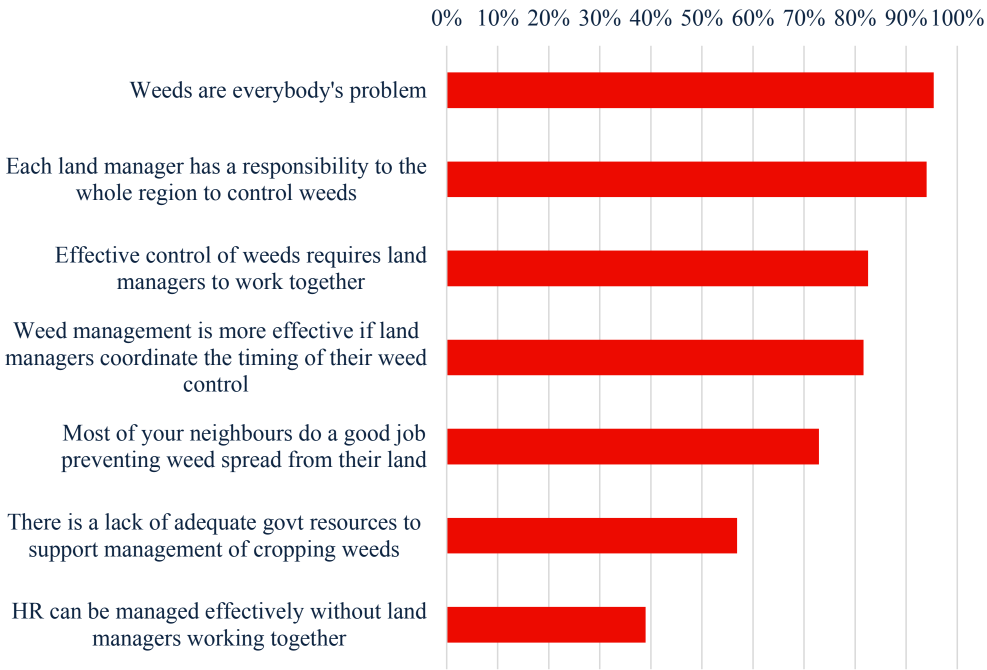
Proportion of growers who agreed or strongly agreed with 6 statements about weed management



"we manage one section that borders on another almond farm and we don't really work together to manage weeds. The channels run wild, that sort of thing. It's probably something that we should do, but no, we don't.

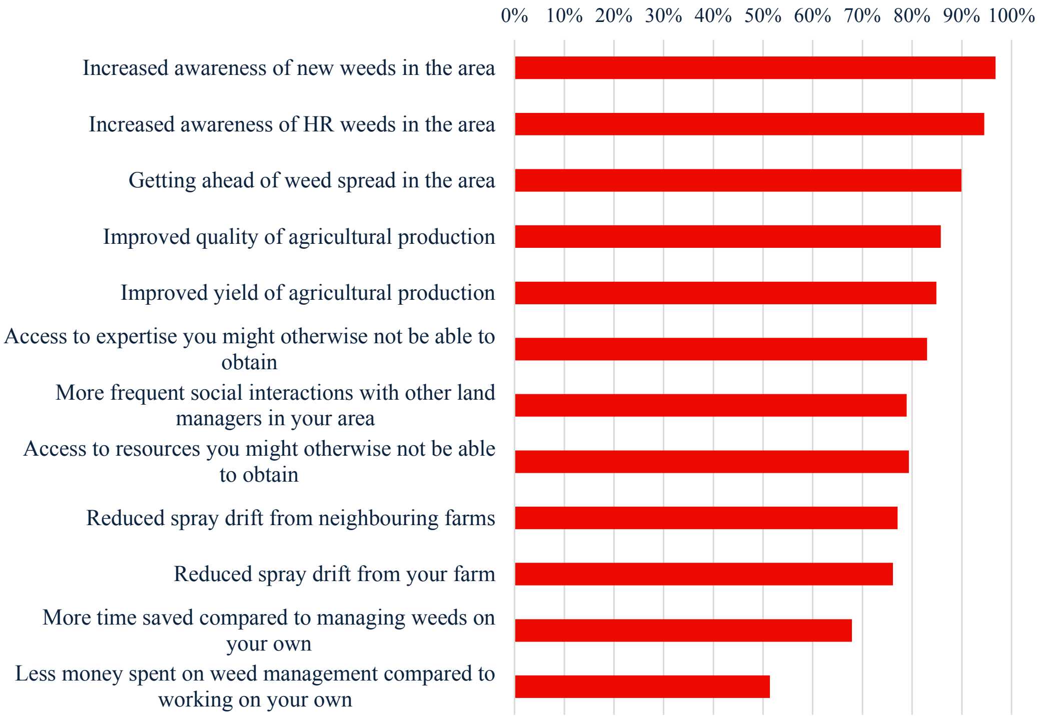
Proportion of growers who agreed or strongly agreed with seven statements about collaborative weed management

"prevention's better than cure. And to have that open communication without feeling like the government departments are coming down on [you] like the hammer, will be a lot more benefit in the long run".

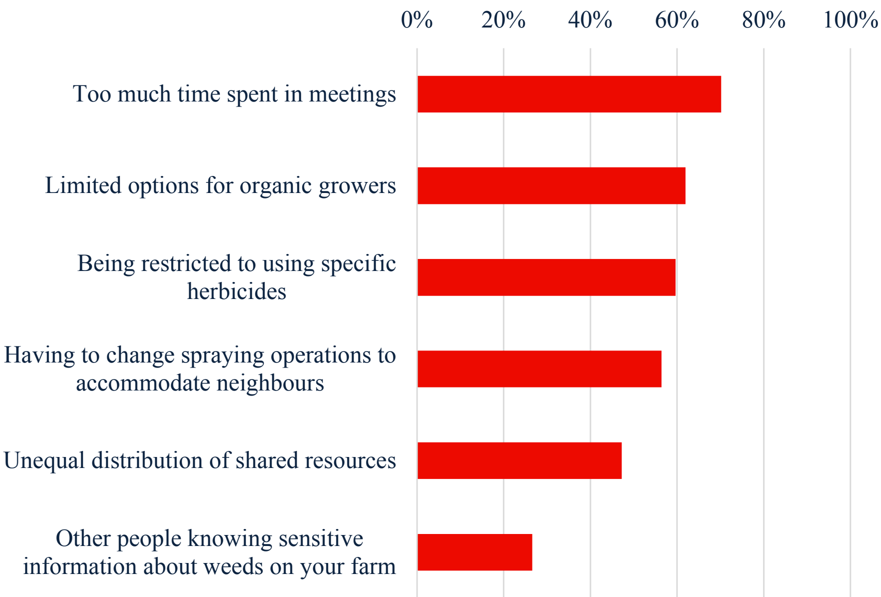


Proportion of growers who agreed that each benefit would arise from managing weeds with other land managers

"I think awareness of the issue, and having an improvement in best practice. So, more people adopting the early residual, the at plant pre-emergence and the in-crop layby. If we can get even a 20 or 30 percent increase in growers adopting one or two of those things, I think we'll see much better, more rigorous weed control than we're seeing at the moment".



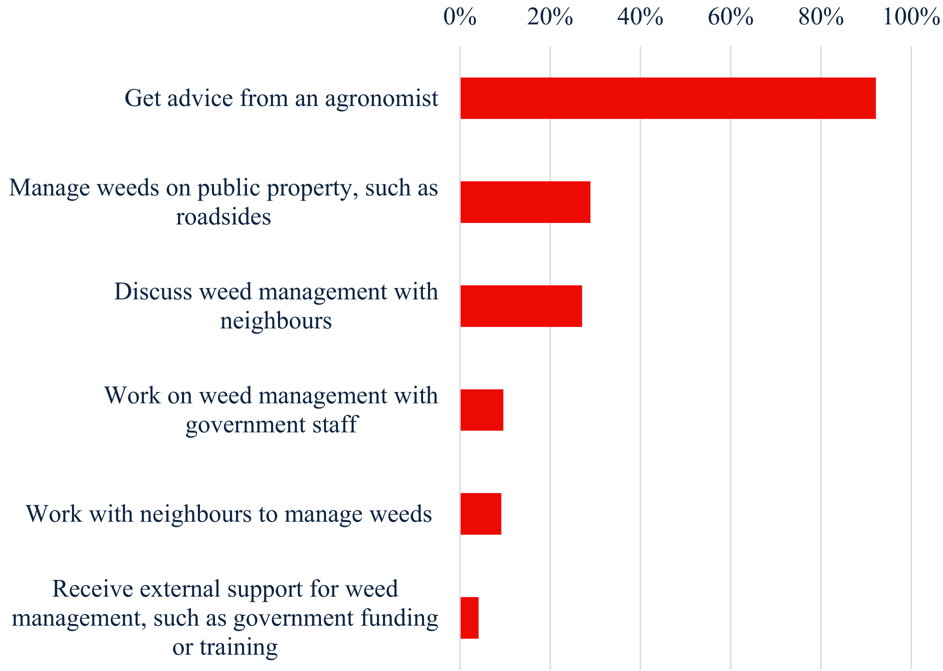
Proportion of growers who agreed that each cost would arise from managing weeds with other land managers



"There could be a number of people that just don't like to get together, so they're not involved. But they could be encouraged to be involved…we probably ask a lot of growers' time to go to meetings. So, they've got to go and get something out of it, and the reality is irrigators grow a number of crops, and probably can't go to everything because they're on their farm… I think if people got something out of that meeting, if they got something they could easily implement practically on their farm, the word would spread that you should come to this meeting".

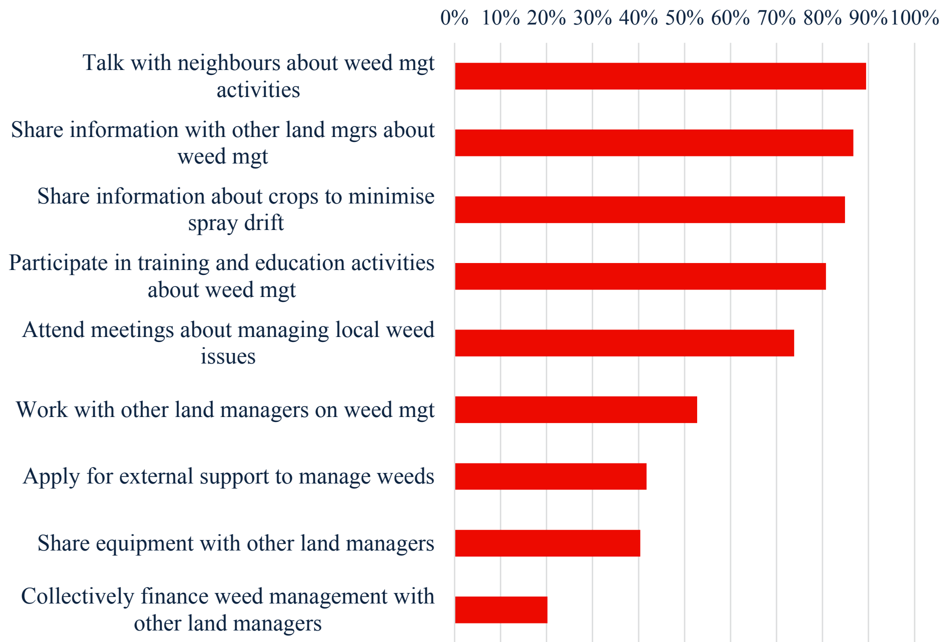
Proportion of growers who frequently or always participate in six collaborative weed management practices

"It would be very handy to have some open communication about what [the local irrigation organization] are planning to do. And also, if they're not planning to do our section for the year. Perhaps, say, "If you guys do it. We'll give you a voucher or we'll give you a metre water for free." I don't know. It would be really nice to be able to work closely with these guys, but there's no discussion with weeds ever."



Proportion of growers who would be likely or very likely to participate in nine collaborative weed management practices in future

"I would love it if my neighbours would get on top of their weeds and work as a bit of a group. I know they don't have the right equipment where we do, but I would love them to say, "Let's work together and get it under control," but I don't think they will. I think it is necessary because weeds spread very easily through just blowing around and with machinery coming in and out of farms. We use a lot of contractors here as well, so that could have been a reason why we've got Fleabane, but I think it is important that people work together, and people identify that weeds can be a major problem."



Controlling weeds around irrigation stops

IREC Demonstration Trial —
Part of the Area Wide Management of Weeds Project

Hayden Petty
SummitAg

Background

As part of the Area Wide Management of Weeds project this proof-of-concept study was designed to identify other weed control methods to:

- Control weeds on farm where over reliance of herbicides is causing resistance
- Control weeds where cultivation cannot be used
- Reduce seed set around irrigation channels/drains to limit movement in water and potentially off farm

Reliance on Chemical Options

Treatments

1. Untreated control
2. Weed matting
3. Bio Diesel
4. River Rock
5. Residual Herbicide (Valor)

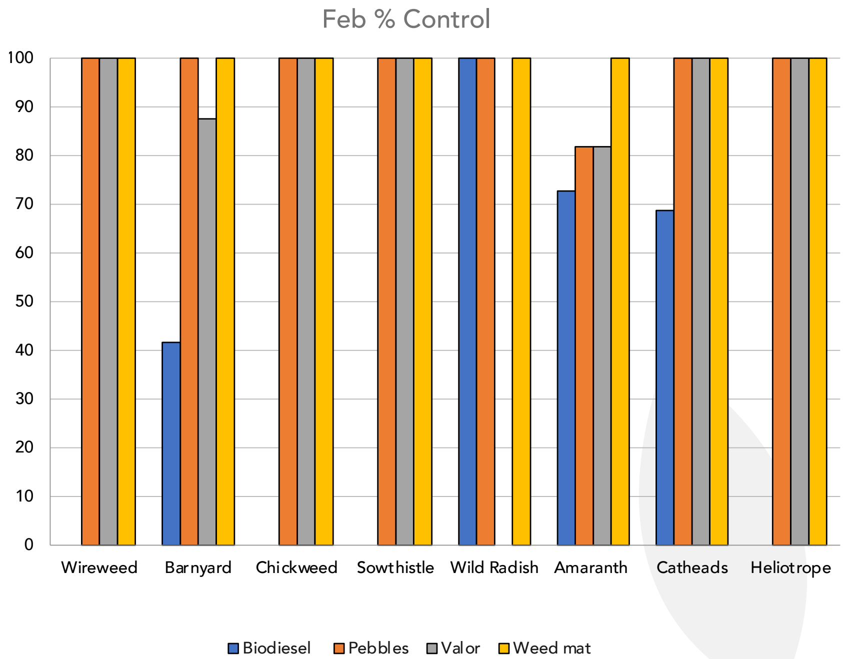
Physical Treatments

River Rock laid 30mm think

Black weed matting

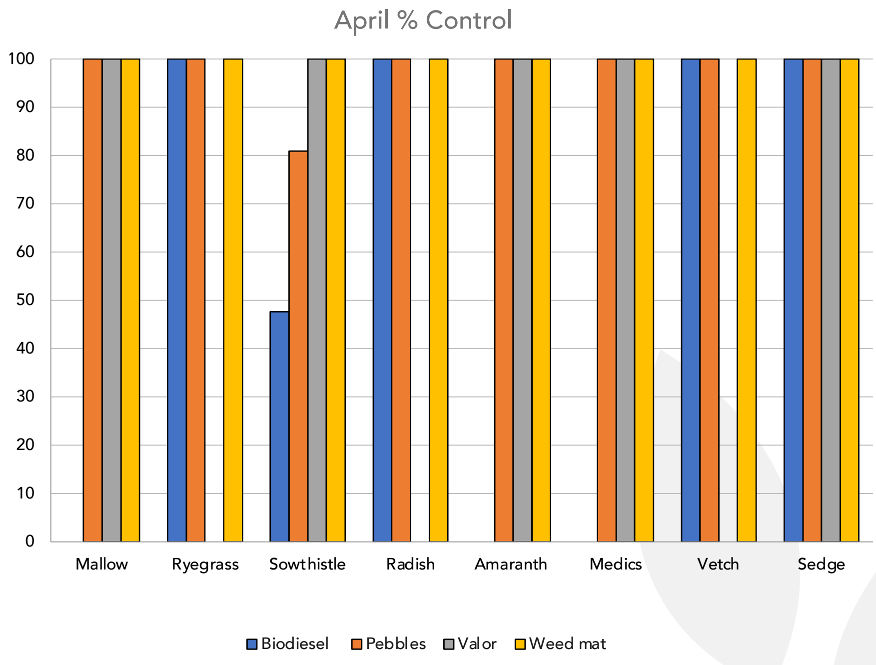
Results – Summer Germinating Weeds

- Weed matting and pebbles being a physical barrier have controlled nearly 100% of weed populations
- Biodiesel had no control on wireweed, chickweed, sowthistle or heliotrope
- The residual herbicide Valor had good control except for on wild radish



