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# THE AUSTRALIAN AGRONOMIST MAGAZINE

Can multi-species planting provide effective weed control?

## Celebrating the importance of pollinators

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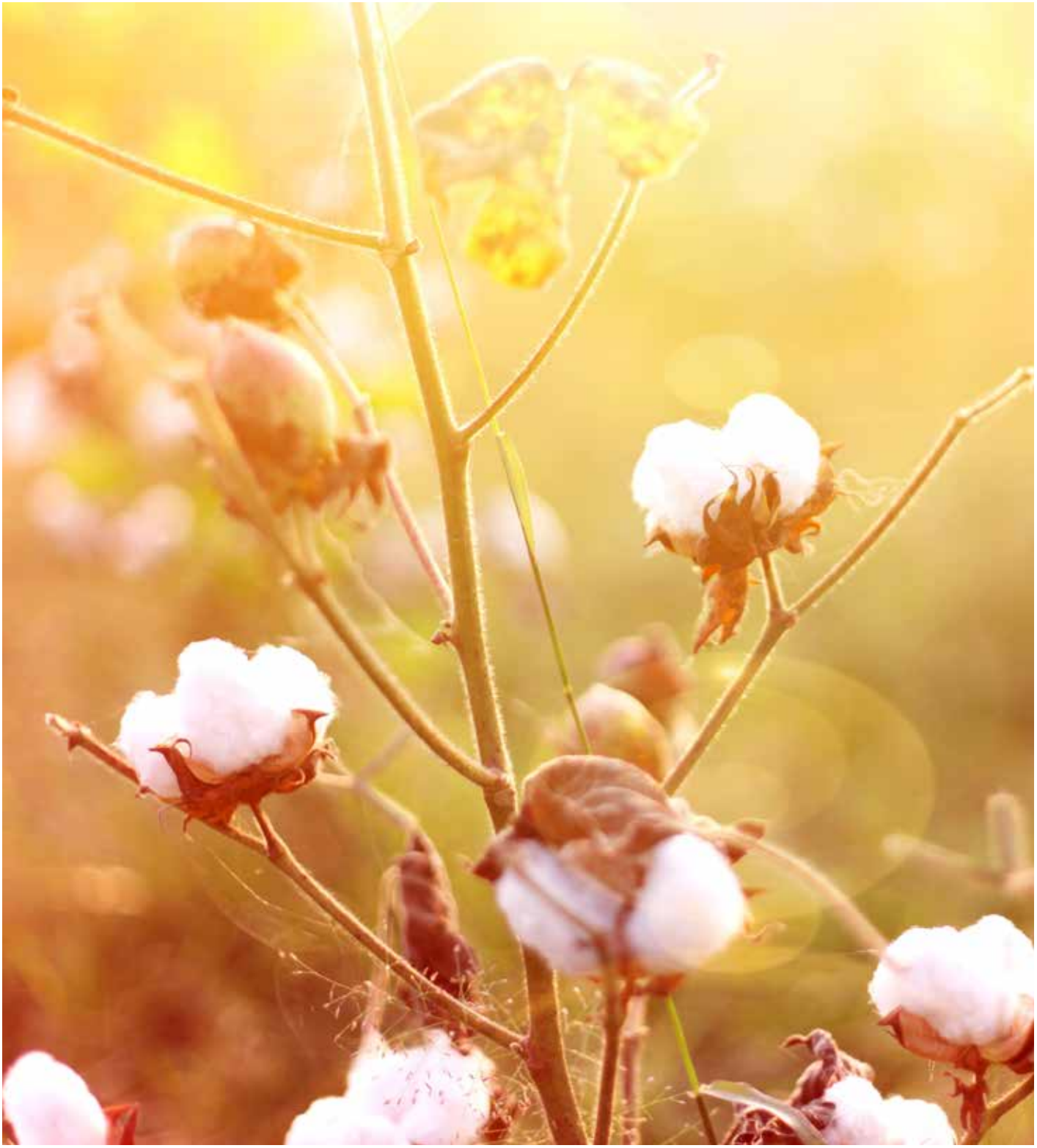

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# CAN MULTI-SPECIES PLANTING PROVIDE EFFECTIVE WEED CONTROL?

Andrew Fletcher, CSIRO farming systems researcher sees potential for multi-species plantings to compete with weeds. Photo: GRDC.

**Crop competition is one of the most effective weed control tools available to growers, but some crops simply don't have a competitive edge.**

Dr Andrew Fletcher, a farming systems scientist with CSIRO, says companion planting and intercropping is an option that growers can consider to bolster the competitiveness of an otherwise uncompetitive but valuable crop in the rotation. International research suggests that it can!

"When two or more species are grown together they can occupy ecological niches that might otherwise be taken up by weeds," he says. "Multi-species plantings have several potential benefits including increased crop yield and improved soil health, but the right combination can also reduce weed biomass by over 50 per cent."

Multi-species plantings can be quite challenging to integrate into a grain cropping rotation but are more easily used in mixed grain and livestock operations and in intensive pastures for dairy cattle.

International research suggests there is a significant untapped opportunity to increase the use of these systems in Australian grain production systems. However, relevant Australian data is scarce and more research is required to understand this untapped potential in Australian systems.

"Crop competition is a non-herbicide pillar in the WeedSmart Big 6, with the potential to do some serious heavy lifting in terms of weed control," says Andrew. "Intercropping and companion planting offers a means to bolster the competitiveness of some crops and to keep them in the rotation without risking a weed blow-out."

Sowing a low-growing species like clover between the rows of cereal can compete with weeds in the inter-row area, fix nitrogen and provide the basis of a pasture after the cereal grain is harvested. This is one example of companion planting.

A mixed-species cover crop can provide multiple soil health benefits, grazing and fodder for livestock and weed control through crop competition and stopping weed seed set.

### What is intercropping, companion planting and mixed-species planting?

**In brief:** These systems all involve planting two or more crop species together. The combinations are almost limitless.

**The details:** Intercropping involves planting two or more species together and harvesting the grain of multiple crops. This generally relies on the grain species having different size seed and compatible harvest times.

Companion planting involves two or more species planted together with the intention to harvest grain from one species only after grazing or terminating the other species before seed set.

Mixed-species planting is used to describe plantings of several species grown together primarily for the soil health benefits, and that may have potential for grazing and or forage conservation.

### How do these systems suppress weed growth?

**In brief:** These multi-species systems are designed to take up the ecological space that might otherwise present an opportunity for weeds to fill.

**The details:** Intercropping and companion planting provide additional weed control in situations where one of the species is a relatively poor competitor as a sole crop. By maximising competition, weed growth is suppressed by up to 58 per cent compared to the least competitive species grown on its own. If a competitive crop such as barley is sown in the most competitive configuration possible, there is little additional benefit from adding a second species.

The downside of using this multi-species strategy for weed control is that the choice of herbicides is limited. This is mainly due to the common combinations being a grass crop with a legume or brassica, meaning grass and broadleaf herbicide options can't be used, except for when one species is terminated. This needs to be factored into decisions around intercropping and companion cropping.

### What are the best-bet combinations for enhanced weed control?

**In brief:** It depends on the farming system and the other reasons for considering a multi-species planting.

**The details:** If the aim is to produce grain, the species selected should have easily separated seed. A well-known example is peaola (field pea plus canola). A recent review of historical trials showed that the median yield increase was 31 per cent compared to sole crops of peas and canola, but the weed control effects of peaola in Australia are unquantified.

An effective companion planting combination is wheat undersown with tillage radish and a legume. The broadleaf companions are sprayed out at stem elongation, leaving the cereal to mature through to harvest.

If there is livestock in the farming system, dual purpose combinations such as grazing canola plus vetch and oats can provide excellent weed suppression. This mix could be grazed and then terminated as hay or silage at stem elongation.

Multi-species plantings add a layer of complexity to the farming system, but many growers have taken on the challenge and are reaping the rewards in crop yield, soil health and weed suppression.

# GLOBAL REPORT PUTS PLANT BREEDING INNOVATION AT THE FOREFRONT OF FOOD SECURITY

**The latest independent report published by the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) highlights the importance of new breeding innovations to meet global food security and sustainability needs.**

The report outlines the importance for the acceleration of new precision breeding innovations like gene editing. This is being driven by the need to address impacts of climate change, drought frequency and to reduce food waste and the environmental footprint of production.

**At the same time, the world will need to produce 50 per cent more food by 2050 to feed the world's population with the same or even fewer natural resources.**

Matthew Cossey, Chief Executive Officer of CropLife Australia, said Australian farmers will need access to all the best tools to get there. "The ISAAA report marks 25 years of successful commercial genetically modified (GM) crop cultivation in Australia. Innovative, safe and approved technologies like GM crops have played a significant role in developing Australian farming systems, enabling farmers to be more environmentally sustainable, reduce their carbon footprint and protect the health of their soil.

"The report confirms the agriculture environment is changing faster than conventional breeding techniques would allow for the establishment of new varieties. Access to new and evolving breeding innovations will be crucial to increasing global food production and meeting sustainability targets for the future. To achieve this we need a modern future proofed regulatory system."

Most countries who have adopted crop biotechnology innovations early are well equipped to realise the potential of new breeding techniques and capitalise on their benefits. The report explores current examples where gene editing innovation is being used to develop drought tolerance, disease resistance and increased water efficiency and nutritional value.

Mr Cossey continued, "All mainland states in Australia have now lifted their GM crop moratorium, allowing farmers to take full advantage of plant breeding innovations, remain globally competitive and more environmentally sustainable."

However, the ISAAA report highlights that as new breeding techniques emerge, their regulation must be fit for purpose, science based, risk proportionate and separates process from the end product. This is something that the Commonwealth Department of Health needs to ensure is addressed as part of the modernisation of the gene technology regulatory system.

"Responsive, science-based regulation will ensure Australia isn't held back from reaping the benefits and continuing its position as a world leader in agricultural innovation," Mr Cossey concluded.

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# ‘WHAT CAN I DO TO CONTROL FTR GRASS IN FALLOW?’

**with Bhagirath Chauhan, professor, University of Queensland**

**Feathertop Rhodes grass (FTR) is a major weed in chemical fallows in Australia, and is notoriously hard to kill with glyphosate.**

Bhagirath Chauhan, professor at the University of Queensland’s Centre for Crop Science, says some other herbicide control measures have potential to manage large FTR plants (40 to 50 leaf stage) that have escaped earlier treatment.

“Feathertop Rhodes grass is an aggressive weed that can establish in bare fallow situations and produce a large quantity of seed if left uncontrolled,” he says. “Several biotypes of this species are resistant to glyphosate and can also survive a double knock of glyphosate followed by paraquat, particularly once the weed is larger than 4 to 5 leaf stage.”

To give growers more options, a study was conducted to assess the potential of other herbicides and use patterns that can control large feathertop Rhodes plants or stop seed set.

“An integrated approach is essential to controlling feathertop Rhodes grass,” says Bhagirath. “In applying the WeedSmart Big 6 to FTR in a bare fallow situation we have identified some tank mix and herbicide sequences that growers could deploy to help manage this difficult weed and stop seed set.”

**Can anything be done to improve the efficacy of glyphosate or the double knock against large FTR plants?**

**In brief:** Adjuvants did not improve glyphosate efficacy on mature (40 to 50 leaf) FTR plants. In glyphosate resistant populations, the second knock product is doing the heavy lifting when applied to large (8 to 10 leaf) FTR plants.

**The details:** None of the commercially available adjuvants improved the efficacy of glyphosate (740 g a.e. per ha) as a single product application on FTR at the 40 to 50 leaf stage. All the plants survived and produced seed after being treated with glyphosate, indicating that the population used in the study was resistant to glyphosate at this rate and weed growth stage.

Glyphosate and the double knock tactic can often provide good control of resistant FTR plants if the herbicide is applied when the plants are small and actively growing.

The traditional double knock of glyphosate (Group 9 [M]) or glyphosate + 2,4-D, followed by paraquat (Group 22 [L]) or glufosinate (Group 10 [N]), applied to older FTR plants (8-10 leaf) achieved increased phytotoxicity through improved mortality, reduced biomass or fewer seed panicles.

However, the double knock was no better than using paraquat or glufosinate alone when applied to 8 to 10 leaf FTR plants. FTR is not listed on glufosinate labels in Australia but is used to control other weeds in fallow situations at the rate (750 g a.i. per ha) tested in this study. For best results, glufosinate needs to be applied in warm, humid conditions, which is not a common scenario for summer fallow situations.

### Are clethodim or haloxyfop suitable alternative herbicides to treat large, glyphosate resistant FTR plants?

**In brief:** Possibly. Excellent results were achieved in pot trials conducted in an open environment, but will be more difficult to achieve in the field.

**The details**: Clethodim and haloxyfop were tested on FTR plants at the 24 to 28 leaf stage. Clethodim is registered for use against FTR in a number of summer crops, but without any crop competition many FTR plants survived the registered rate (90 g a.i. per ha), although weed biomass and seed production was severely curtailed.

Haloxyfop efficacy against FTR at this growth stage was 100 per cent at the registered rate of 80 g a.i. per ha.

A combination of these two treatments also resulted in 100 per cent control. The effective use of these two herbicides (both Group 1 [A]) relies on excellent coverage and application when the plants are actively growing. This is difficult to achieve in field conditions, which is why the label recommendations are typically for younger weeds.

These herbicides are known to readily select for resistant biotypes so when applied in a chemical fallow situation (with no competition), it is necessary to target small weeds with robust application rates and to apply a second knock with a contact herbicide, such as paraquat.

### Did you find any new and exciting prospects for controlling mature FTR plants?

**In brief:** Yes, it seems that there is a truly synergistic effect when isoxaflutole (Group 27 [H]; e.g. Balance) is mixed with paraquat.

**The details:** Neither of these herbicides provided useful control of FTR at the 40 to 50 leaf stage when applied individually. When mixed together, these herbicides achieved a higher level of weed mortality and prevented panicle production. For example, a tank mixture of isoxaflutole 75 g a.i. per ha, with paraquat 600 g a.i. per ha, resulted in 92 per cent FTR mortality and no panicle production.

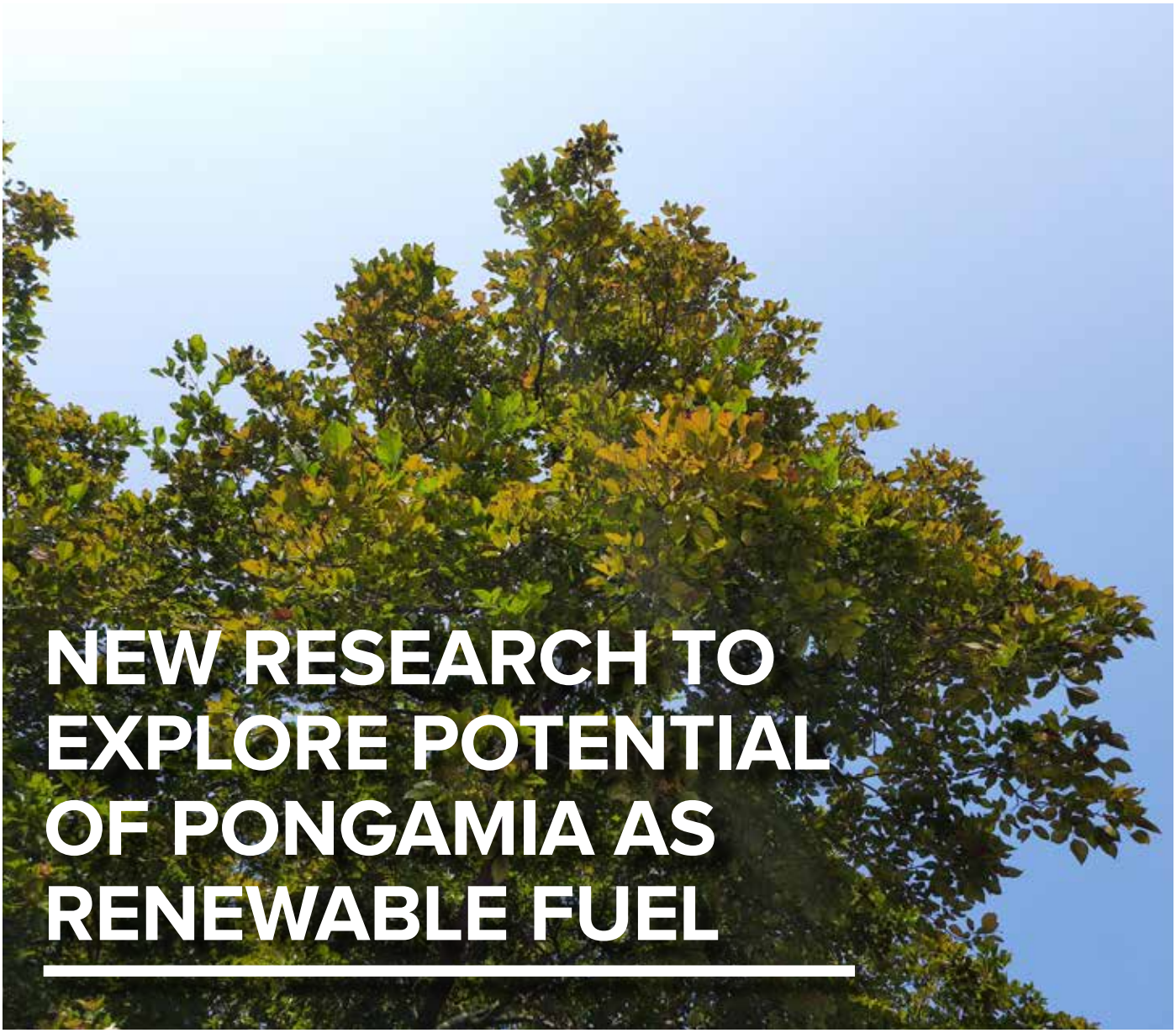
Even at a paraquat rate of 300 g a.i. per ha mixed with isoxaflutole 75 g a.i. per ha, only 17 per cent of the large FTR plants survived when the mixture was applied to both the plant and the nearby soil – allowing uptake through both the leaves and the roots.

The benefit of this mixture may be reduced if the weed patch is dense, potentially reducing the amount of the isoxaflutole that reaches the soil. Even the prevention of seed set in large FTR plants is of significant value in managing the seed bank of this invasive weed, as FTR seed remains viable for less than 12 months.

Such a use pattern is not currently specified on product labels, although both products are registered for weed control in fallow situations.

Rate response (0, 187.5, 375 and 750 g a.e. per ha) to glufosinate applied to large FTR plants.

Professor Bhagirath Chauhan, University of Queensland, says there are some tank mixes and herbicide sequences that growers could deploy to help manage FTR and stop seed set.



# NEW RESEARCH TO EXPLORE POTENTIAL OF PONGAMIA AS RENEWABLE FUEL

**For centuries, pongamia has been used across the Indian subcontinent to fuel lanterns and stoves, make soap and tan leathers, and in traditional medicine.**

Native to northern parts of Queensland and the Northern Territory, this hardy legume tree now offers an opportunity for production as a sustainable, lower emission alternative to non-renewable transport fuels.

The resilient nature of the plant – drought-tolerant and able to withstand heat, salinity and flooding – combined with its ability to produce its own nitrogen, makes pongamia an ideal candidate for production on land unsuitable for broadacre cropping in northern parts of Australia.

Industry experts suggest that an area of 2 million hectares could result in the production of 8 billion litres of biodiesel per annum.

Based on equivalent crops, this could generate an estimated income of $7 billion including pongamia by-products. In addition to the potential economic advantages, the creation of upwards of 16,000 jobs and the stimulation of regional development is also predicted.

## PONGAMIA - THE KEY FACTS

**The native pongamia tree displays abundant seed set and oil-rich seed, together with a lifespan of more than 35 years in full production with high-yielding annual harvests**

**Historically, pongamia has been exploited for a variety of household uses, now its potential as a biofuel, biomass, stockfeed and carbon sequester is being explored**

**Pongamia appears suited to northern Australia, unlocking potential for the development of large plantations in areas where traditional agriculture is unsustainable, which in turn would deliver economic and social outcomes to these regions**

**With support from AgriFutures Australia, a review of pongamia is being undertaken to test its technical readiness, collate information on growing the crop and examine the potential to produce sustainable biofuel at a price competitive with the current petroleum alternatives.**

## INDUSTRY ADVANCEMENTS OFFER FRESH INSIGHTS INTO PONGAMIA VIABILITY

With the aim of evaluating pongamia as a sustainable biofuel, AgriFutures Australia has invested in research to determine the potential of the crop in Australia. The project will include a preliminary economic study to examine the viability of the crop, and the development of a technical manual that will detail how to establish, manage and harvest pongamia in northern Australia.

Laura Skipworth, AgriFutures Australia's Manager, Emerging Industries said that exploring the potential of pongamia and the capacity to find alternative land uses in northern Australia, drew interest from the AgriFutures Emerging Industries Advisory Panel.

"Pongamia has previously been deemed unviable in several economic studies, however in recent years, advancements have seen treatments developed that make the protein meal useful as a plant based stockfeed which further add to crop opportunities."

"The results of the review will help determine whether future support is made to undertake a full economic study into the viability of pongamia," she said.

George Muirhead of Bioenergy Plantations, a commercial pongamia plantation company, said there are two key factors that have substantially changed the economic potential of pongamia.

"Initially pongamia was explored purely as a renewable energy, with the oil used for bio-diesel. Significant research has shown the value of the meal, which alters the economic model completely.

"In Indonesia and the United States, removal of the alkaloids from both the oil and meal have made them suitable for human and animal consumption, which considerably increases the financial viability of pongamia."

Mr Muirhead said the other important development has been the ability to successfully propagate pongamia through cuttings.

"Previously yields were unpredictable and the trees had a high degree of variability, which had made it difficult to achieve industrial scale production. The reliable growth and cropping behaviour and consistent repeatability that comes with cloning the parent tree has been a major breakthrough."

A beautiful yellow flower of Pongamia pinnata plant.

Green seeds of Pongamia pinnata. Millettia pinnata is a species of tree in the pea family, Fabaceae, native to eastern and tropical Asia, Australia and Pacific islands.

## A VERSATILE CROP WITH VALUE-ADD OPPORTUNITIES

Leading the project is Peter Wylie of AgriPath, an agricultural management consultancy, who said the potential benefits of pongamia extend across Australia.

"Pongamia shows promise as an incredibly productive source of biofuel in vast areas of northern Australia where conventional cropping has struggled to be sustainable. For example, the yield of seed from irrigated pongamia at Kununurra, Western Australia has been measured as high as 22 tonnes per hectare, which compares well with the average yield of canola across Western Australia of around 1.4 tonnes per hectare. Both crops have an oil content of around 40%," explained Mr Wylie.

"Pongamia offers an opportunity for agricultural development due to its ability to grow on marginal land. As a legume, pongamia does not require nitrogen fertiliser and feeding the protein meal to livestock could also help to restore fertility on nitrogen depleted grazing lands."