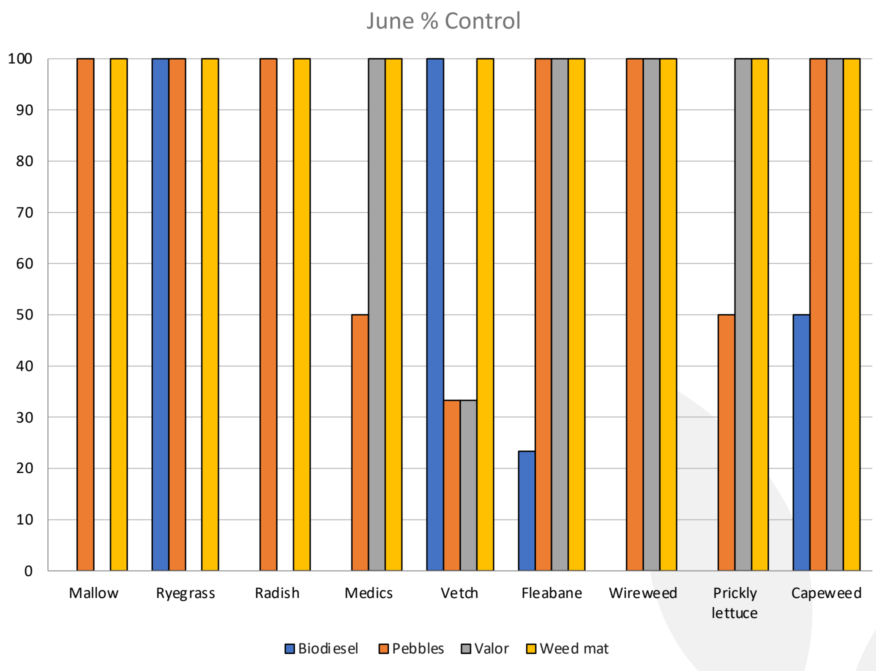
Results – Autumn Germinating Weeds

- Again, the weed matting and pebbles had the best control of weeds
- Valor struggled to control radish, vetch and ryegrass where biodiesel controlled these weeds



Results – Winter Germinating Weeds

- The pebbles started to see medics and vetch break through
- The weed matting has remained weed free
- Biodiesel has had good control on ryegrass germinations
- Valor has controlled 100% of fleabane populations



Summary

- Providing a physical barrier to prevent weed germinations has been the most effective method so far
- The Valor herbicide treatment and Biodiesel have almost been complementary to each other
- Interested to see how the river rock and weed matting plots stand the test of time
- There won't be one single option that will provide continuous control
- Controlling seed set is the main game

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Summit Ag Agricultural Consulting

The Cool Soil Initiative: Program update and relevance for irrigated cropping systems

Dr Cassandra Schefe
Cool Soil Initiative

Overview – Program Update and relevance:

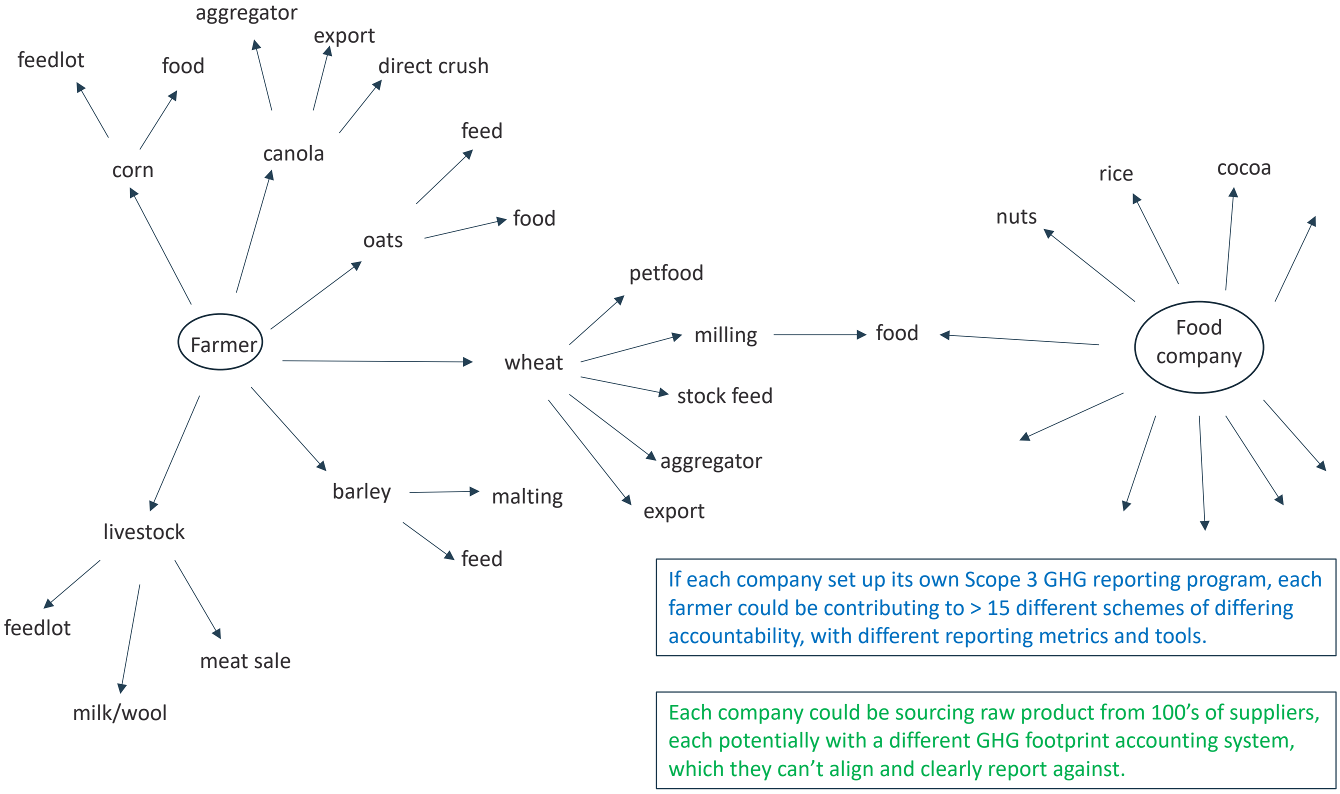
- Why are companies investing in a pre-competitive program?
- What's the outcome that we're looking for?
- What's it all about?
- Where are we up to in the MIA/CIA?
- Next steps

Dr Cassandra Schefe - Project Lead
AgriSci Pty Ltd

AgriSci CPSS FERTCARE® Cool Soil INITIATIVE 4/8/2022 2

Why are supply chain companies interested in emissions?

- "Scope 3"
- All emissions associated with the production of commodities. For food companies, it is the emissions associated with production of raw ingredients, eg wheat production
- Scope 3 can comprise up to 70-80% of total food footprint.
- This means that even if companies reduce their energy usage in manufacturing facilities, the total emission footprint associated with an end product (eg biscuit) does not drop substantially.
- All publicly listed companies will have increasing requirements for emission / sustainable sourcing reporting.
- (For a farmer, Scope 3 emissions are the production of fertilisers, pesticides etc)



Concept of the Cool Soil Initiative (in Grains)

Streamlined Farmer data input
&
Engagement & Support for on-farm change
(not a 'tick & flick')

Grain aggregators / millers

Food/beverage processors

Active engagement & contribution to project success
(Capture *practices*, not just numbers)

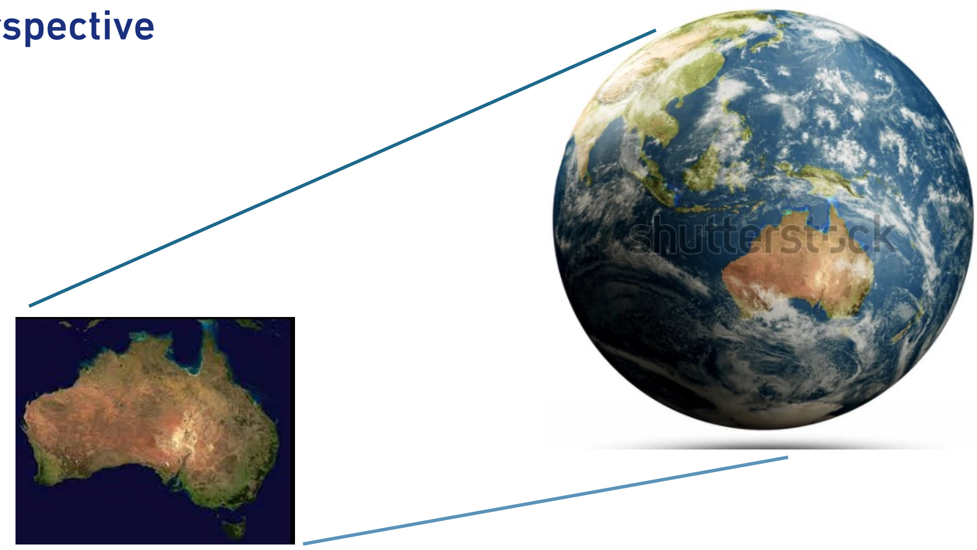
End user recognises low on-farm GHG footprint of commodity (consumers/export reporting)
*Global connection

Scope 3 emission reporting follows international GHG accounting protocols, supported by the Sustainable Food Lab.

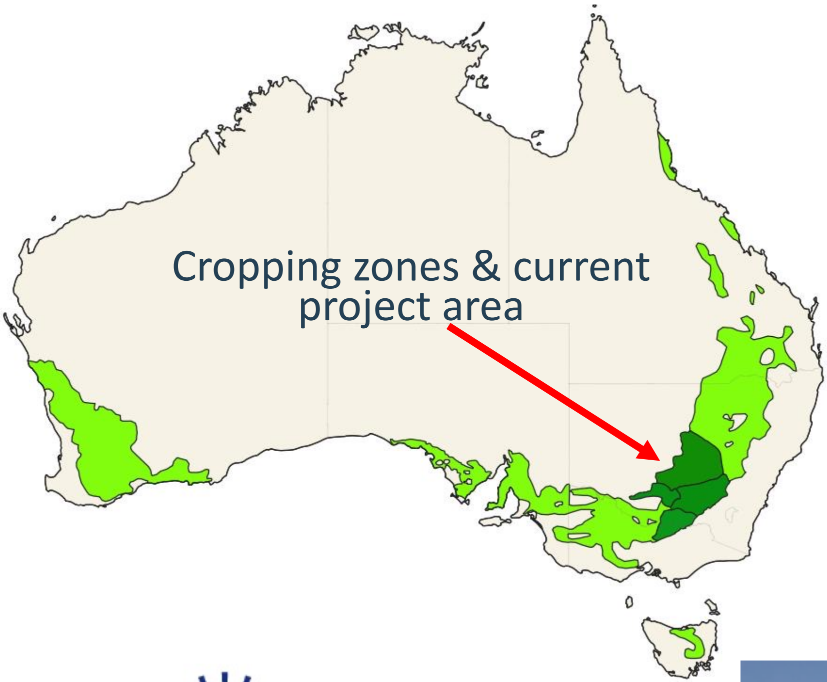
Program audit by Gold Standard.

Learning to date:
Farmers are highly engaged, understand the need to capture emissions (and use GHG numbers to inform on-farm change). They are desperately seeking clarity.

Global perspective



Farming system groups are key to on-ground relevance



Irrigation Research & Extension Committee

CWFS Central West Farming Systems Inc.

FarmLink change • adapt • prosper

RiverinePlains

RiverinePlains

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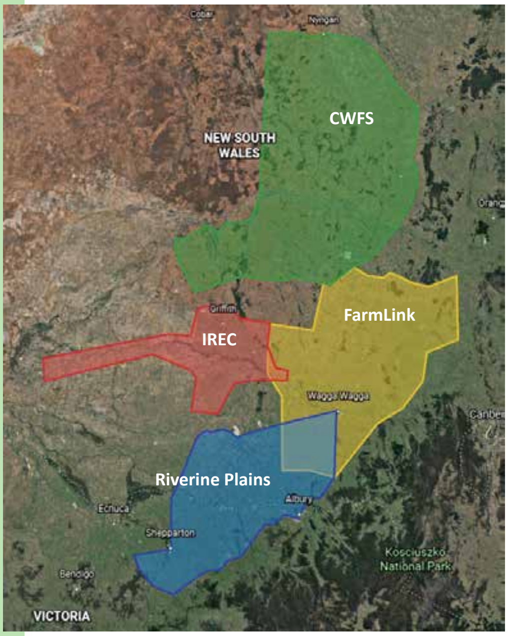
CWFS Central West Farming Systems Inc.

Irrigation Research & Extension Committee



Currently 145 farmers + corporate farming entities, 185 by end 2022

Farming groups are independent and trusted

Support farmer-driven innovation ideas – peer learning

Use farm data to ID good practice, share the stories

Farming groups contribute to project direction, ensuring strong farmer advocacy and reality

Outcome: On-ground reality in productive farming systems

Identify and address key constraints/deficiencies

↓

Support optimal plant growth (& diversity where possible)

↓

High NUE and biomass/root production = greater productivity

↓

Effective use of inputs = increased profitability

↓

Greatest potential to maintain or increase soil C

↓

Reduced GHG footprint

Soil C & GHG footprints are the *products* of the system, not the drivers thereof.