Mr Wylie said that while the primary interest in pongamia is the conversion of its oil for renewable transport fuel, this versatile crop offers many other uses.

"While significant progress has been made in the renewable electricity sector, advancements in the sustainable transport fuel industry has lagged, and Australia currently has limited alternative fuel sources.

"In addition to biodiesel and renewable jet fuel, pongamia can help further mitigate the impacts of climate change, acting as an effective carbon sink, while the seedpods can be used for biomass energy. If the value of all these outputs is added to the use of the protein meal as stockfeed, pongamia is likely to be very profitable. This value could increase if the removal of all the unpleasant ingredients from the protein meal of the pongamia tree enables its use as a human food."

# CELEBRATING THE IMPORTANCE OF POLLINATORS

**Australian Pollinator Week was held on the 13th to the 21st of November, 2021 with the aim of raising awareness of the vital importance of pollinators for agriculture and the environment.**

Chief Executive Officer of CropLife Australia, the national peak industry organisation for the plant science sector, Mr Matthew Cossey, said, “Most people don’t realise that Australia has a vast array of pollinators including birds, butterflies, bats, beetles, and reptiles. Even those pesky flies interrupting your weekend barbeque are crucial to pollination in our country. It’s essential to remember the wide breadth of pollinators that we’re fortunate to have in Australia and recognise their important contribution to biodiversity and our environment more broadly.”

**“The introduced European honeybee is also crucial for pollinating a range of specific crops and we’re fortunate that Australia is home to one of the healthiest populations of European honey bees in the world."**

"Farmers rely on them as pollinators for many of Australia’s food crops which is why it’s essential we all assist to keep their populations flourishing.

“CropLife Australia’s Pollinator Protection Initiative is an award-winning and globally recognised example of what the Australian plant science and agriculture industry is doing to play its part to assist farmers use of necessary crop protection products responsibly and in a manner that minimises risk to pollinators.”

CropLife’s Pollinator Protection Initiative includes BeeConnected, a smart-phone app to help ensure the safety of bees during normal farming practices and The Seed Treatment Stewardship Strategy, a best management practice guide on the handling and planting of treated seed.

Mr Cossey continued, “BeeConnected is just one example of the plant science industry’s commitment to protecting the significant role of Australia’s pollinators. The app connects farmers to nearby beekeepers allowing both parties to communicate about farming practices in relation to hives to ensure apiarists bees remain healthy.

“Our Seed Treatment Stewardship Strategy, developed by Australian industry experts, outlines measures to reduce potential risks from the dust generated during handling and planting of seed and gives guidance to minimise unintended movement of pest and disease management products.

“Australian Pollinator Week is a great way to raise awareness about pollinators and also check in with agricultural and home gardening practices to ensure we’re not inadvertently harming bees and our other important native pollinators.”

Mr Cossey concluded, “CropLife and our members are deeply committed to providing the latest stewardship information and techniques to farmers, environmental land managers and beekeepers alike, to protect Australia’s pollinators.”

Australian Pollinator Week 2022 will be on the 12th to the 20th of November this year. Find out more about CropLife’s Pollinator Protection Initiative at stewardshipfirst.com.au

# CAN PULSE COVER CROPS TACKLE MULTI-RESISTANT RYEGRASS IN IRRIGATED SYSTEMS?

Greg Sefton, principal agronomist with Sefton Agronomics in the Riverina, says legume cover cropping is providing effective control of multi-resistant annual ryegrass in irrigated systems.

**The best weed control comes from tactics that also bring other benefits to a farming system. Greg Sefton, principal agronomist with Sefton Agronomics in the Riverina, says multi-resistant annual ryegrass is becoming a major problem in irrigated systems.**

"Herbicide resistance can move easily through irrigation areas, particularly when the control methods used on the supply channels are limited to just a few herbicides," he says. "The ryegrass here is generally accepted to have resistance to glyphosate (Group 9 [M]), Group 1 [A] such as clethodim, Group 2 [B] and Group 3 [D], such as trifluralin. Growers are now relying heavily on Group 15 [K] products such as Sakura, and doing their best to rotate out of the problem."

To regain control, Greg is working with growers to incorporate a multi-purpose fallow crop such as field pea into the system as a winter fallow clean with the added benefit of contributing biological nitrogen into the soil ahead of planting rice or wheat.

"A competitive pulse crop terminated at maximum biomass is an excellent way to reduce weed seed set," says Greg. "It is a cultural control that also enables the use of some herbicides that are rarely used in our system. Combining the herbicide and cultural methods in the WeedSmart Big 6 is an effective way to keep our cropping options open and to maximise the value of applied water."

### What is the best fit for the legume crop as a winter clean?

**In brief:** In the Riverina, the optimal place in the rotation is ahead of rice.

**The details:** Fields selected for rice production are usually bare fallowed for the preceding winter. The aim of the fallow is to control weeds and conserve soil moisture.

Some growers are having success with field pea sown in May as a winter cover crop then terminated for silage or as a brown manure in early September. This fits well with preventing seed set in annual ryegrass, including late germinating plants.

Field pea is a competitive legume and can suppress weed germination and growth when planted in the most competitive configuration possible with minimal soil disturbance and no gaps.

A knockdown treatment of glyphosate (Group 9 [M]), clopyralid (Group 4 [I]) and carfentrazone (Group G [14]) is applied at planting then a mix of pendimethalin (Group 3 [D]), clomazone (Group 13 [Q]) and paraquat (Group 22 [L]) is applied after an irrigation flush to initiate rice germination and prior to rice germination to knockdown both newly emerged barnyard grass (BYG) and persisting ryegrass. This provides a double knock on ryegrass whilst applying a pre-emergent herbicide for barnyard grass in the rice phase.

When implemented once every 4 or 5 years, with a diverse rotation of winter and summer crops in-between, growers can keep a lid on herbicide resistant annual ryegrass populations.

### How do you manage weeds on the non-crop areas?

**In brief:** The same herbicide mix is applied to the whole paddock, including the weeds growing in the check banks.

**The details:** Weed seed, often carrying herbicide resistance genes, travels easily through irrigation systems and can colonise non-crop areas. Seed from these plants readily infests the cropping areas if not controlled effectively. The control measures used on non-crop zones are often limited to herbicide tactics, so it is important to make sure the herbicide is applied to maximum effect to prevent seed set.

Farm hygiene and physical removal of isolated weeds will also have a positive impact on weed seed production.

### What farming system benefits come growing a legume cover crop?

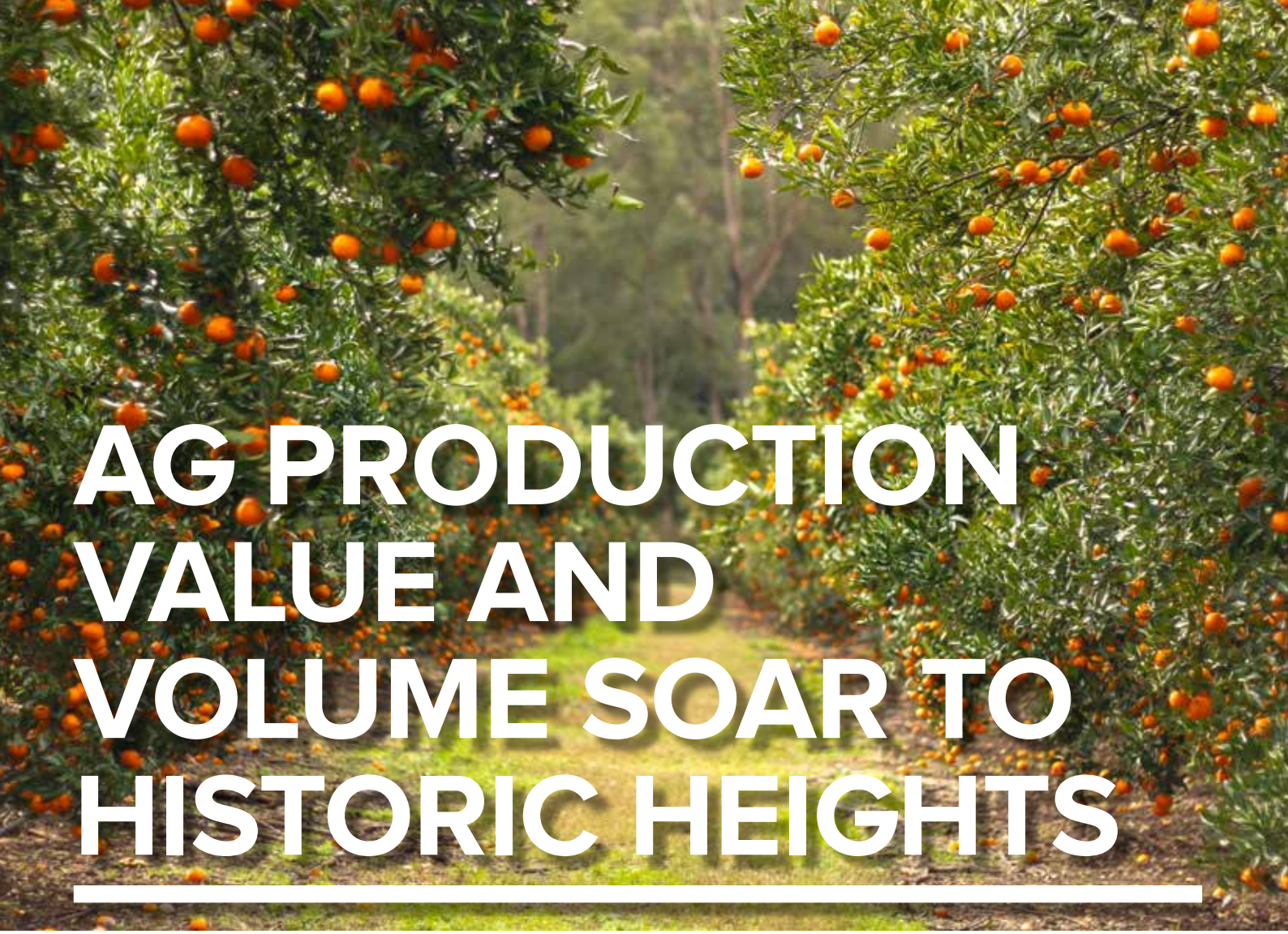
**In brief:** A legume crop grown for biomass rather than grain can improved soil tilth and reduce crusting on some sodic soils. This practice also allows better soil nutrition management and keeps the grower's options open if the water allocation situation changes.

**The details:** The field pea crop will fix atmospheric nitrogen and this allows the grower to use 100 to 150 kg/ha less urea to grow the following rice crop without any yield penalty. If there is insufficient irrigation water available for a rice crop, then the fixed nitrogen is still available for a winter crop of canola or wheat.

The phosphorus fertiliser required for rice can be applied when the field pea crop is planted, giving the phosphorus time to become more available in the soil and ready for uptake when the rice is planted.

Field pea is quite drought tolerant, so if irrigation water is not available for rice, the field pea can be grown through to harvest the grain and will usually yield 0.7 t/ha, which can be more profitable than, say, a 1 t/ha drought-affected wheat crop.

Building an integrated farming system based on methods that have multiple benefits is fundamental to staying ahead of weed pressure.



# AG PRODUCTION VALUE AND VOLUME SOAR TO HISTORIC HEIGHTS

**Australia's farmers are on track to smash production value and volume records in 2021-22 on the back of exceptional seasonal conditions and a surge in world commodity prices.**

Despite recent flood and rain damage in the eastern states, the ABARES Agricultural Commodities: December Quarter is forecasting a history-making agricultural gross production value of $78 billion – $5.4 billion more than predicted just a few months ago.