Key drivers of on-farm emissions

- Nitrogen
  - Due to high manufacture emissions, N_2O has high GWP, and high rates of application (triple whammy!)
  - Reducing urea from 900kg to 765kg/ha (15% reduction) resulted in a 16% GHG reduction if yield was maintained
  - Soil testing and refinement to match N requirements to yield
  - If other nutrients are not adequate, N efficiency will be low
  - Need to focus on improved system fertility
- Soil disturbance
- Waterlogging
- Soil carbon provides a valuable offset to reduce emissions

Farmer engagement project

- Each farming group engages with farmers within the region (local relationships)
- Farmers nominate up to 5 paddocks each year to be included in the project, with paddock history, input data and yields to be provided (data portal in development for ease of inputting – for whole farm data). Data is sent via API to the Cool Farm Tool for GHG assessment with data returned to database.
- Each farmer receives up to 5 free soil tests a year, to ensure the best quality data to go into the assessments (especially soil C and pH)
- Receives GHG assessment with anonymous benchmarking across region, and invite to attend a series of small group peer sessions and an annual grower meeting each year.
- While the GHG metrics are needed for project value, focus on soil C initially, while GHG values are being evaluated.
- Project is supporting 'innovation' trials, through providing additional funding to farmers who want to try something different that may benefit soil health / farming system – learnings shared with the group
- All data coded and anonymised before submission

Key point – the real value of this program is the local relationships and peer learning

Local connection:

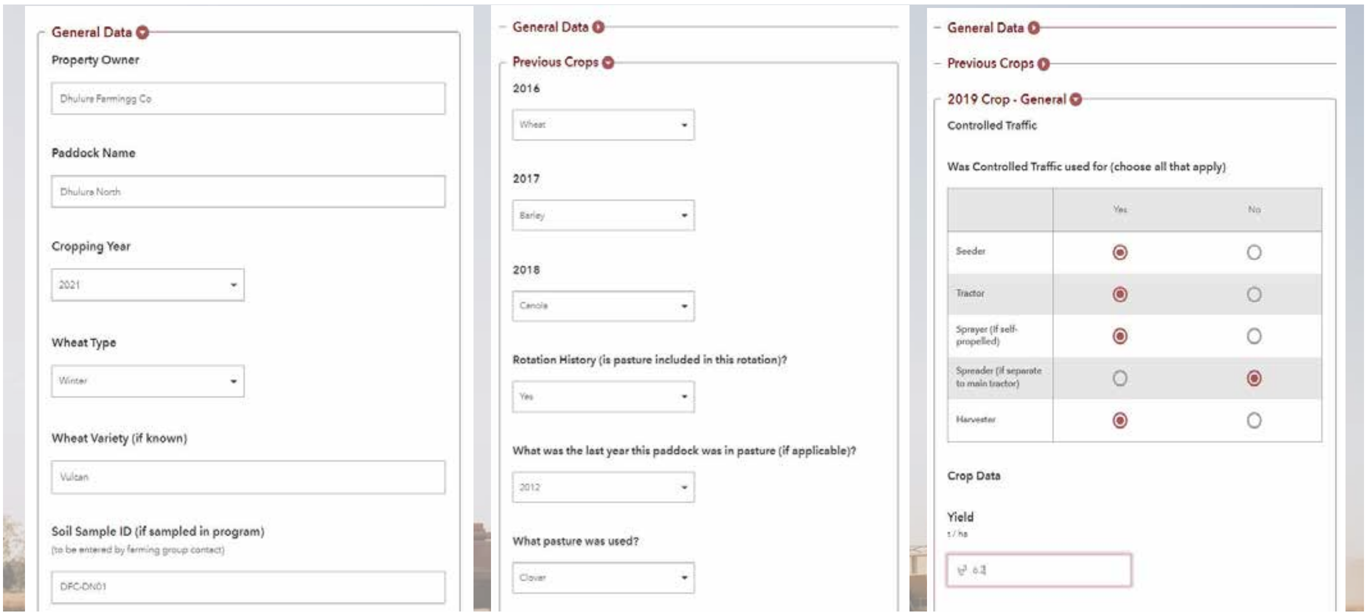
- IREC are the local partner of the Cool Soil Initiative
- Up to 5 paddocks of maize and/or soft wheat can be inputted each year
- Free soil tests in each of the 5 paddocks
- Paddock history and crop input data 'shared' under legal data sharing agreements (Your information cannot be used for any purpose other than the project, you retain ownership).
- Data entry and GHG emission reporting through a web portal with access to additional satellite imagery
- Corporate investing partners only receive anonymised, aggregated data
- Peer learning, soil pits, paddock walks
- Fully supported entry into emission reporting, focus on farmer value

Irrigation Research & Extension Committee

Why should farmers consider participating?

- Participation in **Cool Soil Initiative** (with no lock-in contracts) means that farmers can:
- Quantify your carbon balance on farm (on a commodity-basis), using any net C gain to offset your own emissions,
- Demonstrate C Net Zero (or low emission grain) through credible, accountable processes (and get recognition for that),
- Report your emissions (and reductions thereof) through your supply chains, which will contribute to maintaining market access in future
- Down the track, choose to share your sustainability metrics with agribusiness partners etc for potential financial gain
- Initial framework development in cereals and irrigated maize, future development across sectors for full supply chain integration
- Local connection, global relevance

Using smart forms to streamline data collection



Progress in the MIA / CIA

15 farmers came on-board in late 2021, with a focus on maize production

- Soil testing has been completed
- Activity data being collected now, in order to calculate GHG assessments

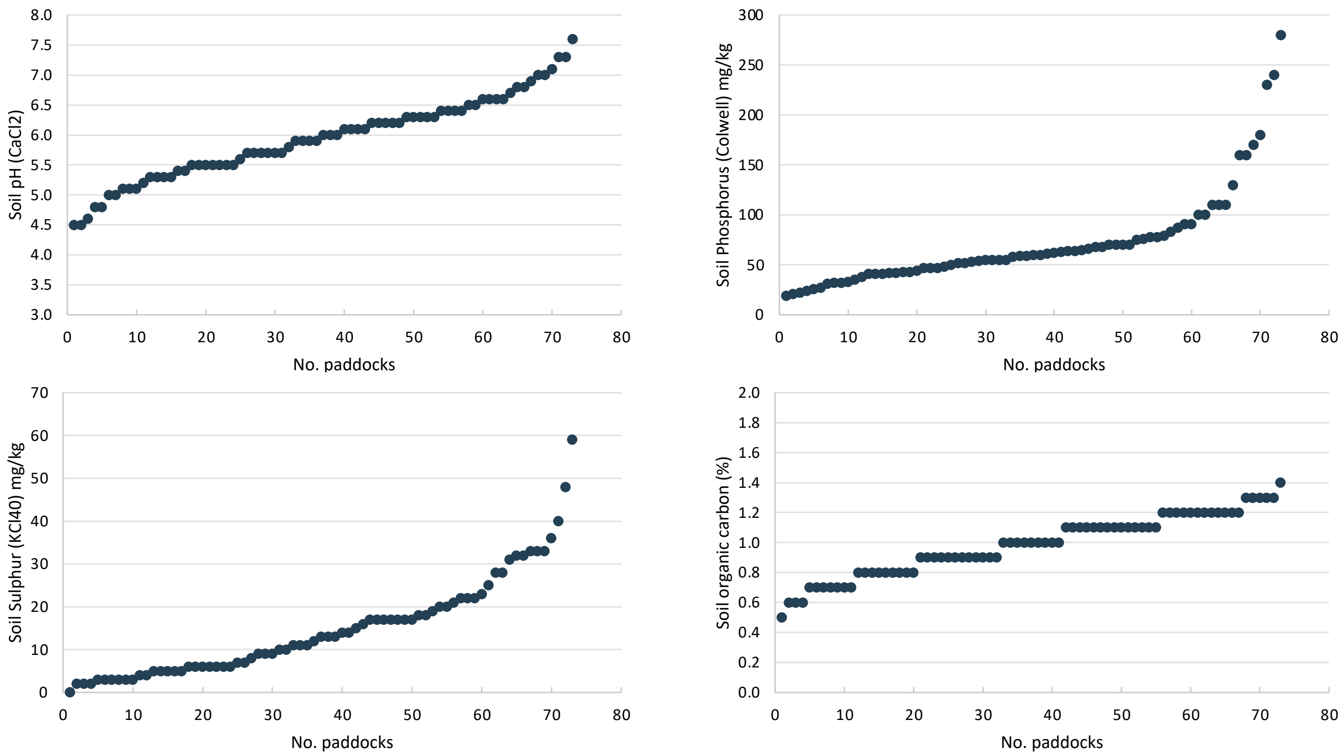
Opportunity for an additional 25 farmers to come on-board in 2022

- 10 in maize
- 10 in soft wheat

A number of small group sessions have been held, with a focus on soil health and nutrition

Annual meeting of corporate partners and participating farmers to connect the dots

Initial findings – soil tests



Next steps

- As more farmers come on-board in the irrigated region, the more evidence we have to demonstrate good farming practices, and their connection with emission reductions
- As more companies come on-board, we can expand the range of crops of interest – farming system focus
- The Cool Soil Initiative team is building an ongoing hub/organisation to enable companies to continue to invest in a common framework of emission reporting, which...

... will support farmers in on-ground best practice, reduces reporting overload, and provides information back to farmers for on-farm benefit.

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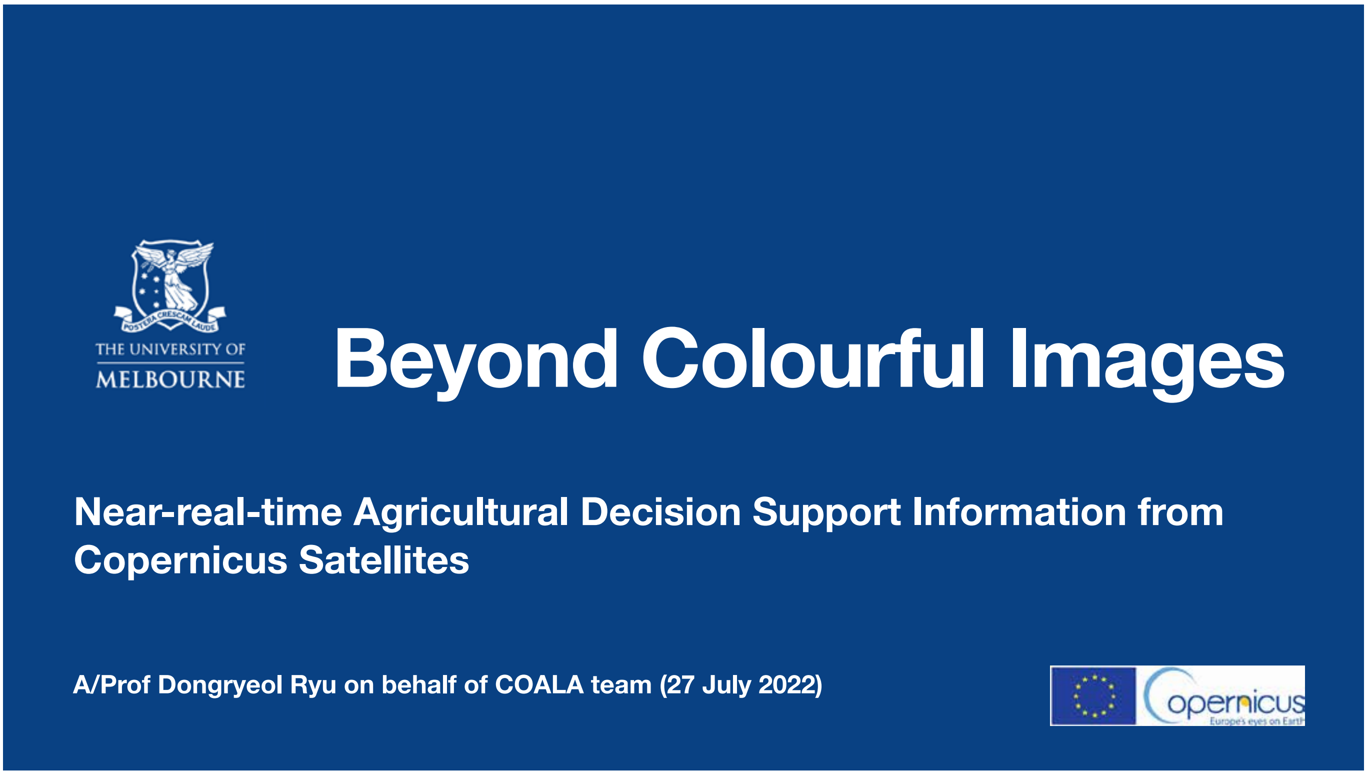
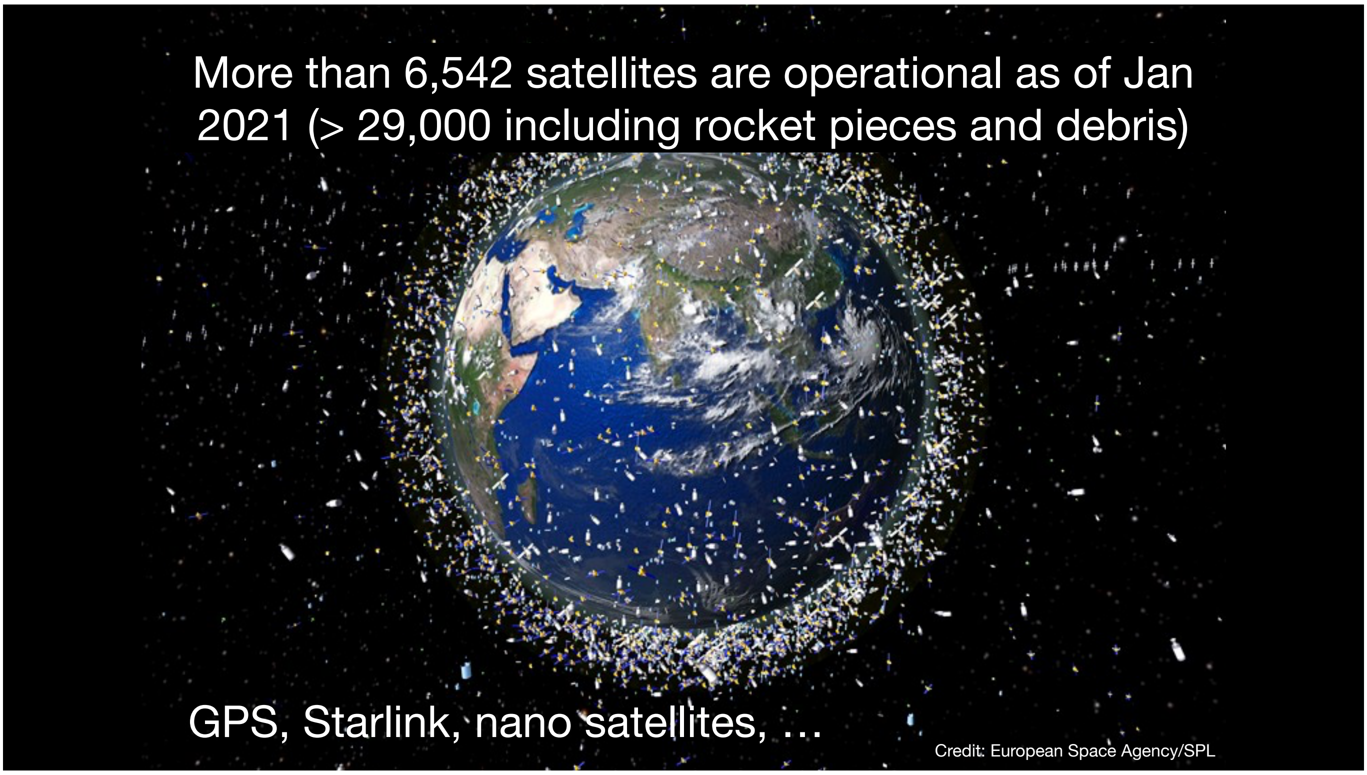
Beyond colourful images – Near-real-time agricultural decision support information from Copernicus satellites

A/Prof Dongryeol Ryu
on behalf of COALA team





Earth Observation Satellites

NASA's Earth Observation System

ESA's **Copernicus** Satellites

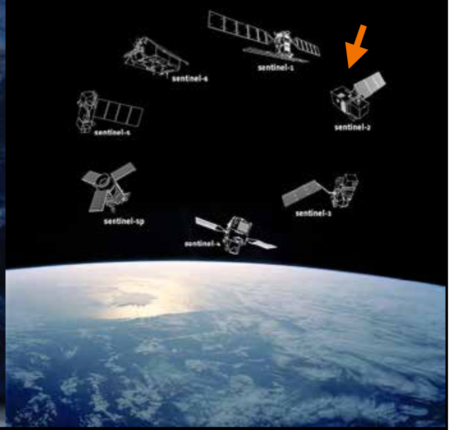


Image Credit: European Space Agency (ESA)

Earth Observing Satellites
+
Information Science
+
High-performance Computers
+
Mobile Device & IoT
↓
More Robust, Accessible and Operational Decision Support

COALA

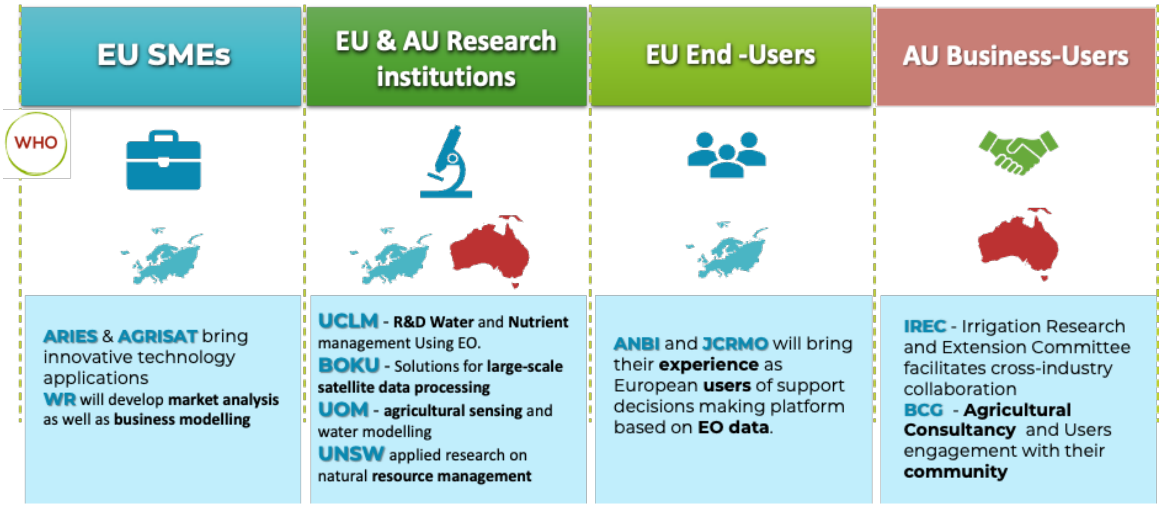
COpernicus **A**pplications and services for **L**ow impact agriculture in **A**ustralia

THE UNIVERSITY OF MELBOURNE

- COALA aims to develop Copernicus-based services for:
  - Supporting more sustainable use of **water** and **nutrients** in the advanced agricultural systems of Australia
  - Sharing knowledge and experience in **Earth Observation (EO)** based applications for agriculture with Australian Institutions
  - Facilitating new business experience between Australia and Europe

COALA Consortium

Industry and R&D Partners



COALA EO-based Products

Crop Water and Nutrient Status

Crop Water Use/Demand

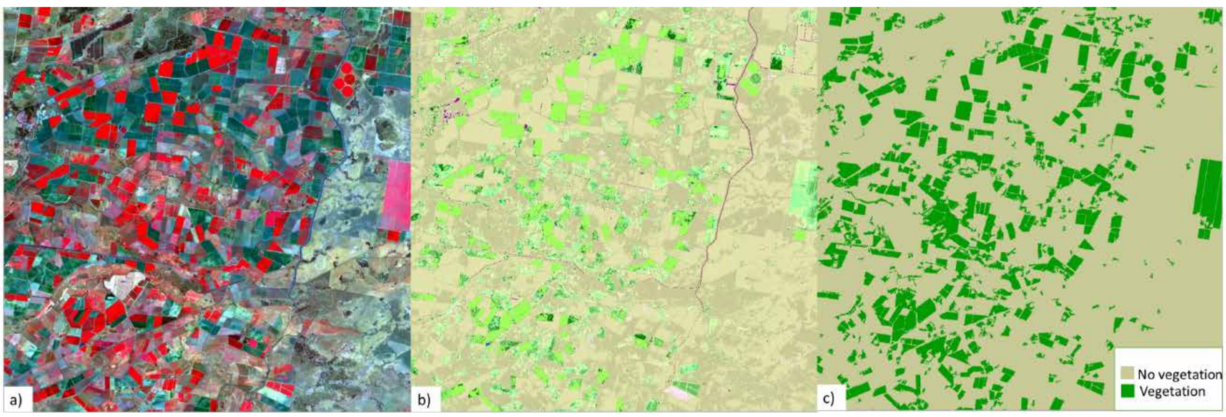
- Irrigated Area/Crop Map
- Crop Water Status
- Crop Water Use
- Irrigation Water Requirement

Crop Nutrient Status

- Crop Growth Time Series
- Crop Yield Modelling (Cereal Crops)
- Management Zone Map (MZM)
- Nitrogen Nutrition Index (NNI)
- Fertilisation Map

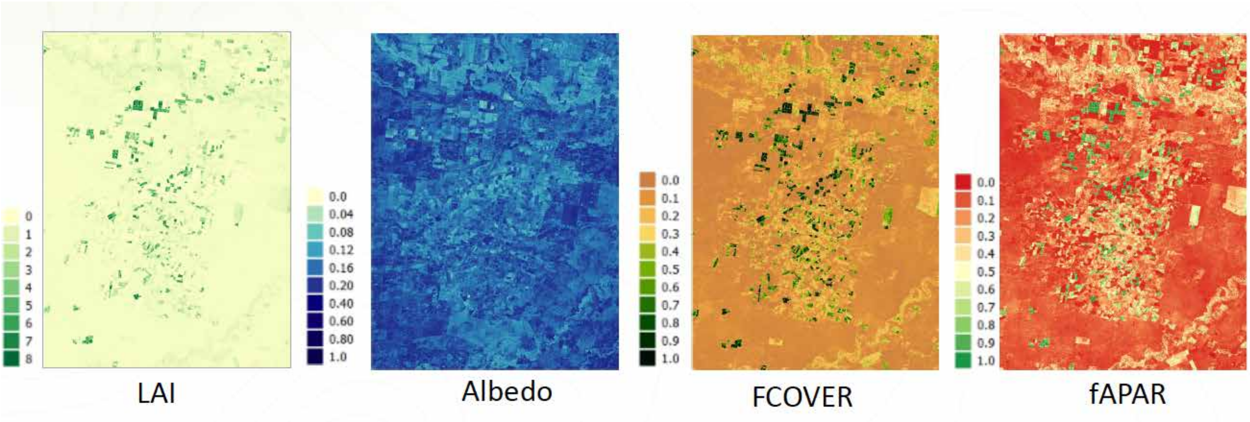
Crop Water Monitoring

Irrigated Areas Map



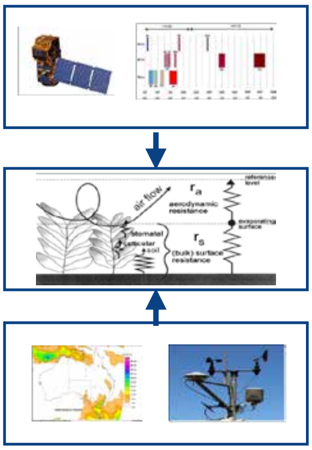
- Identification of irrigated areas from EO data by using machine learning algorithms trained with ground truths

Crop Water Monitoring
Crop Water Status and Biophysical Parameters

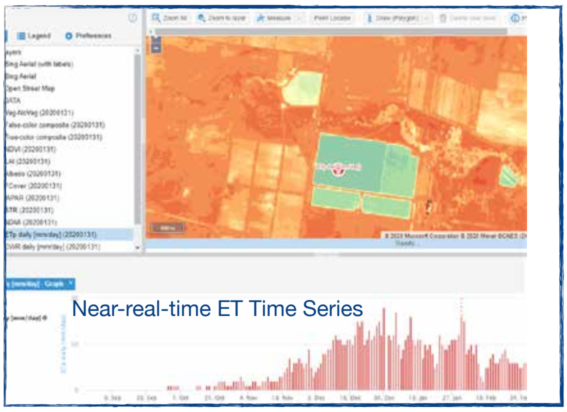


- Various measures of crop growth and photosynthetic activity

Crop Water Monitoring
Crop Water Use (Evapotranspiration) and Demand (Forecast)



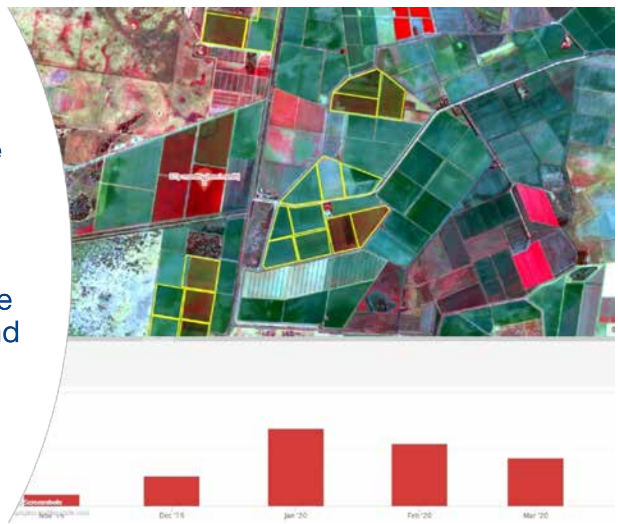
- High-resolution multispectral radiometric images from Sentinel-2. SWIR band (B12) are used for canopy water status estimation.
- Penman-Monteith based evapotranspiration combining weather monitoring + satellite + short-term forecast
- Agro-meteorological data from BoM (near-real-time) + NWP-based short-term weather forecast



Crop Water Monitoring
Aggregation to Larger Areas

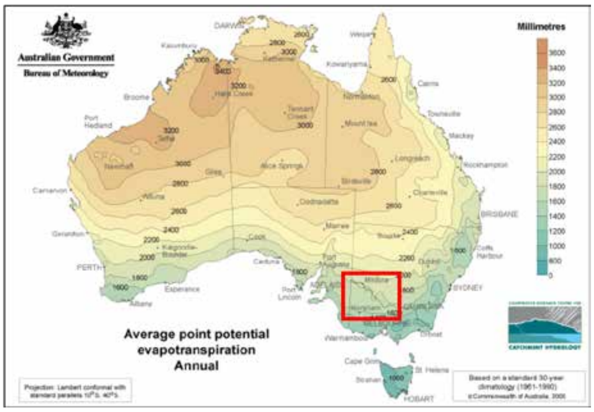
Estimation of Irrigation Water Use from Paddock to District Scale

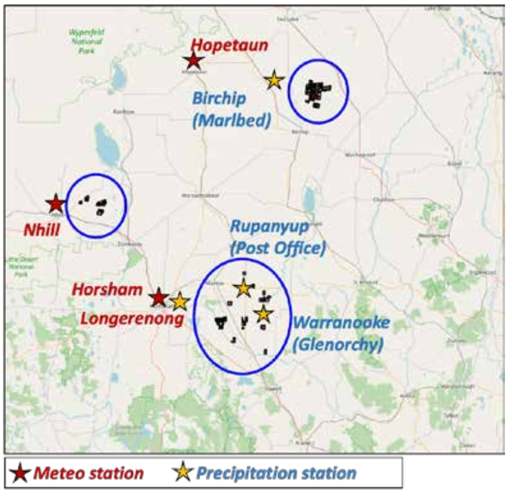
Irrigation water volume estimation based on modified PM-FAO56 can be aggregated from pixel to paddock and large district level



Crop Nutrient Management

Applications to Dryland Cropping Fields in Wimmera





Crop Nutrient Management

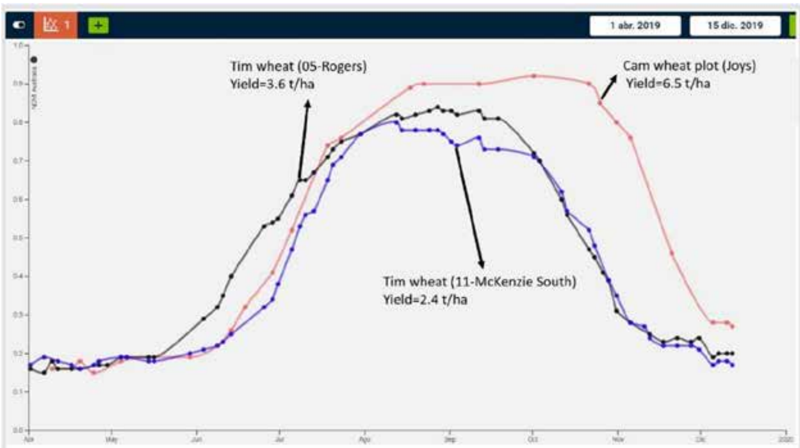
Basic Ideas

- Crop nutrition status is linked directly to the crop yield
- Satellite NDVI time series provide basic input for estimating field-scale yield and its within-field variability
- Satellite NDVI time series is the tool for constructing Management Zone Map (MZM), which guides ways for variable rate fertilisation
- Recent advances in new Sentinel bands (Sentinel 2A/2B) provide tools for estimating in-season crop N status via Nitrogen Nutrition Index (NNI)