The value of agricultural exports is forecast to hit a record $61 billion. Production is expected to increase year-on-year for every major livestock commodity and almost every major crop commodity – with farmers forecast to produce the largest volume ever.

ABARES Executive Director Dr Jared Greenville said Australia was enjoying an extraordinary combination of favourable conditions and 30-year price highs.

"It would be the first time in at least half a century that production will increase for so many products at the same time," Dr Greenville said.

"And if these forecasts are realised, 2021–22 will see the largest total volume of agricultural commodities Australia has ever produced. "Prices are also at multi-year highs for many agricultural commodities.

"Higher export volumes and higher prices are forecast for almost every major export commodity, with the total value of agricultural exports being revised up $6.5 billion to $61 billion, also an all-time high.

"This uplift in Australian agricultural production value and volume is unprecedented and the result of exceptional growing conditions here and poor seasons being experienced by key overseas competitors.

"There is uncertainty how long prices will remain at these levels – and supply chain disruptions, higher fertiliser prices and heavy rainfall domestically will continue to be watch points.

"This forecast accounts for the unfortunately timed substantial rainfall and localised flooding in east coast growing regions during November.

"This will delay harvests and result in some crop losses, but this is unlikely to reduce national harvest tonnage significantly. "The larger impact will be on grain quality, with a higher than usual proportion of the crop being lower-value feed-grade wheat."

**"Higher export volumes and higher prices are forecast for almost every major export commodity, with the total value of agricultural exports being revised up $6.5 billion to $61 billion, also an all-time high."**

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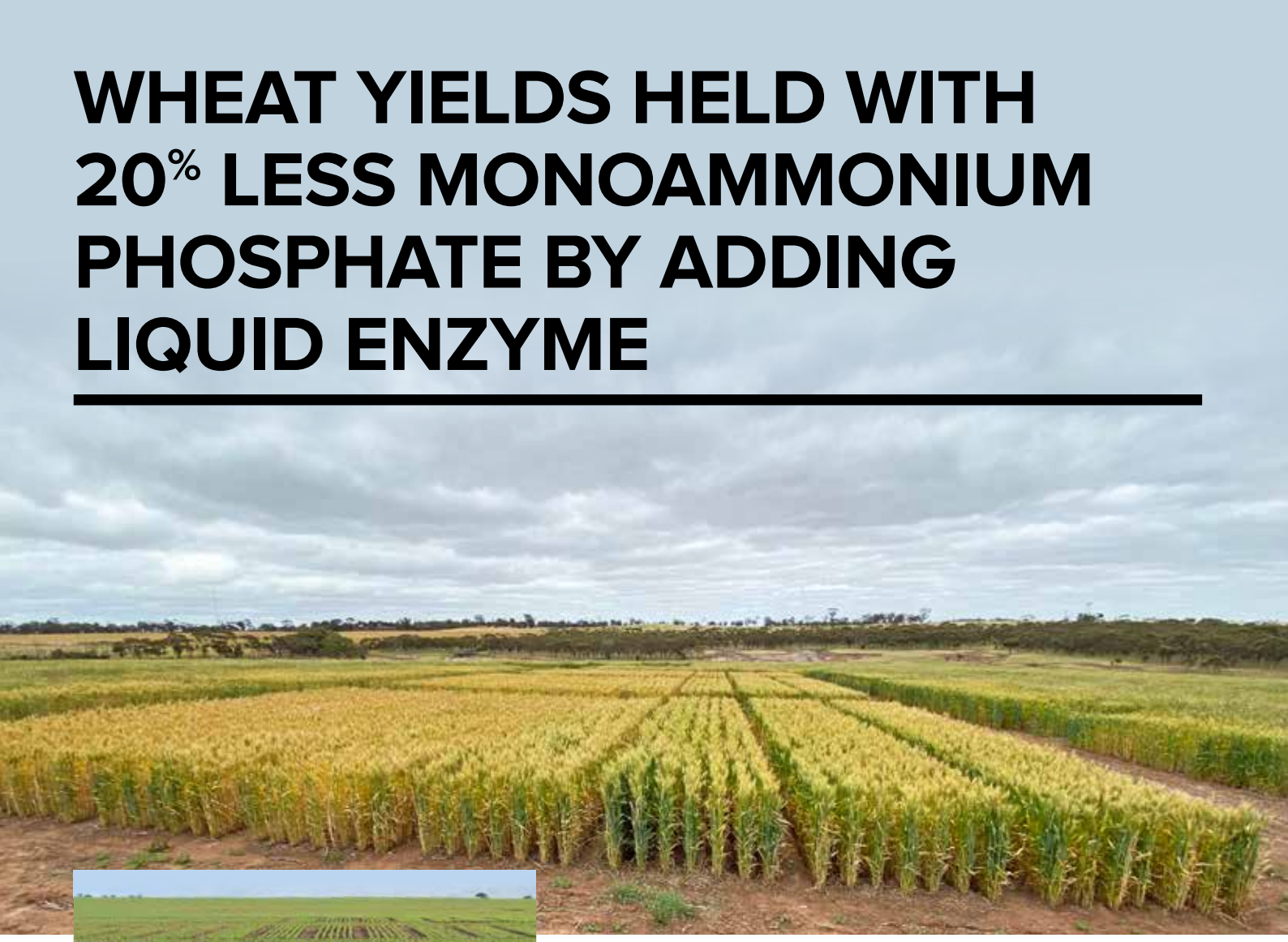
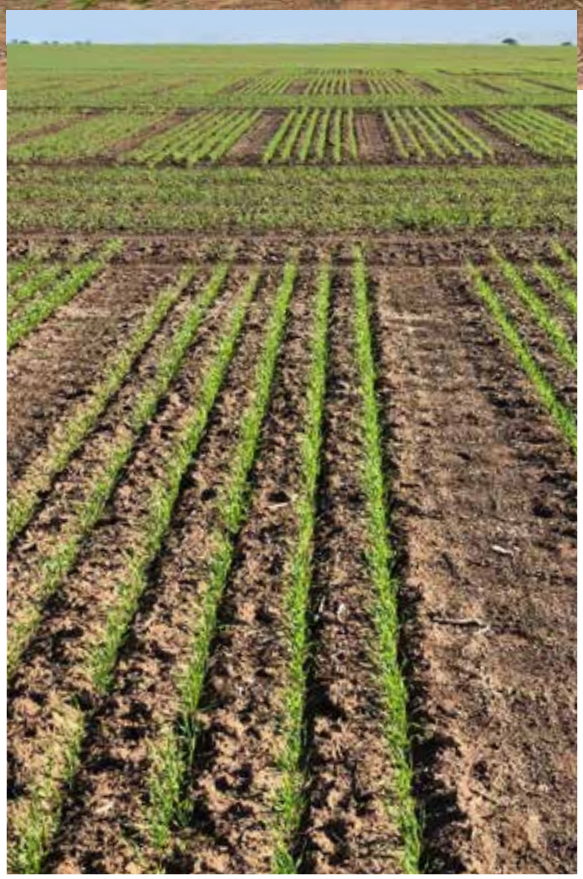




Wheat trials Katanning, WA – part of large-scale trials in WA, SA, Victoria and NSW that showed the soil enzyme Lumen applied in-furrow or on fertiliser at seeding, with MAP at 80% of standard rate, resulted in wheat yields equal to the standard 100% MAP rate of 80kg/ha.v

**Applying 80% of the standard rate of MAP, plus the liquid enzyme Lumen, has produced wheat yields, plant-counts, biomass and grain-quality equivalent to the 100% MAP rate in soils where phosphorus fertilisers are recommended.**

This result, from two and a half years of replicated field trials by Elemental Enzymes in Australia, supports and backs more than six years and 100 trials in the US.

The launch of Lumen liquid enzyme in Australia comes at a crucial time, with farmers facing enormous price hikes for fertiliser and potential supply shortages as they make their 2022 winter-crop planting decisions.

Cereal growing is one of the top five industries most impacted by the escalating domestic price of fertiliser.

The estimated tonnes of wheat Australian farmers needed to sell to cover the purchase of MAP fertiliser rose from 1 tonne in late 2020 to 2.5 tonnes in 2021, with further rises in 2022.

One option growers are likely to be considering is to reduce the amount of fertiliser they apply to their 2022 winter crop, potentially leading to a shortfall in crop yield and income.

The liquid enzyme Lumen now offers them a way to maintain yield at a lower rate of MAP.

Elemental Enzymes Australia sales and marketing manager Chris Ramsey estimates Lumen could save Australian grain farmers $20-$45/ha in MAP fertiliser costs in 2022, allowing them to stretch their available MAP supplies across 20 per cent more hectares, without sacrificing yield.

### What is Lumen and how does it work?

Lumen is a patented liquid additive for improving phosphorous fertilizer efficiency.

It contains enzymes that are naturally secreted by both plants and microbes to convert complex soil-borne molecules into smaller, easily-absorbed nutrients. These enzymes provide plants with greater access to soil nutrients and the ability to absorb them.

Chris Ramsey: "Lumen contains a blend of two enzymes, lipase and mannanase. Lipase converts lipids in soil organic matter, allowing release of bio-available nutrients for the plant, and stimulating native microbial soil activity. Mannanase breaks down exudates around the outer layers of root tips, making it easier for them to absorb extra nutrient.

"Adding these enzymes in a higher concentration and distributing them more widely in the soil improves the use of nutrients applied in fertiliser, plus nutrients already present in soil organic matter. And Lumen fits in well with existing crop-sowing operations."

### Australian trial results

In 2020 and 2021, large replicated trials conducted by independent agricultural research companies in West Australia, South Australia, Victoria and NSW, plus large-scale farmer demonstration trials, have proven the ability to reduce fertiliser rates without yield loss, by adding Lumen liquid enzyme.

Trials were typically run with MAP, which is used extensively in cropping systems in Australia, with its low level of nitrogen and no free ammonia making it a useful 'starter' fertiliser with minimal risk to germinating seeds.

As well as getting more out of the applied fertiliser before it is tied up, the data has also shown improved utilisation of N, P and K, with the enzymes making these nutrients more available to the plant.

The bar charts summarise the impact of Lumen on wheat crops in South Australia's Eyre Peninsula and at Katanning in West Australia.

Mr Ramsey said the replicated trials conducted by an independent trial company at Katanning in West Australia were a good example of the positive results.

The company reported that the addition of Elemental Enzymes soil enzyme product Lumen applied in-furrow or on granular fertiliser at seeding, with MAP at 80% of standard rate resulted in:

- Wheat plant counts, biomass, yield and grain quality equal to the standard 100% MAP rate of 80kg/ha.

They also reported that:

- Lumen proved safe to wheat, when applied in-furrow or on fertiliser at seeding.
- Lumen could improve phosphate fertiliser efficiency for wheat farmers.
- Lumen could save $20 to $45/ha MAP fertiliser cost in 2022.
- Lumen could allow available MAP to be stretched across 20 per cent more hectares.

Lumen has also been trialled in canola and grain legume crops such as chickpeas and lentils in Australia, with equally promising results.

### Dealing with climbing fertiliser prices

Global prices for fertiliser neared record highs last year and are still climbing, with prices likely to remain high and volatile in 2022.

Recent reports of P-based fertiliser prices at port were around A$1500 per metric tonne (1000kg).