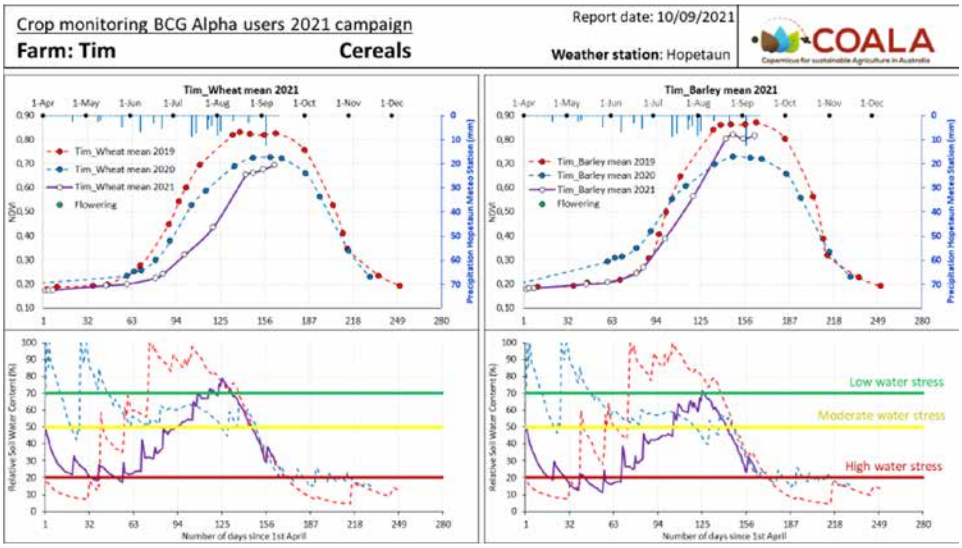
Crop Nutrient Management

Crop Growth Monitoring

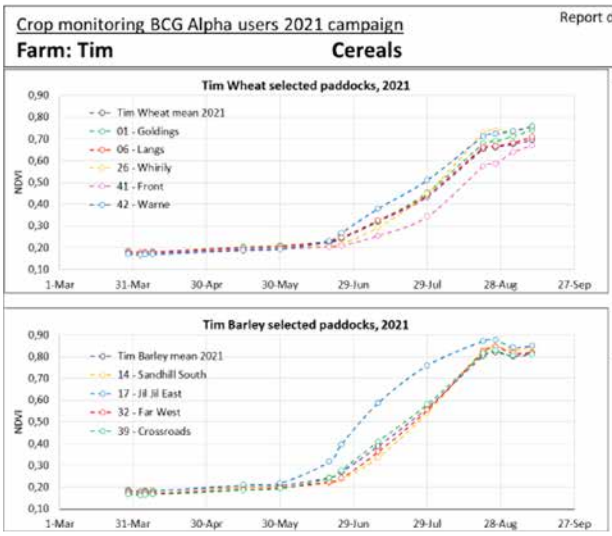
- Time series of NDVI from Sentinel 2A/B provides basic input for monitoring crop growth and yield



Crop Nutrient Management
Crop Growth Monitoring

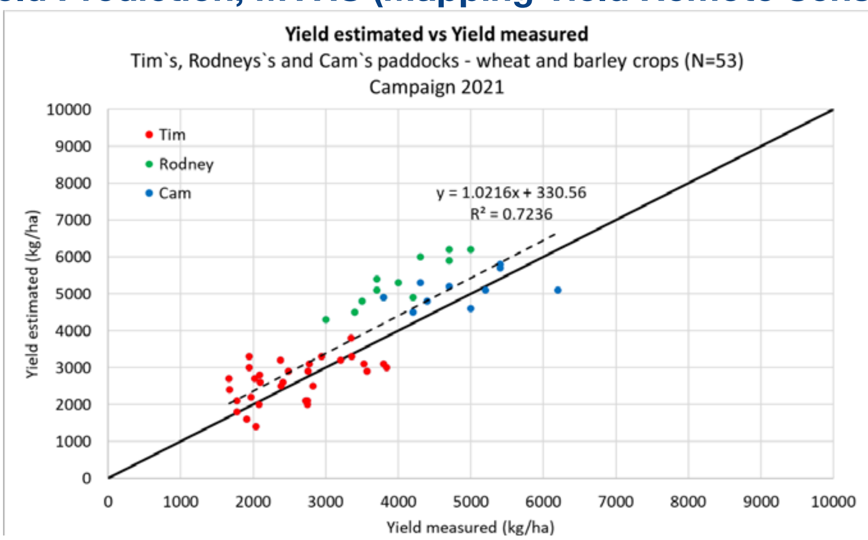


Crop Nutrient Management
Crop Growth Monitoring



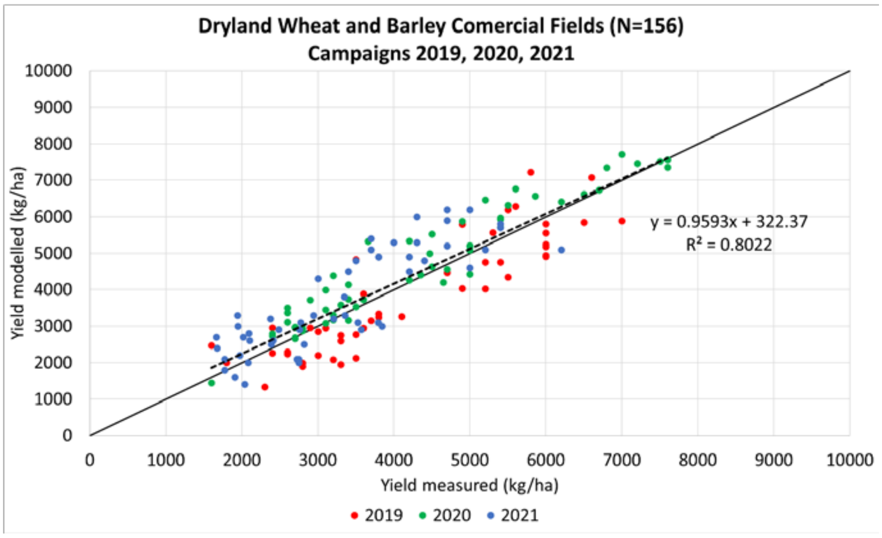
Crop	Paddock	NDVI 10-Sep	Var. Mean NDVI (%)
Wheat	01 - Goldings	0.74	6.8
	03 - Perns	0.66	-5.7
	06 - Langs	0.71	2.0
	07 - Spittles	0.58	-16.4
	09 - Bennetts	0.67	-4.0
	13 - Billabong	0.67	-4.2
	15 - Sandhill North	0.80	15.2
	22 - OKeefes	0.72	3.2
	23 - Alfies	0.64	-8.1
	26 - Whirily	0.76	8.9
	28 - Clovers West	0.57	-18.4
	30 - Hancocks Hill	0.78	13.0
	31 - Back Jack Sheahans	0.73	4.8
	33 - Near West	0.74	6.2
	37 - Barrell	0.62	-10.2
	41 - Front	0.67	-3.9
	42 - Warne	0.76	9.0
	45 - Dip	0.68	-2.5
	47 - Vernies	0.73	4.6
	50 - Hogans	0.69	-0.2
	Mean Wheat	**0.69**	0.0
Barley	02 - Landers	0.77	-5.8
	12 - McKenzie North	0.80	-2.5
	14 - Sandhill South	0.84	3.4
	16 - Bishes East	0.81	-0.7
	17 - Jil Jil East	0.85	4.1
	32 - Far West	0.82	0.1
	34 - North West	0.84	2.7
	35 - Jil Jil West	0.84	3.1
	39 - Crossroads	0.81	-0.7
	44 - Windmill	0.82	0.2
	46 - Monnies	0.77	-5.7
	54 - Sandhill Central	0.83	1.5
	Mean Barley	**0.82**	0.0

Crop Nutrient Management
Crop Yield Prediction, MYRS (Mapping Yield Remote Sens.)



Crop Nutrient Management

Crop Yield Prediction, MYRS (Mapping Yield Remote Sens.)



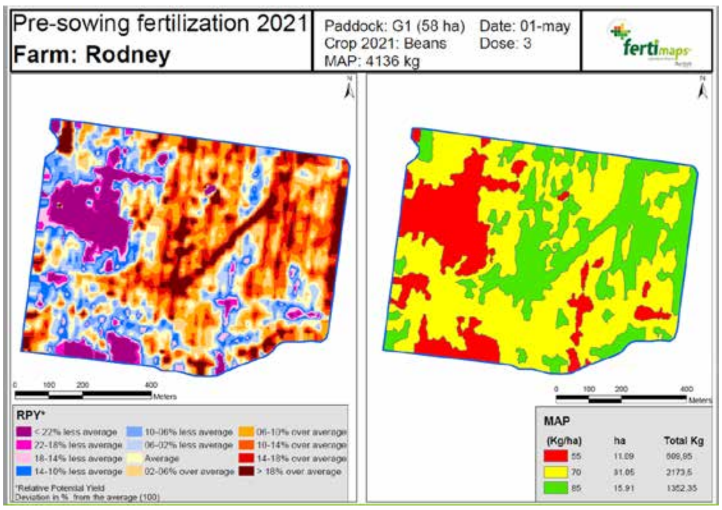
Crop Nutrient Management

Management Zone Map (MZM)

- MZM can be used for
  - Variable rate fertilisation
  - Soil sampling
  - Following-up ripening process of final quality in woody crops
  - Design of irrigation systems
  - Classification of soil qualities for land valuation

Crop Nutrient Management

MZM and Fertilisation

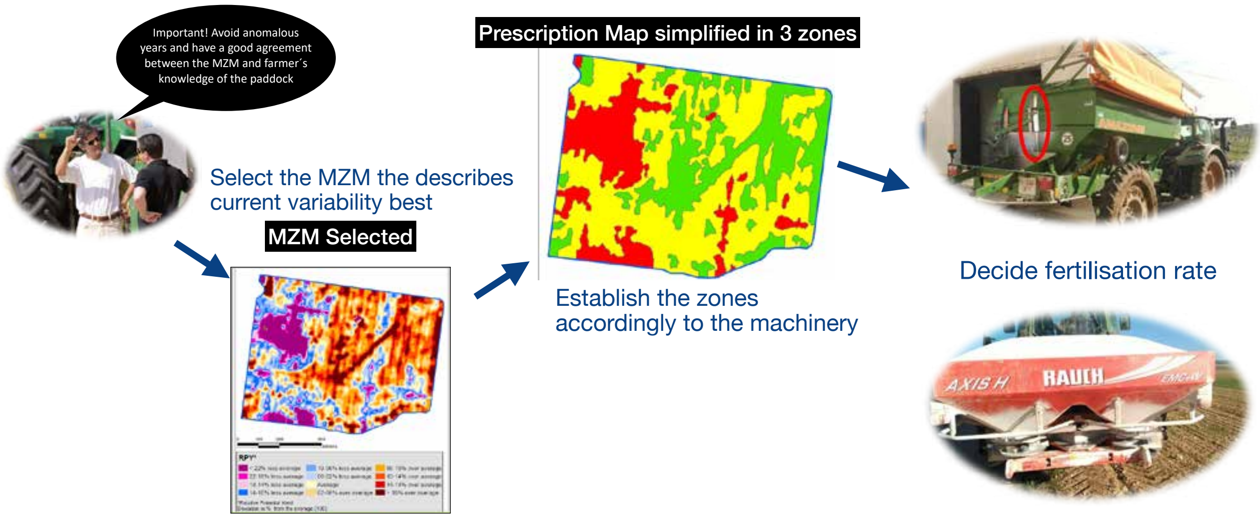


Crop	Beans
Year	2021
Surface	58 ha
Target Yield	1.800 Kg/ha

Fertilization Planning	Phenological Stage	Fertilizer Type	Rates
Presowing Application	Pre-plant	**MAP (N 10% , P 21.8%, S 4%, Zn 1%)**	70 kg/ha
Top dressing application	?	?	?

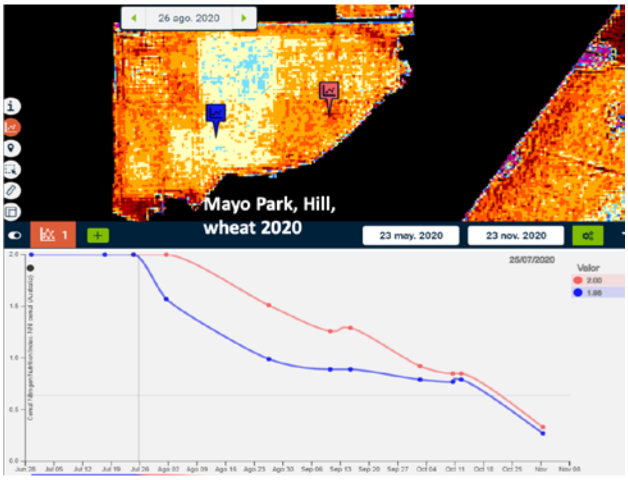
Crop Nutrient Management

MZM and Fertilisation - Operational Steps



Crop Nutrient Management

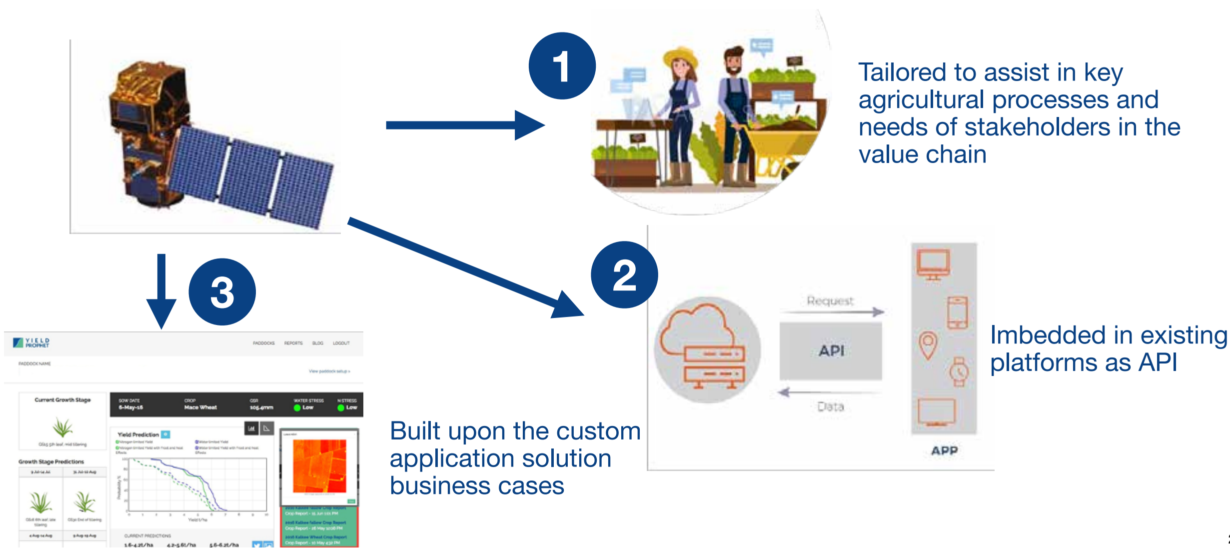
Nitrogen Nutrition Index (NNI)



- NNI is the ratio of actual N concentration vs. ‘critical’ N concentration (N mass/ biomass)
- Critical N concentration is the minimum N required to maintain optimum crop growth (typically declines as crop grows)
- N is estimated from a unique ‘red edge’ band of Sentinel 2 whereas biomass is estimated from NDVI
- NNI is useful for determining N top-dressing application in grain-filling stage to increase protein quantity over irrigated wheat fields

COALA Information Services

Three Ways to Use Earth-Observation Products



23

Optimising Irrigated Grains

Key Learnings – 2020 & 2021

FAR Australia
New South Wales

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.

Canola under irrigation

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/m² can produce a significant drop in productivity compared to plant populations that are above 40 plants/m² 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.

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/m². Although hybrid plant populations of 25-30 plants/m² removes much of this penalty, productivity and profitability has been increased further with populations at 40-50 plants/m², despite the additional cost of seed.

Nitrogen applications for 5t/ha irrigated canola

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.

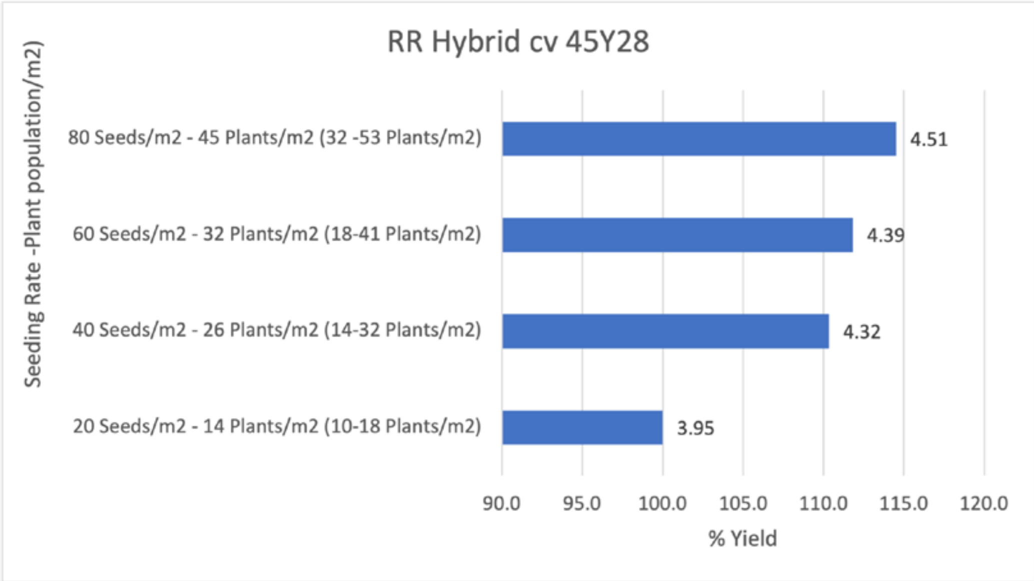


Figure 1. Influence of plant population on seed yield (t/ha) using the RR hybrid 45Y28 in 6 irrigated trials conducted at Finley and Kerang – 2020 and 2021.

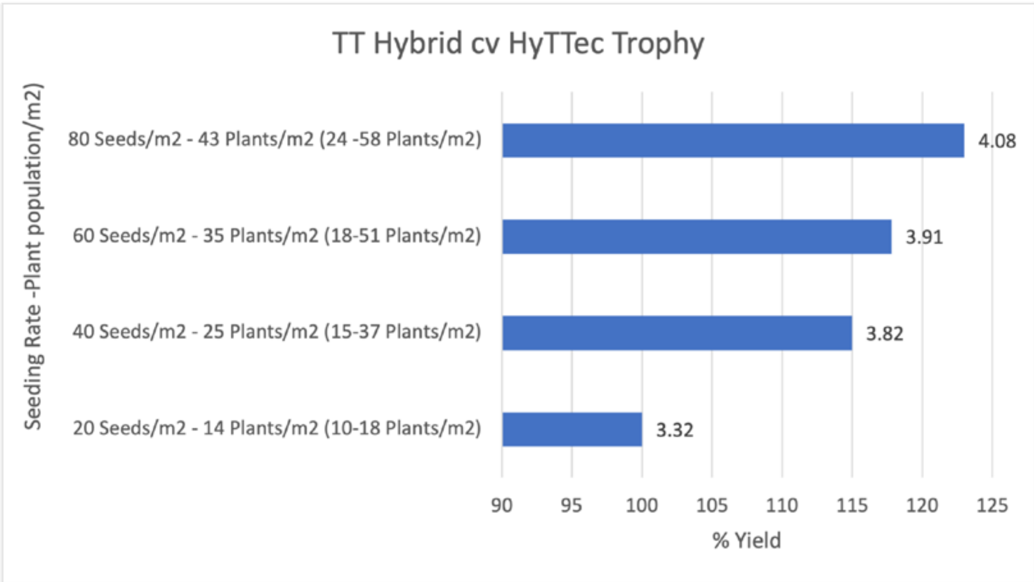


Figure 2. Influence of plant population on seed yield (t/ha) using the TT hybrid HyTTec Trophy in 6 irrigated trials conducted at Finley and Kerang – 2020 and 2021.

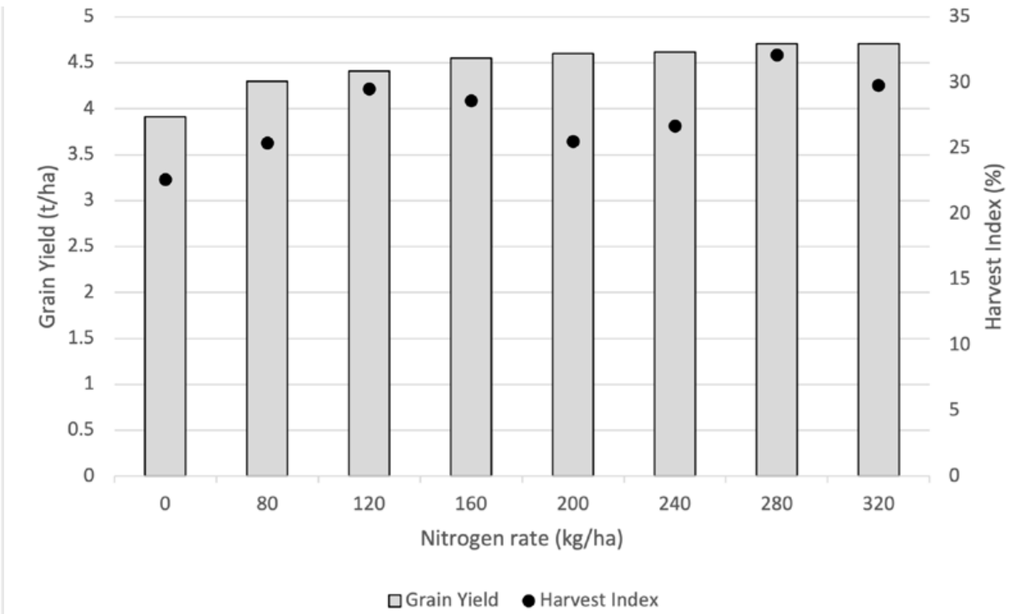


Figure 4. Influence of applied N rate on seed yield (t/ha) and harvest index (%) – cv RR Hybrid 45Y28, Finley, NSW 2020

Durum under irrigation

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.

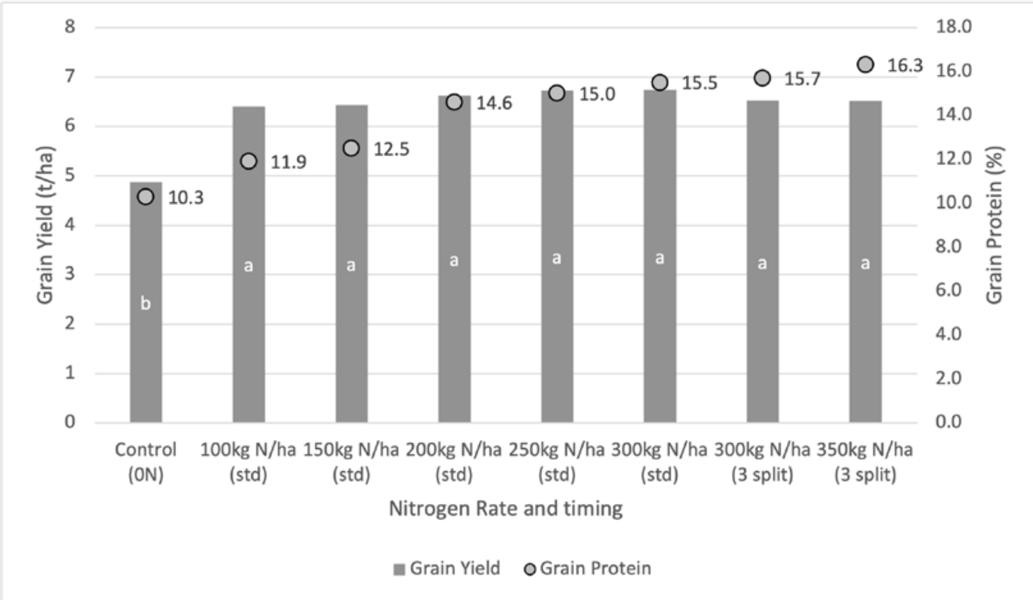


Figure 1. Influence of applied nitrogen at stem elongation on grain yield (t/ha) and protein content (%). – Finley 2021 Notes. Std – nitrogen split 50:50 between GS30 and GS32. 3 split – 100kg of nitrogen withheld until GS39 with the remainder split 50:50 between GS30 and GS32. *Yield bars with different 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 Rate	LSD	ns	**P val**	**0.235**
Soil N available – 47kg N/ha 0-90cm				

Faba Beans under irrigation

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/m²) PBA Amberley appears to drop in yield slightly.

Irrigated grain yield plateaus at around 30 plants/m² and there is little gained going above 25 plants/m². However, when plant populations start dropping below 20 plants/m² 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/m²). In contrast, moving from 20-30 plants/m² 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.

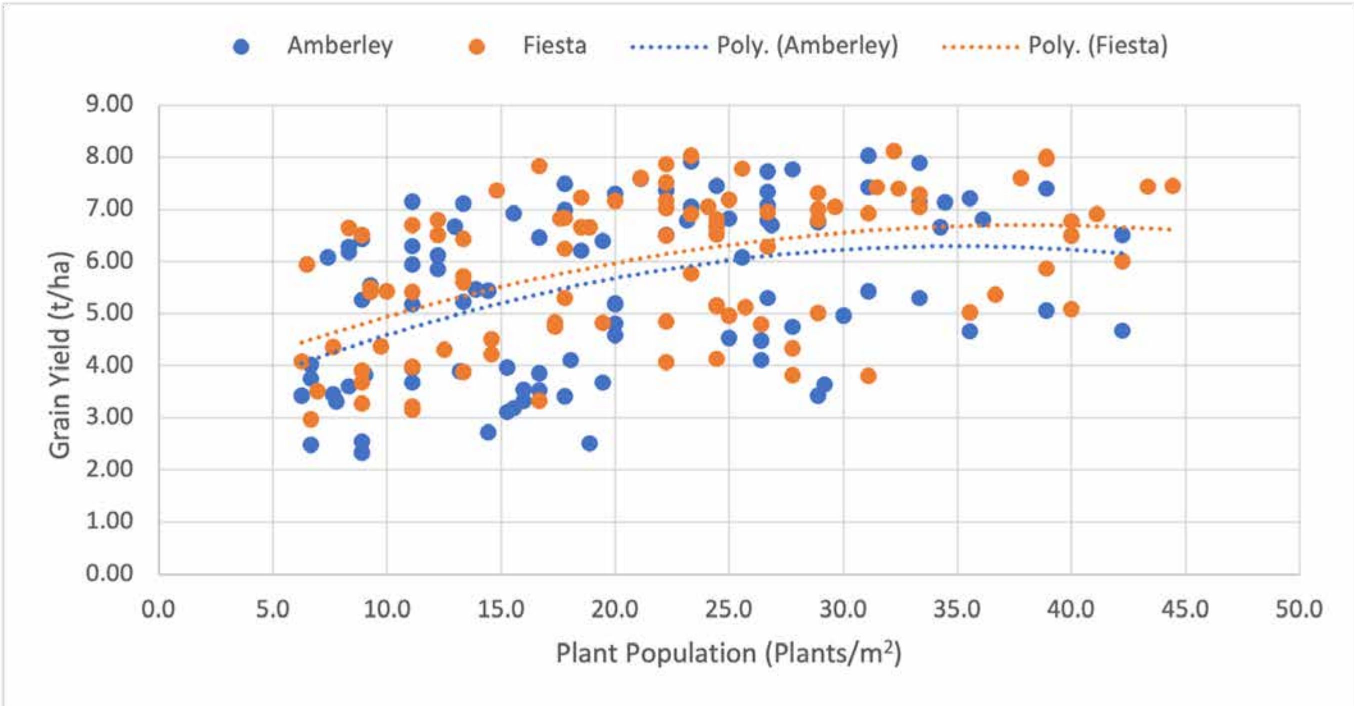


Figure 1. The influence of faba bean plant populations on grain yield (t/ha). Data points from 6 trials across 2 years and 2 sites.

If aiming for 20 plants/m², 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/m². Therefore, there is less risk of losing yield if aiming for higher populations (25-30 plants/m²) 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/m² 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/m²)	Harvest Dry Matter (t/ha)	Stems/m²	Pods/m²	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/m² 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).

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.

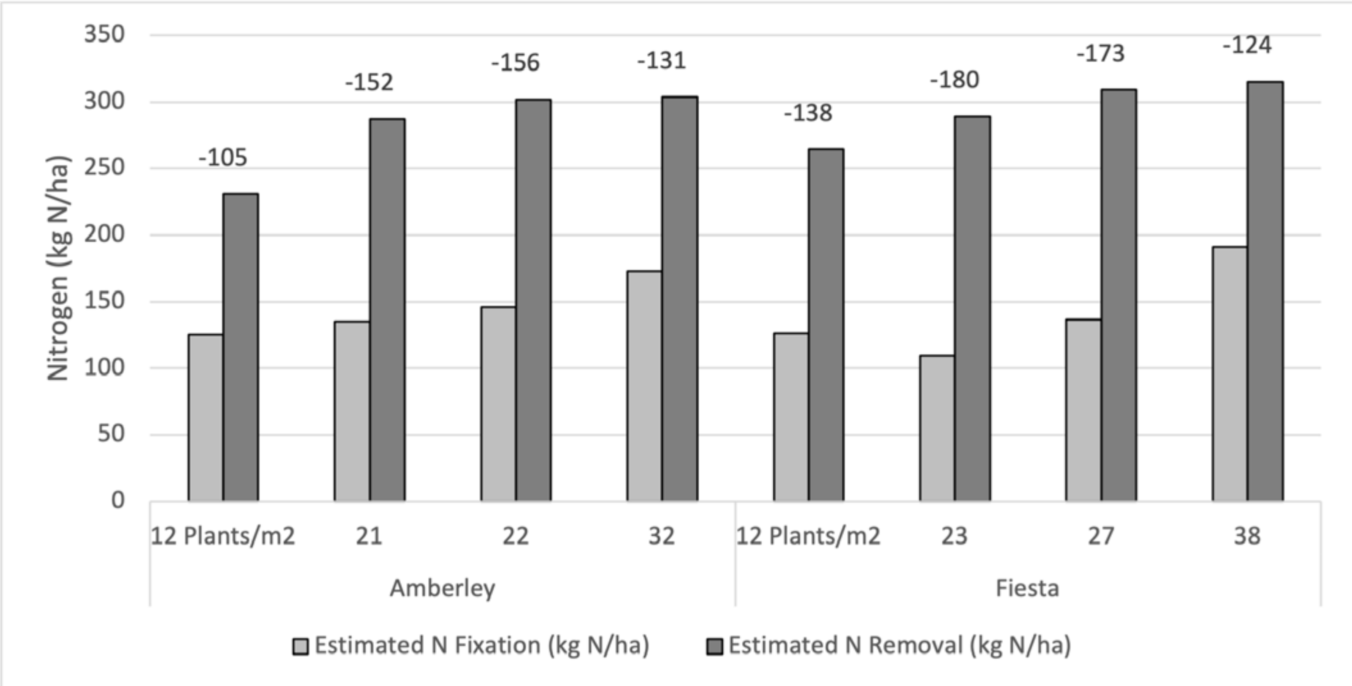


Figure 2. Estimates of nitrogen fixation and removal from high yielding irrigated faba bean crops. Data labels show the nitrogen deficit.