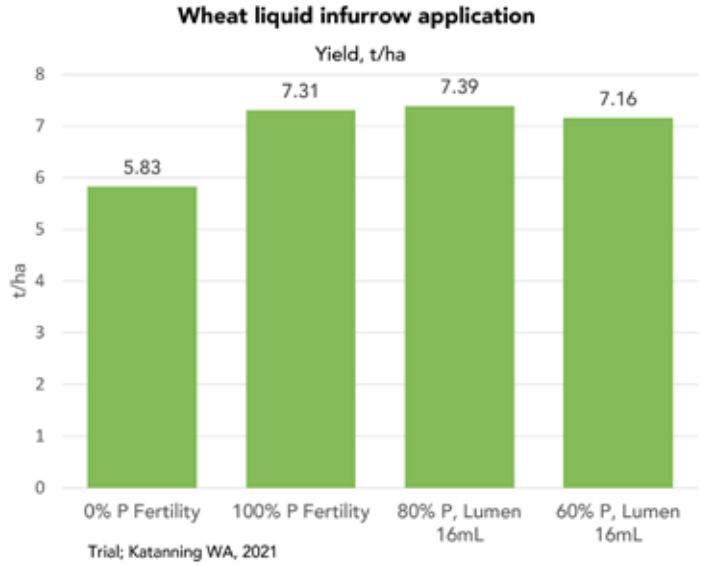
At that price of $1.50/kg, using MAP at 64 kg/ha (80% of the recommended rate), with the addition of Lumen liquid enzymes, would translate to a fertiliser saving of around $24/ha for an equivalent crop yield.

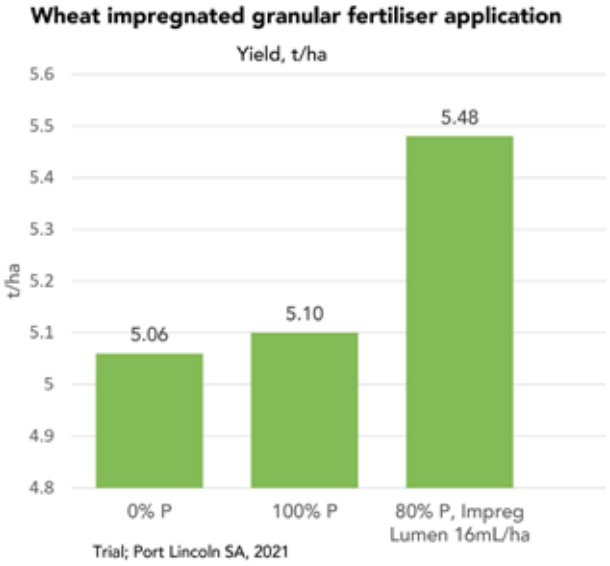
Make the most of expensive fertiliser applications this season by supplying the right amount of soil enzyme, right where and when it's needed – by adding Lumen to improve both nutrient availability in the soil, and nutrient absorption by plant roots.

Lumen is available in a 1L pack and treats 62.5ha at the recommended rate of 16ml/ha.

Supplies of Lumen are now available across Australia for the 2022 autumn-planting season, and can be ordered through growers' usual rural supply outlets.

For further information contact info@elementalenzymes.com or 1800 691 440.



# FLOW LAUNCHES GLOBAL REFORESTATION PROGRAM TO PROTECT POLLINATORS

**Flow, creators of the revolutionary Flow Hive, will work with partners to plant more than 1 million trees.**

The Billions of Blossoms project is a partnership between Flow and some of the world's best reforestation and conservation projects. The goal is to create billions of new flowers for pollinators through a mix of reforestation and habitat protection, including agricultural reform.

"Today – as we face climate, pollution and extinction crises, with insect populations and overall biodiversity in drastic decline – committing to the regeneration of the natural world has never been more important," said Cedar Anderson, Flow Hive co-inventor and CEO. "Flow is delighted to be partnering with some of the world's best reforestation and conservation projects, to help create a bright future for pollinators, people, and the planet."

Earth is at the start of the sixth mass extinction in its history. More than 420 million hectares of forest have been destroyed worldwide since 1990.

Flow will help to protect and re-establish healthy forests, so as to provide forage for billions of pollinating animals worldwide.

The Billions of Blossoms project is funded by Flow's online education initiative, TheBeekeeper.org. More than $325K has been raised for the Billions of Blossoms project so far, which will be used to partner with high-quality reforestation projects around the world.

Billions of Blossoms partner organisations currently include Eden Reforestation Projects [Africa]; One Tree Planted [Australia, USA, Indonesia, NZ]; World Land Trust [Latin America]; YAKUM [Ecuador]; Hometree [Ireland]; and ReForest Now [Australia].

One Tree Planted works with reforestation partners across 43 countries. In 2020 they planted 10 million trees.

"We are thrilled to be partnering with Flow's Billions of Blossoms project, which supports our mission of planting trees and creating healthy ecosystems where biodiversity can thrive. Bees need trees too!" said Beth Dalgliesh, One Tree Planted's Regional Director, Australia and Asia Pacific.

YAKUM works with Indigenous people in the Amazon rainforest to build cultural, medicinal and food sovereignty, through reforestation with carefully selected native tree species and territorial resource mapping.

"We're really happy to be collaborating with Flow and their Billions of Blossoms Project to do reforestation in the Ecuadorian Amazon. These funds help to continue our work with organisations like the Sachawaysa eco-tourism workgroup in Ecuador, who've been reforesting cattle pasture land with ancestral fruit, nut and palm trees since 2018," said YAKUM's Executive Director Nick Ovenden.

For more information about the Billions of Blossoms project, including Flow and its partner organisations visit www.honeyflow.com/blossoms


## ABOUT FLOW

Flow are the creators of the Flow Hive, a revolutionary way to extract honey straight from the hive. The product has been hailed as the most important advancement in beekeeping and honey extraction in nearly two centuries. Launched in 2015 by father and son duo Stuart & Cedar Anderson, Flow is now an award-winning certified B Corporation. The company has shipped more than 85,000 hives globally and seeks to educate the general public on the benefits of beekeeping and the importance of supporting pollinators worldwide.

# BEYOND THE PADDOCK

## PERCEPTIONS OF AUSTRALIAN AGRICULTURE ARE SHIFTING

**Five young leaders in agriculture give us their perspective on the future of agriculture and the opportunities that lie ahead for others interested in pursuing a career in the industry, and those who hadn't even considered it.**

Traditionally, individuals who pursued careers in agriculture sought a life on the land, surrounded by paddocks, animals and tractors. But the ever-expanding fields in agriculture and agritech offer so much more than this 'traditional' avenue. This is exactly what Horizon Scholars Matilda Meppem, Paris Capell, Pippa Pryor, Bill Hyem and Demi Taylor are chasing.

In the past, growing up amidst the high-rises of Sydney would have been seen as counterintuitive to a career in agriculture, however Pippa is just one of many young people from non-traditional agricultural backgrounds drawn to the industry.

"I did a farm stay when I was younger and thought it was better than Christmas! Then I went on to study agriculture in high school and was loved learning about technology, how agriculture impacts on climate change and how everything is integrated.

"At university, I'm realising more and more that we need clever people solving the challenges of the future, and agriculture is the future," Pippa says. One of the challenges Pippa hopes to solve in the future is the impact of climate change on cattle, with the vision to support her Horizon sponsor, Meat & Livestock Australia (MLA) hit their Carbon Neutral by 2030 target.

Matilda Meppem is sponsored by Grains Research and Development Corporation (GRDC) and her passion for agriculture grew from the grassroots, growing up on a cattle and cropping farm in Western Queensland. Now studying Civil Engineering and Business Management with a focus on the water sector, Matilda is excited to bring her passion for agriculture and science together.

"Water underpins everything we do in agriculture, and something I'm really excited to work with is our ability to harvest data from water. For example, how much water is being absorbed in the soil, how much is running off and more. From there, using technology to take that data and turn it into real results to help farmer's management practices and decision making is really important."

Despite being passionate about rural Australia, Paris says agriculture wasn't a career path that was encouraged for high-achieving school leavers like her.

"I decided to go to university and study environment science, however when I started I realised my heart was in agricultural production. At the time, I had grown an interest in geospatial information systems for vegetation classification and loved that part of remote sensing and that side of agritech.

"I decided to do a major in precision agriculture, which meant I could combine my favourite things and be back in agriculture."

Paris is sponsored by Cooperative Research Centre for Developing Northern Australia (CRCNA) and believes the agritech revolution might just be the missing piece when it comes to making agriculture an attractive career path.

**"I think it signals to high school students that agriculture is not dying or stagnant, we are innovating and thinking outside the box all the time and it is such an exciting place to be.**

It's the limitlessness of agritech that excites Paris, who sees her future in the industry through the lens of the next revolution.

"Since the green revolution, we haven't had a push in agriculture to take us to the next level, particularly in Australia. Slowly our productivity factors are declining due to factors like climate change and COVID-19, and complex supply chains also present their own challenges. I think agritech could be that next revolution, with its ability to provide huge insights into our production systems, quickly and cost effectively," says Paris.

She sees an opportunity to bridge the gap between technology innovations and adoption on farm and hopes to create a platform that does just that.

"In the future I'd love to create a platform that makes carbon farming and natural capital counting more accessible to farmers. I don't think it has to be as complicated as all the methodologies are now. There are some really simple metrics that can be communicated to break down the barriers to entering those new markets."

Suffice to say, Paris says there's a need to change the narrative about what jobs in agriculture look like.





**Future Young Leader program participants** (Left to Right) Paris Capell, Matilda Meppem, Bill Hyem, Demi Taylor, Pippa Pryor.

**"Things like high school agronomy and cattle teams are great, but they don't articulate how complex the system is and how many disciplines are involved," Paris explains.**

"I think programs like the AgriFutures Horizon Scholarship and evokeAG. Future Young Leaders provide a platform to show that the ecosystem of agriculture is more than just farmers. It's universities, entrepreneurs and so much more.

"Things like high school agronomy and cattle teams are great, but they don't articulate how complex the system is and how many disciplines are involved," Paris explains.

Pippa's perspective is not dissimilar, suggesting that educating children and teenagers could be key to turning the farmer stereotype on its head.

"I was really lucky that my school even offered agriculture, but this is rare for city schools. Teaching children that agriculture includes research, science, technology, marketing and more is really important."

Studying Agricultural Science majoring in Communications and also sponsored by GRDC, Demi Taylor hopes to support Research, Development and Extension in the grains and oilseeds sector. Growing up on a farm, Demi hopes to one day return to her family's property and implement the things she learns along the way.

"There are barriers to adoption on farm for sustainable farming practices, this is where correct extension has a significant opportunity to support and engage the diverse group of people in Australian agriculture," Demi explains.

According to Pippa, fresh perspectives and diversity might help agriculture deliver the innovation it will need for the future.

"There is so much to learn from people who have grown up in the industry, but it's great to come in with an outside perspective, because it means you can question why things are done the way they are.

"I think the agricultural ecosystem needs extend and expand from its historically insular community. City kids need to see that they can find a way into the community, because once you're in, it's golden," says Pippa.

Bill Hyem grew up on a farm and was always encouraged to get to university and experience life off the farm. He's done just that but has found himself coming full circle wanting to use his inquisitive nature to ask the question, "How can we make Australian agriculture more sustainable and profitable?"

Bill explains, "The perception of agriculture is shifting away from traditional farmers sitting in a paddock with their tractor and their kelpie. It's really exciting for young people to see the potential of technology to change and adapt agriculture in Australia."

During his time as a Horizon scholar sponsored by GRDC, Bill has been able to see the huge opportunity for young people in agriculture.

"Being a part of the Horizon Scholarship Program has opened so many doors for me. I have been able to build my network and connections, working with CSIRO on research to increase wheat productivity, and also Ceres Tag to look at provenance traceability and improving animal welfare. It has been amazing to be involved with these businesses and to see how agritech evolves from just an idea."