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https://faraustralia.com.au/resource

Managing irrigated Durum wheat for yield and protein

Sam O'Rafferty and Hayden Petty
Optimising Irrigated Grains

Two Projects in irrigated cereal crops

- 1. Managing irrigated durum for yield and protein.
- 2. PGR in irrigated barley production.

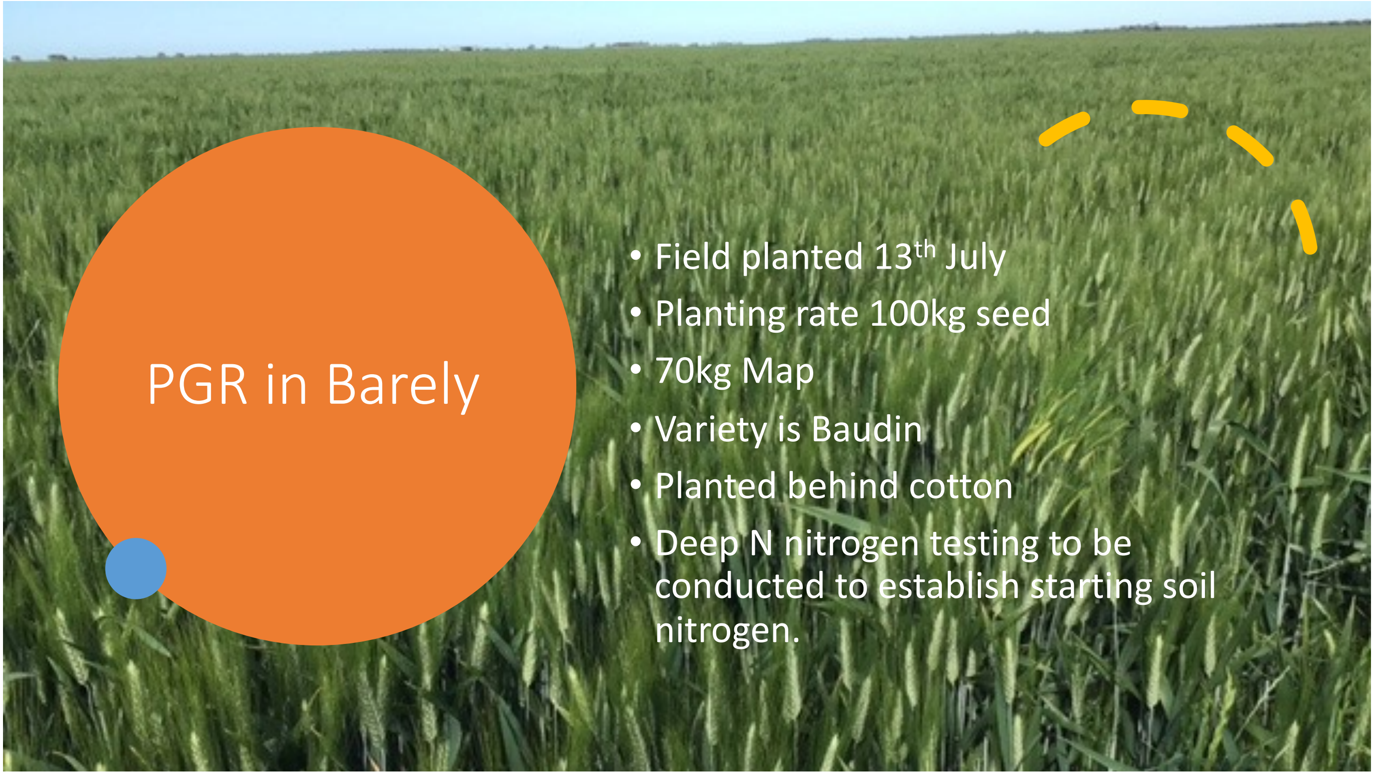
Will adapt management techniques to later planted crops.

Trial Protocol

DBA Mataroi				DBA Vittaroi			
N Target 2		N Target 1		N Target 1		N Target 2	
+PGR	-PGR	-PGR	+PGR	+PGR	-PGR	-PGR	+PGR
24	24	24	24	24	24	24	24
			Power Pole				

Treatments:

1. Mataroi vs Vittaroi
2. Nitrogen rate
3. Plus & minus plant growth regulators through stem elongation



PGR in Barely

- Field planted 13th July
- Planting rate 100kg seed
- 70kg Map
- Variety is Baudin
- Planted behind cotton
- Deep N nitrogen testing to be conducted to establish starting soil nitrogen.

Trial design

Control	Promote @ Z31	Promote @ Z37	1 x Moddus Evo @ Z31	2 x Moddus Evo @Z31 & Z37	Promote @ Z31	1 x Moddus Evo @ Z31	Control	Promote @ Z37	2 x Moddus Evo @Z31 & Z37	2 x Moddus Evo @Z31 & Z37	Promote @ Z37	1 x Moddus Evo @ Z31	Control	Promote @ Z31
50kg Nitrogen					150kg Nitrogen					250kg Nitrogen				

- Promote @ Z31
- Promote @ Z37
- 1 x Moddus Evo @ Z31
- 2 x Moddus Evo @Z31 & Z37
- Nitrogen to be applied at late tillering.

Optimising Irrigated Grains Project
Local Maize Trial Results

Damian Jones
Irrigated Cropping Council

Maize Trials

Nitrogen management, potassium* and micronutrients*, row spacing & population and fungicides*

Yenda, Murrami, Kerang, Peechelba, Boort

Potassium Nutrition

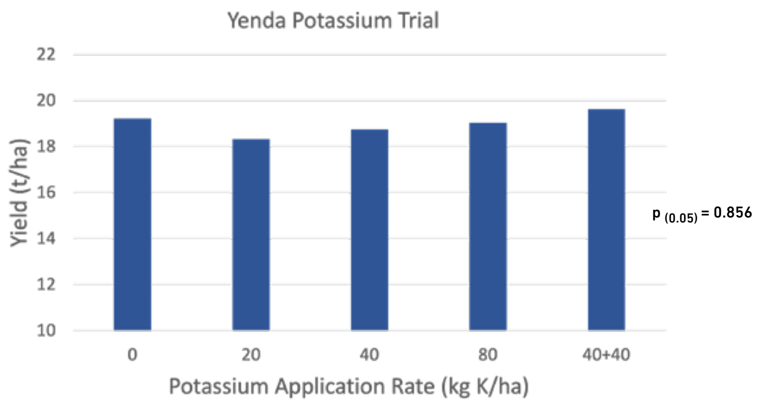
<u>Treatments</u>

0, 20, 40, 80 & 40+40 kg K/ha @ 4 (&8) leaf

Soil K ≈ 600ppm

No yield response at Yenda (or Kerang)

No influence on K tissue levels



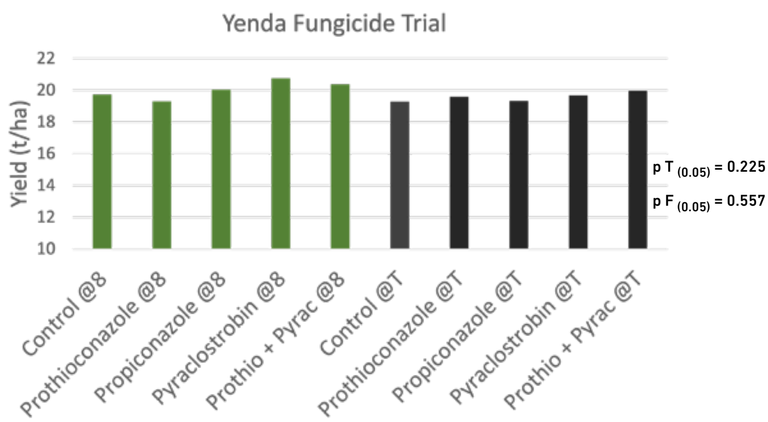
Fungicide Management - Yenda

<u>Treatments</u>

Pyraclostrobin, Prothioconazole, Propioconazole & Pyrac+Prothio @ 8 leaf or tasselling

No yield response at Yenda (or Kerang)

No influence on 'green retention'



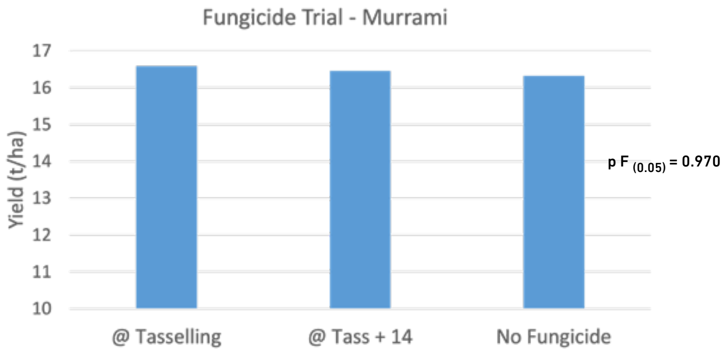
Fungicide Management - Murrami

<u>Limited Treatments</u>

Azoxystrobin @ tasselling or tasselling+14 days

No yield response

No influence on 'green retention'



Micronutrients - Murrami

<u>Treatments</u>

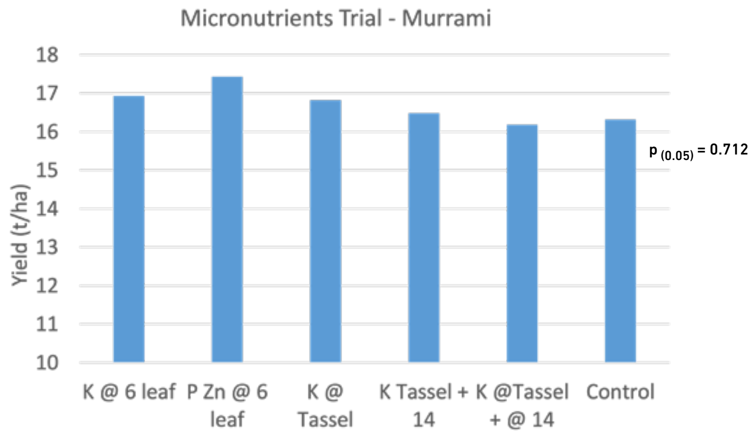
'K Complete' @ 6 leaf (10l/ha soil)

'K Complete' @ tasselling, t+14 days (5l/ha foliar)

'P + Zn' @ 6 leaf (5l/ha soil)

No influence on tissue levels

No yield response (or at Kerang)



N Management

Irrigated grain maize crops yielding 16 -19t/ha with dry matters of 33 - 35t/ha commonly remove 400kg N/ha from the soil, but in results generated over the last two years these crops do not respond significantly to N fertiliser inputs greater than approx. 250kg N/ha.

In-crop mineralisation in the summer months is an extremely significant contributor to the N budget calculations under irrigation.

N timing (all upfront, split up to tasselling, coated) has failed to generate significant yield responses

Population, row spacing

Mixed responses to both factors

No response at Kerang in 2021/2

More biomass but not yield from 500mm at Kerang 19/20

500mm x 80k pop'n highest yield at Kerang 20/21

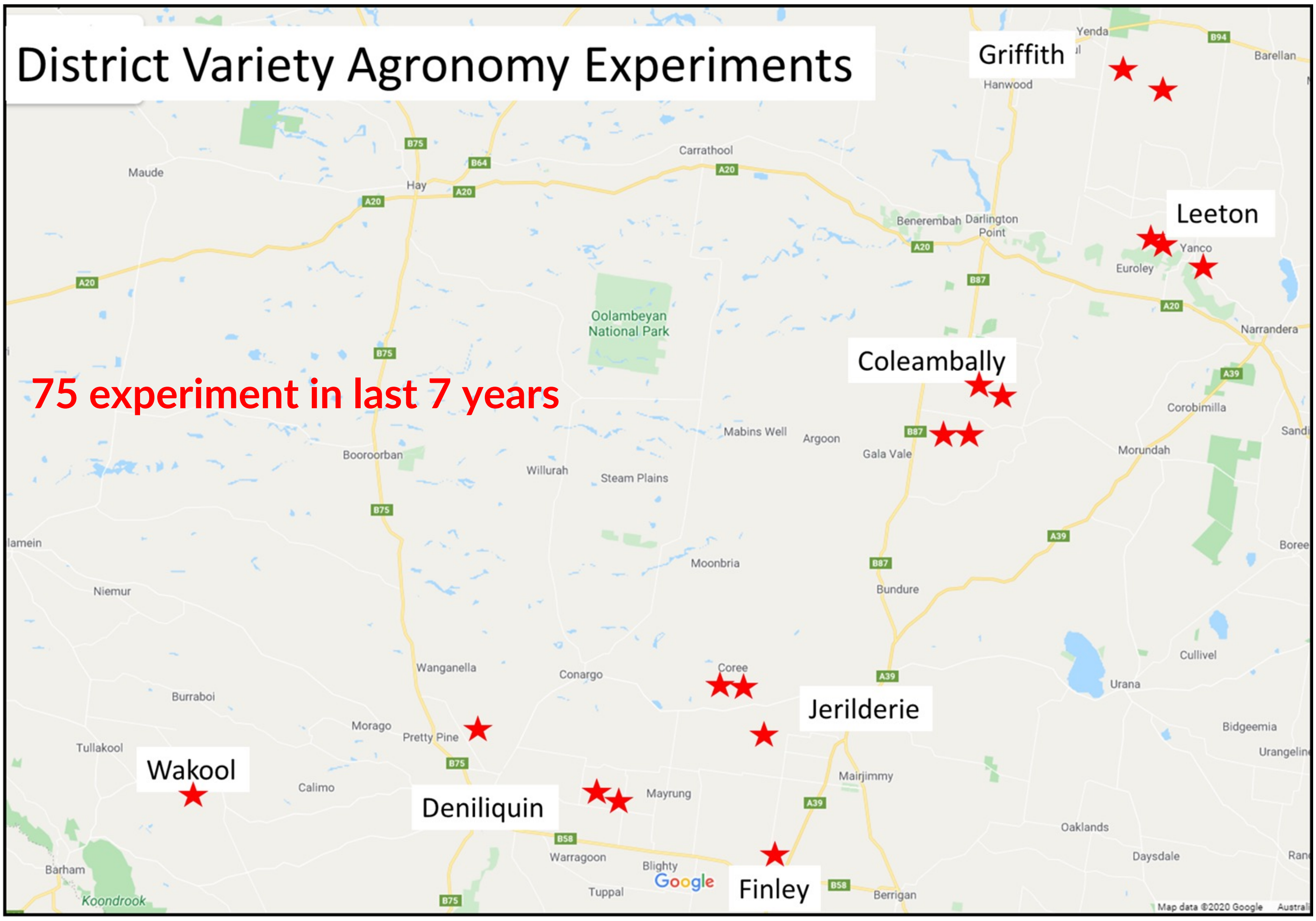
3.5 t/ha response to 500mm RS at Boort 19/20