For more information on the Horizon Scholar program with AgriFutures Australia, head to agrifutures.com.au/horizon.

Applications for the Future Young Leader program for evokeAG 2023 will be opening later this year, to get more information on applying head to evokeag.com

# EARLY FUNGICIDE APPLICATIONS CAN BOOST YOUR CROP YIELD

**A GREATER focus on disease prevention through earlier application of crop fungicides is contributing to improved grain yields for the Kellock family near Lake Rowan, hence it will be high on the radar again in plans for the coming season.**

Chris and Libby Kellock, together with their sons Sam and Nick, grow wheat and canola across their 'Hillview' farm as well as at properties near Dookie and over the border at Mulwala in New South Wales. About 600ha is under irrigation, while they also run a small Merino sheep flock and mixed herd of beef breeders.

Crops are now sown with a Seed Hawk air drill set on 300-millimetre row spacings after years of using an Ausplow DBS precision seeder, while stubble retention and management has played a long-term role to help improve their soils.

All canola stubbles are mulched using a stubble cruncher, wheat stubbles are sometimes cut for straw if it is marketable and burning is carried out only if required.

With the tight canola-wheat crop rotation, diseases are a constant threat and high on the management agenda. "We are certainly looking at diseases more and have become more reliant on fungicides,'' Chris said.

"We also rotate our varieties – we are growing hybrid Roundup Ready varieties now. It's always a challenge, but we are seeing yield responses to fungicide usage and it has been best to concentrate on disease prevention rather than cure. Once disease takes hold, it can be difficult to control, so we mainly use fungicides for prevention now.''

Blackleg and sclerotinia are the key diseases in canola, with aerial blackleg becoming more prevalent depending upon rainfall.

In wheat, the main target has shifted from stripe rust to powdery mildew in recent years. Disease pressure can also be influenced by the level of disease resistance in different varieties and the Kellocks ensure they use different fungicide groups and active ingredients to control both diseases. Most varietal resistance occurs at adult plant stages, so the need to monitor crops early and apply preventative applications remains crucial.

"We really look at the active and the percent of active in fungicides,'' Chris said.

After monitoring the single use of the prothioconazole active ingredient in other parts of the world, the Kellocks were pleased with its introduction into Australia last year following the release of Proviso® fungicide by ADAMA Australia.

"We were waiting for a specific active for blackleg and 'sclero' to come out. Other products have prothioconazole and tebuconazole for use in wheat and canola, but with tebuconazole we are paying for something that we don't really use,'' Chris said.

Proviso, which also can be used in cereals, is a novel prothioconazole fungicide featuring ADAMA's unique Asorbital™ technology. This enables enhanced uptake and systemic activity for improved efficacy, compatibility and crop safety.

It also can be used in tank mixes with a range of other crop protection and nutrition products to control a broad range of diseases, as well as to assist disease management, from an early stage.

Plant fungal disease; close-up of an affected leaf with severe case of powdery mildew.

Potato plants heavily infested by Potato Blackleg Disease caused by pathogens: bacteria Pectobacterium atrosepticum, carotovorum and Dickeya. Symptoms on leaves.

Sclerotinia affected cucumber.

Chris said depending upon the paddock and threat of blackleg, they used Proviso in the canola early and applied another fungicide later. “We have gone early the last couple of years to give protection and that is responsible for some of the increase in yield we are seeing. It’s protecting the leaf as well as against the aerial blackleg and it’s reducing the amount of ‘sclero’ in crops.”

“Proviso, with straight prothioconazole, was more economical and I definitely think it has a fit in controlling blackleg and ‘sclero’ in canola. It seems to be doing the job and I think we will go with a similar plan this season.”

He said the powdery mildew in wheat can be difficult to control, especially in irrigated crops, and prevention was again the best strategy.

“We are seeing it in thick crops of some wheat varieties and it’s particularly hard to cure once it’s in the thick canopy.” Chris said they liked to use a mix of fungicides to guard against powdery mildew resistance and, on the recommendation of long-term agronomist Tony Kelly from Advanced Ag, based at Shepparton, they also used the new Maxentis® EC fungicide from ADAMA Australia last year.

As a dual mode of action fungicide containing both prothioconazole and azoxystrobin, Maxentis EC provides improved disease control spectrum, efficacy and resistance management in cereals and canola, as well as an important rotation option following commonly used in-furrow and seed treatment fungicides. Research has confirmed it offers better crop safety than existing benchmark fungicides whether applied alone or in tank mixes.

“We got in early, when the disease pressure was not as great, and it was effective,” Chris said. “The dual mode of action works well as another tool and we will look to use it again this year in certain situations.”

Meanwhile, the Kellocks applied another ADAMA Australia product last season when Tony recommended the use of the new, flexible herbicide tank mix partner, Priority®, with LVE herbicide for improved control of marshmallow in wheat.

Priority, which contains florasulam, can be used in all major cereals as well as established ryegrass pastures and is ideal to broaden weed spectrums and enhance the efficacy of tank mix partners. “It was applied with our broadleaf weed control spray,” Chris said.

The Kellocks use of ADAMA Australia products last year paid-off too when they became one of the winners of the company’s major product competition and received on-farm delivery of a Traeger PRO 780 wood-fired pellet grill package valued at $2200. Chris said the family’s chemical bill had been getting pretty high, so he was thrilled to win the Traeger package.

**“We were waiting for a specific active for blackleg and ‘sclero’ to come out. Other products have prothioconazole and tebuconazole for use in wheat and canola, but with tebuconazole we are paying for something that we don’t really use” Chris said.**

Lake Rowan growers Chris (centre) and Sam Kellock were thrilled to receive delivery of a Traeger PRO 780 wood-fired pellet grill package from ADAMA Australia North East Victoria Commercial Manager Jenny Haupt as one of the winners of the company’s major product competition last season.

# BETTER RECOGNITION NEEDED FOR WOMEN AND GIRLS AS AGENTS OF CHANGE

**The 11th of February was the International Day of Women and Girls in Science which recognises the critical role that women and girls play in science and technology.**

To mark the day, the UN identified gender equality and science as vital to achieving the 2030 Agenda for Sustainable Development in time. It acknowledges that while significant progress has been made towards increased participation in higher education, women remain under-represented in these fields.

In Australia, girls and women still only make up around a third of students and workers in STEM courses or occupations for agriculture, environmental and related fields in Australia.

Chief Executive Officer of CropLife Australia, the national peak industry organisation for the plant science sector, Mr Matthew Cossey, said, "Ensuring equal opportunities for women and girls in science is essential to realising the potential of science as a means of improving the world.

"Science and technology are core to the future success of Australia's agricultural sector and agriculture worldwide. Gender equality in science will drive new ideas and innovations towards a productive and competitive agriculture sector that can sustainably contribute to food security in Australia and globally," said Mr Cossey.

It's important we recognise and acknowledge the significant contributions of women that drive innovation in this country, from science and research, manufacturing, policy and on-farm to set an example for future female leaders in science. It's also crucial we recognise the benefits that will come for humanity by ensuring full and equal access and participation for women and girls in science.

CropLife and its member companies actively look to support initiatives that support and promote girls and women in science and are fortunate to have some amazing female scientists on our team and in our industry that deliver thought leadership for the plant science industry.

"New ways of thinking bring innovative solutions and broader perspectives amongst policy makers. This is crucial if we want to give ourselves the best chance of solving the challenges that have become closer to home," Mr Cossey concluded.

**In Australia, girls and women still only make up around a third of students and workers in STEM courses or occupations for agriculture, environmental and related fields in Australia.**

# DR JOE SMITH WELCOMED AS NEW CHAIR OF ABCA

**The executive of the Agricultural Biotechnology Council of Australia (ABCA) is delighted to announce Dr Joe Smith as its new Chair.**

Dr Smith brings to the role high-level regulatory scientific expertise and leadership which will further support ABCA continuing to provide credible, balanced and science-based information about the current and potential benefits of agricultural biotechnology for the nation's farming sector.

As former national Gene Technology Regulator, Chief Executive Officer of the Australian Pesticides and Veterinary Medicines Authority and Director of the Therapeutic Goods Administration Laboratories, Dr Smith has had an extensive and distinguished career leading key Australian regulatory authorities.

On a global scale, Dr Smith has been actively engaged in the significant issues of biotechnology and agricultural chemicals regulation through forums such as the Organisation for Economic Co-operation and Development, Food and Agriculture Organisation of the United Nations and World Health Organisation. He is also currently President of the International Society for Biosafety Research, an organisation that brings together researchers, technology developers, industry, regulators and non-government organisations to engage in meaningful dialogue about cutting-edge biotechnology and biosafety research, risk analysis, policy, regulation and communication.

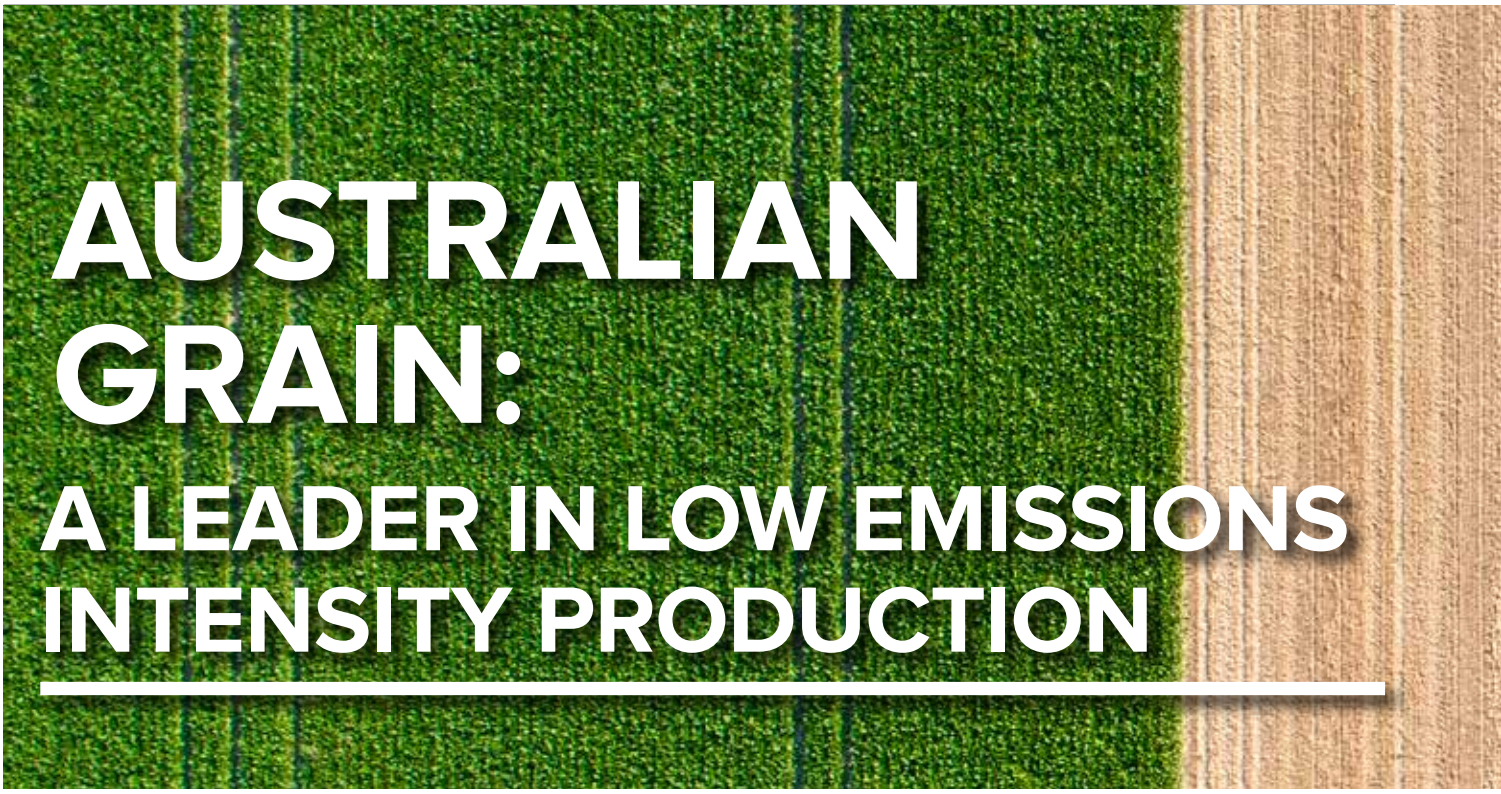
The appointment of someone with such standing speaks to the important role of ABCA in improving accessibility of new agricultural biotechnology innovations to deliver a more sustainable, productive and profitable future for Australian agriculture.