Thanks to

Campbell Dalton
James Mann (YP)
Brad and John McDonell
Sam McGrath (YP)

Rice variety and agronomy update

Brian Dunn
NSW Department of Industries



Variety yield tables

Murrumbidgee Valley			Grain Yield relative to Reiziq (%)					
Harvest year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Average**
Avg Reiziq yield (t/ha)	**13.34**	**12.58**	**12.02**	**11.09**	**13.23**	**12.77**	**13.19**	**12.60**
Reiziq	100	100	100	100	100	100	100	100
V071					114	104	112	110
Sherpa	96	104	110	110	105	108	101	105
Viand	104	98	95	95	98	111	97	100
Langi	91	92	95	98	89	90		92
Topaz	82	86	88	84	87			85
Doongara	90	93	102	109	100			99
Number experiments	6	5	4	5	6	5	3	34

Yield tables available in NSW DPI – Rice variety guide 2022/23

Season	Location	Sow method	Reiziq[A] (t/ha)	V071[A] (t/ha)	Yield Difference (t/ha)
2019/20	Coleambally	Drill	11.70	13.32	1.62
	Jerilderie	Drill	11.71	13.66	1.95
	Logie Brae	Drill	10.55	12.87	2.31
2020/21	Yenda	Drill	14.26	14.60	0.34
	Benerembah	Dry broad	11.26	11.66	0.40
	Leeton	DPW	13.52	13.92	0.40
	Mayrung	Aerial	11.91	14.48	2.57
	Jerilderie	DPW	12.39	14.05	1.66
2021/22	Yenda	Drill	13.81	15.20	1.39
	Benerembah	Dry broad	12.58	14.19	1.61
	Coleambally	Drill	13.18	14.72	1.54
	Bunnaloo	Drill	12.42	13.78	1.36
	Moulamein	Drill	13.32	14.95	1.63
	Mayrung	Aerial	14.50	15.28	0.78
	Jerilderie	DPW	12.79	14.60	1.81
		Average	**12.66**	**14.09**	**1.43**

V071 compared to Reiziq

V071 is superior to Reiziq in all agronomic attributes

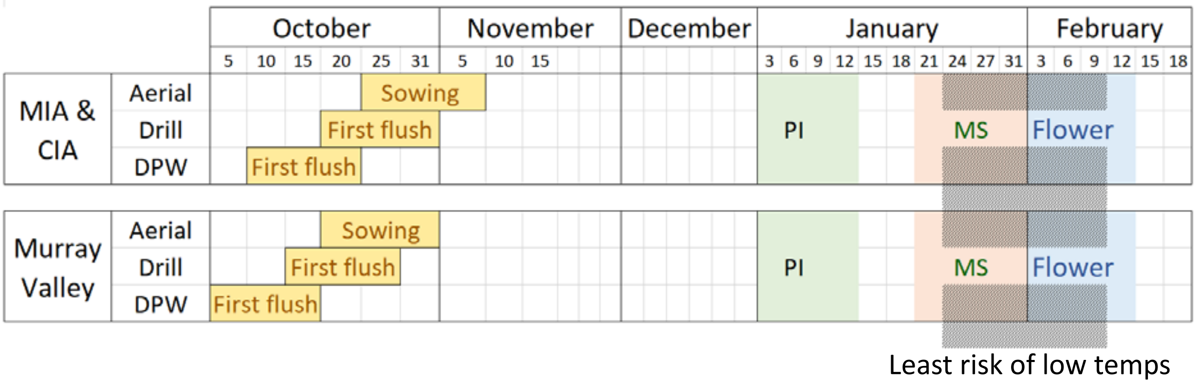
- **V071 yielded higher than Reiziq in all experiments - average 1.43 t/ha**
- **Development doesn't slow like Reiziq during periods of low temperatures**
- **Strong emergence and establishment vigour, equal to Reiziq**
- **Higher tolerance to grain shattering than Reiziq, similar to Sherpa**

Agronomically, V071 has the potential to replace Reiziq, the industry standard bold medium grain for the last 18 years

Nearing maturity V071 looks greener than Reiziq

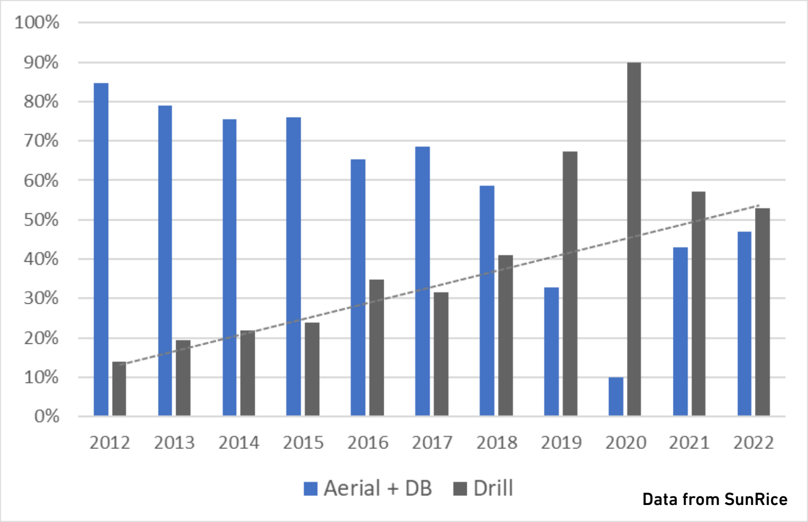
Sowing dates

Sowing windows in NSW DPI – Reiziq growing guide



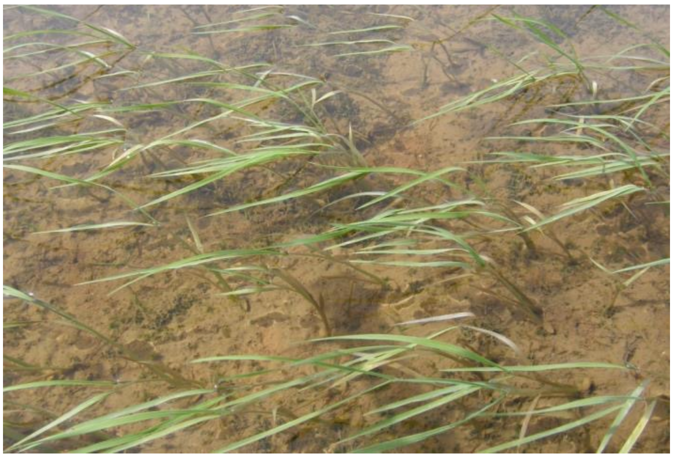
The less time a crop is ponded the longer its growing period – need to sow earlier

Rice sowing methods



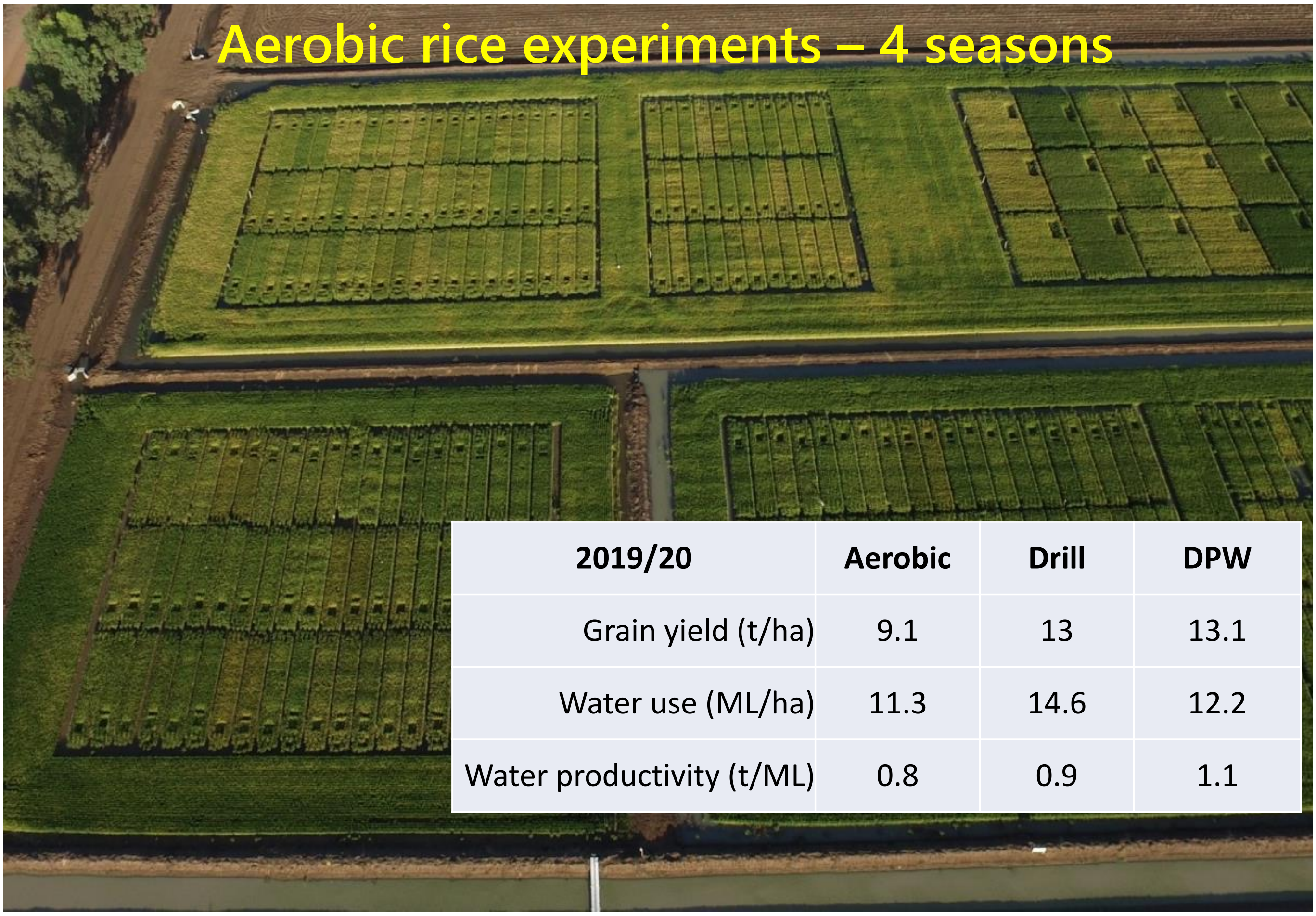
Aerial and drill sowing

- Drill sown crops use less water use than aerial sown
- Water savings from reduced period of ponding
- Less evaporation & percolation losses



Delayed permanent water — DPW

- Delay filling up with permanent water (PW)
- Don't severely moisture stress crop – delays development
- Very high nitrogen use efficiency



2019/20	Aerobic	Drill	DPW
Grain yield (t/ha)	9.1	13	13.1
Water use (ML/ha)	11.3	14.6	12.2
Water productivity (t/ML)	0.8	0.9	1.1

Growing rice aerobically — no ponding

- Nitrogen losses are large so need split applications
- Keep soil near saturation during reproductive period, water every couple of days
- 10.2 t/ha our highest yield, 7 to 9 t/ha more the norm
- Could never grow sufficient biomass to get a high yield

Rice gross margin — Mark Groat

MIA		MG Rice Drill Sown	MG Rice Dry Broadcast
Rice System	Yield	$ 12	$ 12
	Price/mt	$ 400	$ 400
	INCOME:	**$ 4,800**	**$ 4,800**
TOTAL VARIABLE COSTS		$ 2,254	$ 2,503
Approx. breakeven yield		5.64	6.26
GROSS MARGIN/HA		$ 2,546	$ 2,297
GROSS MARGIN/ML		**$ 212**	**$ 164**

Includes variable cost of water (delivery charges/ML) but not buying water in

PW nitrogen requirements

- **Semi-dwarf varieties require at least 200 kg/ha urea pre-PW**
- **Cut or poor areas may require 400 kg/ha urea or more pre-PW**
- **Must supply enough pre-PW N to obtain sufficient growth at PI**
- **Yield is already lost if crop is poor at PI (PI N uptake < 80)**

Variety PI N uptake target and pre-PW nitrogen requirement ranges

Variety	PI N uptake (kg N/ha)	Pre-PW urea (kg/ha)	limiting factor
Reiziq	100 - 140	200 - 320	-
Sherpa	100 - 140	200 - 320	-
V071	100 - 140	200 - 320	-
Opus	100 - 130	200 - 300	Protein
Viand	90 - 120	180 - 260	Lodging
Topaz	90 - 120	180 - 260	Cold risk
Doongara	90 - 120	180 - 260	Cold risk
Langi	90 - 120	180 - 260	Lodging and Cold
Koshihikari	70 - 90	100 - 150	Lodging

New Primefact NSW DPI – Managing nitrogen in rice

Urea expensive – must use efficiently

- Most efficient to apply urea pre-PW – attaches to clay particles
- Do not do the following – large losses
    - Apply urea into flooded bay before tillering
    - Sow urea with seed or spread urea prior to flush irrigations
    - Spread urea onto damp soil prior to PW
- Better to drain and dry field than spread urea into a flooded bay when plants are small
- New Primefact – Managing nitrogen in rice

Remote Sensing

- Working on using remote sensing to predict PI N uptake for several years.
- Ceres aerial NDRE – system established, variability due to atmosphere changes
- Last season tested Sentinel-2 (10m, 5 days) and Planet Labs Fusion (3m daily)
- 4 experiments with 30 x 30 m nitrogen plots
- PI N uptake correlated with imagery

Lots of resources available to growers

NSW Government | Department of Primary Industries | primefact

Managing nitrogen in rice

July 2022, Primefact 22/619, first edition
Brian Dunn, Research Officer, Yanco
Tina Dunn, Technical Officer, Yanco

Rice growing guide
2nd edition
NSW DPI MANAGEMENT GUIDE

Rice variety guide 2022-23

July 2022, Primefact 1112, 12th edition
Brian Dunn, Research Agronomist, Yanco
David Troldahl, Research & Development Agronomist, Yanco

NSW Government | Department of Primary Industries | primefact

V071 growing guide

June 2021, Primefact 21/448, First edition

Reiziq growing guide

July 2021, Primefact 1644, 3rd edition

Irrigation Research & Extension Committee

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