"It's an honour to be able to continue to serve the sector at a time of great opportunity for Australian agriculture and food security, said Dr Smith. "It's vital that the Australian farming sector can access and adopt new technologies in an environment where there is good awareness of the science and realistic appreciation of risk. For this to happen there needs to be open and transparent dialogue.

"At its core, ABCA encourages informed debate about agricultural biotechnology so that the public and particularly primary producers can make well-informed decisions about the future application of biotechnology in Australia," concluded Dr Smith.

Dr Smith will be supported by ABCA's secretariat, founding members, council members and Patrons, The Hon. John Anderson AO and Professor Adrienne Clarke AC.

The executive also thanks Mr Ken Matthews AO who was ABCA's independent chairman of for eight years and acknowledges his commitment and significant contribution to ensuring science and evidence-based information about agricultural biotechnology is widely available.



# AUSTRALIAN GRAIN:

## A LEADER IN LOW EMISSIONS INTENSITY PRODUCTION

**Australian grain growers are producing low emissions intensity, high quality cereals, pulses and oilseeds, according to a new report released today by the Grains Research and Development Corporation (GRDC).**

The report, Australian Grains Baseline and Mitigation Assessment, found that the Australian grains industry exhibits low greenhouse gas emissions for each tonne of grain produced compared to other grain producing regions and countries, including the EU, USA, Canada, Russia and Ukraine.

GRDC Chair and Goondiwindi grain grower, John Woods said Australia's national science agency, CSIRO was commissioned to prepare the report to establish a detailed and robust greenhouse gas (GHG) emissions baseline for the Australian grains sector and explore mitigation opportunities that maintain or increase profitability.

"The risks of climate change and climate variability including low rainfall and increased temperatures to the Australian grains sector are significant," Mr Woods said.

"Yet climate challenge creates new opportunities for innovation and growth for the agricultural sector, and with the right approach, Australia's grain sector can prosper in a changing environment.

"Grain growers manage about four per cent of the Australian continent with 22,300 grain farms covering an estimated 31 million hectares, so they play an important part in delivering economic and environmental outcomes on behalf of the broader community.

"As growers we continue to apply farming practices that result in world-leading low emissions intensity grain production, while maintaining and improving profitability."

Mr Woods said there were multiple drivers for the agricultural sector to investigate low emissions intensity opportunities, including market preferences, financial investment advantages and environmental considerations.

"International markets are now looking to source grain grown with the lowest emissions and they should be looking at Australian grain growers. We are amongst the most efficient producers in the world," he said.

CSIRO Senior Research Scientist, Dr Maartje Sevenster led the 18-month research initiative and co-authored the report. She said the information provided essential baseline data around the current level of greenhouse emissions for the Australian grains industry.

"Having robust reference information for greenhouse gas accounting and assessing priorities for mitigation is essential. This type of information will also be increasingly important for the Australian grains industry in maintaining access to global markets," Dr Sevenster said.

"If Australia can produce grains to feed the world at relatively low greenhouse-gas intensity there is global benefit."

To identify a GHG emissions baseline for the Australian grain production sector, CSIRO scientists used the 2005 baseline for Nationally Determined Contributions under the Paris Agreement (COP 21). Their research found:

Emissions arising from Australian grain production in 2005 were 13.75 million tonnes CO2~e or 315 kg of CO2~e per tonne of Australian grain produced.

Approximately 60 per cent of these emissions are direct farm emissions.

The report notes that approximately 40 per cent are scope three emissions external to the farm gate, which include the emissions produced in the manufacture of the inputs growers use such as fertiliser.

On-farm emissions from Australian grain accounted for 1.7 per cent of all of Australia's national emissions reported in 2005-06.

**"If Australia can produce grains to feed the world at relatively low greenhouse-gas intensity there is global benefit."**

Dr Sevenster, CSIRO Senior Research Scientist

Reducing overall net emissions of the Australian grains industry by 2030 is unlikely to be achieved without decreasing Australian production.

Any reduction in Australian grain production is likely to result in an increase in grain production in regions of the world that are not able to achieve the low emissions intensity of Australia, increasing global grains emissions.

"We focused our assessment of mitigation opportunities on measures that would maintain or improve average production across the sector and found that it is possible to increase production dramatically while keeping net on-farm emissions more or less constant," Dr Sevenster said.

"While this is not the same as reducing emissions, it is a very important finding. The next step is to determine what information and tools farmers need to make those modelled scenarios reality."

Mr Woods said there was significant complexity in terms of greenhouse gas mitigation in grain production, however several opportunities existed to further reduce emissions intensity of Australian grain production.

"Six scenarios were modelled to reduce emissions intensity: current rotations and nitrogen rate, best practice nitrogen application, perfect nitrogen management, optimised rotation, green ammonia fertiliser and controlled traffic farming," Mr Woods said.

"These are key areas where GRDC has a long track record of research, development and extension (RD&E) investment and where we will continue to invest to drive profitability for growers and enhance environmental outcomes.

"Two prime examples of GRDC's ongoing investment in this area include extensive nitrogen use efficiency research and our 2019 CSIRO ARENA investment to develop green ammonia fertiliser."

Mr Woods said the CSIRO report indicated the collective adoption of modelled scenarios could reduce greenhouse gas emissions intensity per tonne of grain by up to 15 per cent.

"This report has identified opportunities for further research and demonstrated that best practice farming has the potential to further reduced emissions intensity for Australian growers."

He said the report's findings gave the grains industry a realistic pathway towards reducing the greenhouse gas intensity of Australian grain production as part of a profitable grain growing business sector.

"GRDC has a long history of investing in RD&E to help grain growers adapt to climate, mitigate its impact and to manage industry-wide emissions," said Mr Woods.

"Going forward recommendations from this GRDC-commissioned CSIRO report will help inform RD&E that supports a realistic trajectory towards reducing the greenhouse gas emissions intensity of Australian grain production, through practices that can be integrated into a profitable grain production business."

# NEW 'ROADMAP' TO ACCELERATE RESEARCH, DEVELOPMENT AND EXTENSION OUTCOMES FOR THE AUSTRALIAN RICE INDUSTRY

**The Australian rice industry has developed a new five-year roadmap focused on achieving an aspirational water productivity target of 1.5 tonnes of rice per megalitre of water by 2026 to future proof the industry.**

This target represents a 75% increase on 2021 water-use efficiency – which already places the Australian rice industry as the most water efficient in the world, using some 50% less water than the global average.

**Commenting on the new roadmap, the rice industry's RD&E plan, John Harvey, Managing Director of AgriFutures Australia said the roadmap involved extensive consultation with rice growers and industry and sets an exciting and bold research path for the industry.**

"Fundamentally, this roadmap seeks to invest in key activities and projects that can deliver more tonnes of rice per hectare and use less water per tonne. We want to ensure rice is a more competitive and attractive summer crop delivering greater financial returns for growers," said Mr Harvey.

"The investment of rice growers' levy is a responsibility AgriFutures Australia does not take lightly. To develop this roadmap, we have been working closely with AgriFutures Rice Advisory Panel, growers and our colleagues at SunRice, the RGA, NSW DPI and the Rice Marketing Board. Our end goal is to ensure rice remains a competitive and profitable option for all rice growers," added Mr Harvey.

Rob Gordon, Chief Executive Officer at SunRice, said the new roadmap and significantly increased investment would see a renewed urgency in the pursuit of new varieties and agronomic practices to deliver a step-change in water-use efficiency, while ensuring the profitability of rice production for growers.

"The Australian rice industry is world class. We grow some of the highest quality Japonica-style varieties anywhere in the world while already using 50% less water than the global average. SunRice then takes that rice and transforms it in our facilities in the Riverina into value-added branded products which are valued by customers and consumers in some 50 global markets.

"SunRice's operations directly contribute close to $400 million in years of normal production, employing more than 500 people across our facilities in Leeton, Coleambally, Jerilderie and Deniliquin, and supporting some 400 local businesses and growers.

"However, given the changing environment for water availability in the Riverina, there is an urgent need to deliver a step-change in our research, development and extension efforts to enable a fundamental shift in our water-use efficiency.

"This new RD&E plan will assist us in maintaining the high quality of our rice varieties, while increasing focus on water-use efficiency. While the target is openly ambitious – we believe it is achievable and necessary to ensure the ongoing profitability of our growers and to future-proof this great industry."

A new roadmap to accelerate research, development and extension outcomes for the Australian rice industry from SunRice on Vimeo.

Graeme Kruger, Executive Director of the RGA reiterated the importance of grower engagement in the development of the roadmap and continuing to work with growers.

“Throughout the development of this roadmap, AgriFutures Australia, SunRice and the RGA have worked with growers to understand their priorities and needs. It’s important that this conversation does not stop here.”

“The RGA will be responsible for continuing the conversation with all levy payers, seeking their input on opportunities and challenges on-farm, and working with the Management Committee to ensure grower input is reflected in the management of the program,” said Mr Kruger.

The roadmap, seeks to accelerate and drive progress towards the ambitious water productivity target of 1.5 tonnes of rice per megalitre of water by 2026 through four areas of work:

1. Optimising genetic improvement: The establishment of Rice Breeding Australia, an incorporated entity between AgriFutures Australia, SunRice and RGA. This new entity will embed a commercial focus and introduce state of the art breeding technologies to accelerate the development of new varieties with increased water productivity and cold tolerance.
2. The current Rice Breeding Program, led by NSW Department of Primary Industries (NSW DPI), will transition to the incorporated entity from June 2022. In the interim, NSW DPI will continue to manage the breeding program.
3. Targeted agronomy and farming systems: An agronomy and farming systems program with an objective to increase on-farm productivity through investment in agronomy and crop management R&D.
4. Coordinated industry extension: Increasing the adoption of the outputs from rice research through Rice Extension. In 2022, Rice Extension will transition to a single industry extension team, which brings together Rice Extension and SunRice Grower Services. This team will be overseen by Rice Research Australia Pty Ltd (RRAPL) and will focus on supporting growers to adopt technologies and best practice management to increase rice growers’ profitability now and into the future.

# LEADING WA GROWER ALWAYS SEEKING NEXT STEP

**Despite the complexities, challenges and, at times, mysteries of broadacre cropping today, you get the feeling some have a good handle on it and could attract a "look over the fence" – and Mic Fels at Wittenoom Hills in WA's south-east region is one of those.**

Mic is confident in the direction of the family's continuous, disc-sown cropping operation, reinforced by improving soil health, grain yields and profits, as well as reduced inputs, but he is always seeking the next step to further build soils and their resilience. This, combined with coming up with a farming system where they can apply the same, simple methods across their range of soils and achieve good results on all of them.

Mic knows that focusing on building soil health has solved a lot of problems, and, while recognising the good fortune of farming young, quality country and adopting this approach, he also admits this has not always been a top priority over the history of WA agriculture.

"In the early days, it was probably more about getting as much as you can out of the land than it was about putting back into it, but I think things have changed a lot in the last 20 or 30 years," Mic said.

"Since no-till, we've been constantly improving and people are getting better productivity even on our traditionally poorer soils, but we are having to spend a fair bit of money to ameliorate them in certain cases, which is probably now a bit of catch-up from years of taking from those soils.

"All soils can be improved and it's about being careful – treating them with kindness rather than just flogging them. Eliminating basic things (like bare ground) is good for a start. Then it's about how we can keep building it from there."

**He said over his 30 years in farming, agriculture had become a more technical, scientific and exciting industry to be in, and the focus was now moving beyond chemical farming.**

"It was a revelation what we could achieve with chemicals and chemical fertilisers and how much it grew our productivity, but I think it has got to a point where 'if a little bit is good, it doesn't mean a lot is better'. The green revolution has brought us a long way, but I think now that agriculture has gone through that incredible period, we are realising there's a bit more nuance to this."

"More people are now starting to think, 'we can't keep putting more and more stuff on this soil and think it's going to make it better'. A lot of these products are actually designed to kill things when, as a farmer, I see my job as trying to grow things – it doesn't all stack up when you think about it.

"It's now more about, 'let's get down to the nitty gritty of what's really helping and what's interfering with the process of building our soils'. And we can probably start taking some of those things out and replace them with things that are more positive in terms of soil health.

"In our case, we haven't used prophylactic insecticides for three to four years – not even on our canola, which people find a bit shocking. It's become a bit normal for people to use broadspectrum insecticides several times a year on their farms, which I'm a bit horrified what that's doing to the soil biology that we are trying to grow. Imagine if we all took constant, broadspectrum antibiotics – what that would do to our own health. That's what's driven it for us, and we are not getting any more insects without using insecticides, and I think that's because our system is becoming a bit more resilient."

The Fels' crop 6000 hectares at Wittenoom Hills, including leased land, to cereals, canola and some lupins over soils ranging from coastal sandplain through to traditional mallee country with sandy tops, as well as some heavy clay areas.

A controlled traffic system, use of their own designed and built iPaddock-Alphadisc seeding rig on narrow rows for increased biomass production and full residue retention, and amelioration, including mouldboard ploughing, has dramatically improved soils and crop yields. A stronger legume component in the rotation, where it is profitable, is now being considered to help further build resilience and also allow herbicide rotation benefits.

Mic said he was interested in alternative ways of building soil health and is excited to be monitoring a five-year trial commenced on their farm by independent research company, South East Agronomy Research, for Carbon Ag that is investigating the banding of its C33 carbon compost product at seeding, as well as high concentrate liquid phosphorus and potassium fertiliser, PowerPK.

He said snake oils and remedies had been promoted previously without demonstrating replicated data and had not survived, whereas Carbon Ag was making this commitment over an extended period of time.

"When you look at the total tonnes of carbon per hectare being applied, it's tiny and our scientific instinct is to say that can't increase soil carbon. Building carbon is incredibly hard to do in

agricultural soils, and so if it can it's a breakthrough, so I'll keep an open mind with the opportunity to test it in this trial and see in five years."

The trial has been established on a consistent, shallow duplex soil type comprising a sandy layer over a dome clay base and was one of the drier areas of the wheatbelt last season despite waterlogged conditions nearer to the coast.

Banded applications of the C33 carbon product and PowerPK liquid fertiliser are being compared with traditional seeding applications supplying around 15 kilograms/ha of phosphorus and potassium and 5kg/ha of nitrogen, with another 100kg/ha of nitrogen topdressed after seeding. The trial is also investigating substituting half of the traditional seeding application with the PowerPK, which, although supplies less total volume of phosphorus and potassium, matched the similar yields achieved by all treatments across the site last year.

Mic said the C33 and PowerPK treatments certainly looked good in the trial last season, with noticeably improved plant health and vigour.

"If I was set up for liquids at seeding, I would certainly be doing some strips with the PowerPK product, but my air cart is not. But we have the trial here, so I will definitely be looking at that, and, with people getting some good results using soil wetters at sowing as well, it's not to say we won't consider moving to using liquids again in four to five years."

**"We will keep an eye on the carbon product in the trial over time as well and if any product shows an economic benefit or some other benefit that can be quantified, we would definitely phase it into the program."**

"Ultimately, with any product, we need to see a gain for it. I'm not here to build soil carbon as an end in itself – the point is building the resilience and health of the soil so we can then grow better crops, which is also more sustainable and profitable.

"So, we are looking for a profitability edge and even if you see it's not doing it in the short term, but you know it's building sustainability and profitability in the longer term, then by all means. If applying the carbon product can build soil carbon, I know that is good for productivity and that it will increase our profitability over time. If it shows it can do that, there would be a strong case for bringing it in.

"The tiny bit of carbon being put in the soil is not going to increase soil carbon, but if it does trigger some other processes, let's see. We like to think we are a scientific industry and understand everything. I think when it comes to soil health, we know almost nothing. There's a lot of mystery and mystique about it still. There's an element of stuff we don't understand what's happening in there.

"So, some trial and error is required to see if we can trigger things to improve that process of carbon sequestration – that's the buzz word, but we're really about just building soil health. I feel like our deliberate strategy of using narrow rows, higher biomass varieties and concentrating on plant health is already helping, and any edge we can get might just get us over the line for actually growing soil carbon.

"If it can trigger some biological processes, maybe it can prevent some of that carbon in cellulose from being released back into CO2 when it's broken down. If you are building soil biology that is capturing it a bit more and putting it into a soil form of stable carbon, who knows – let's wait and see.

WA grower Mic Fels, Wittenoom Hills.

"I'm no evangelist about it, but there's a bit in this 'we don't understand what is happening but it still helps approach' and I'm pleased to have a trial on our farm to see what it can do. I certainly don't think we can answer all these questions with current scientific theory – because we can't.

"It's really pleasing that now in 2022, this is a bit more mainstream and part of our vernacular. There's a bit of pull coming from farmers in talking about soil health and that is making it easier for companies like Carbon Ag to come out with a product and properly validate it. You can't call it a snake oil if it shows that it works in a proper scientific, replicated trial run by an independent company.

"Rather than just 'fert' and squirt, we are now looking a bit wider – bring it on as far as I'm concerned," he said.

After conducting an EM38 survey of the farm and deep soil coring in 2007, Mic is keen to gain a carbon baseline for the farm and is working in conjunction with Carbon Ag to mount a Veris module on their seeding bar for the coming season that will achieve that.

"I'm not interested in selling carbon credits, but I think it would be really good to do, and there is now the technology to do it – so as we are seeding, we will be getting a carbon baseline of the farm. If we do one day end up where carbon credits have a worthwhile commercial value, I want them sitting in our balance sheet."

"In 20 years' time, it would be good to know what we have achieved and it will be good to compare with some of the 2007 results. I wouldn't mind betting soil carbon could still be going down slowly, because despite what politicians like to tell us, it's incredibly hard to grow, and also with the constantly increasing yield productivity we seem to be getting off this country. We are probably 1t/ha better than 10 years ago on the same country with the same rainfall, which is huge.

"That doesn't come from nowhere and we are always playing catch-up with fertiliser rates to ensure we keep up to new productivity levels. Some of that would be coming out of soil, so we need to be staying in front of it. Our big challenge now is to keep growing our soils as well as our production – if you can't measure it, you can't manage it," Mic said.

# SWEET SURVEY RESULTS FOR SUGARCANE FARMERS

**The ABARES Financial performance of sugarcane farms 2020–21 to 2021–22 survey finds Australian sugarcane farm cash income was 91 per cent higher compared to 2013-14, reaching an average around $190,800 in 2020-21.**

ABARES Executive Director Dr Jared Greenville said the improved financial performance of sugarcane farms since the previous survey in 2013-14 is due to adjustment in the industry, increased sugarcane production per farm and higher average yields.

“While a number of smaller, less profitable farms exited the industry, the remaining farms got larger and also increased their cane yields. But these changes vary across the regions,” Dr Greenville said.

“Overall industry value remained stable over the period, contributing $1.3 billion to total agriculture gross value of production in 2020-21.”

The survey was commissioned by the Queensland Department of Agriculture and Fisheries (QDAF) and Sugar Research Australia (SRA), with sugarcane making up four per cent (around 3000) of Australia’s farms and accounting for $1.33 billion in gross value of production.

QDAF Director-General Bob Gee said the project had generated a wealth of data and other evidence for the industry to support the ongoing development of this important Queensland industry.

“The Queensland Government’s funding support for this analysis reflects the value we see in sugarcane industry stakeholders having access to comprehensive and timely statistics on the physical and financial characteristics regarding farm management practices,” Mr Gee said.

“Despite the last survey being conducted in 2013-14, the results were not surprising as the sugarcane industry continues to grow.”

SRA Chief Executive Officer Roslyn Baker said the Australian sugarcane industry has an exciting future.

“Sugarcane is a resilient crop and world demand for raw sugar is growing. The industry’s future is positive with some exciting opportunities to build grower profitability through complementary value adds,” Ms Baker said.

Questions about farm management practices were also asked as part of the survey, covering constraints to productivity, nutrient management, use of technology and harvesting practices.

**“Sugarcane is a resilient crop and world demand for raw sugar is growing. The industry’s future is positive with some exciting opportunities to build grower profitability through complementary value adds.”**

SRA Chief Executive Officer Roslyn Baker

# SEAWEED COULD REDUCE NITROGEN FERTILISER USE

**In some good news for sustainable agriculture, work aided by the APPF with Seasol® has shown the positive effect of seaweed extracts on nitrogen use and photosynthesis**.

Future agricultural systems will require sustainable management practices, including the use of fertilisers. We know the application of nitrogen fertiliser enhances yield, but it can also lead to environmental damage and greenhouse gas emissions. Improving the nitrogen use efficiency of crops could alleviate the negative impact of nitrogen fertilisation without yield loss, and that's where seaweed comes into the picture.

Seasol seaweed extract is an organic liquid fertiliser classified as a plant biostimulant that is known to have a positive effect on plant productivity. The Director for R&D at Seasol International, Dr Tony Arioli, has been working with the APPF and CSIRO to assess the effect of Seasol application on nitrogen uptake and efficiency in bread wheat (Triticum aestivum). Dr Arioli said, "the research aimed to determine whether Seasol could be added as a supplement to nitrogen fertilisation and potentially reduce the quantity of nitrogen applied to agricultural systems".

The research was conducted in glasshouse pot-based experiments at the APPF's controlled environment facilities located at CSIRO in Canberra. The effect of Seasol was assessed at varying nitrogen application rates corresponding to those used in Australian agricultural systems.

Researchers found the addition of Seasol was associated with a positive impact on plant growth with less nitrogen, and lower nitrogen uptake and lower plant nitrogen content. Furthermore, a positive effect was found on plant photosynthesis, which plants use to convert light into chemical energy. Senior Research Scientist on the project Dr Gonzalo Estavillo said, "the results are significant because nitrogen is a major constituent of the plant photosynthetic machinery, and these efficiencies were achieved despite Seasol plants containing less nitrogen overall".

While more work is needed to understand the mechanism leading to these positive effects of seaweed extract on plant performance and carbon assimilation, the research does support looking into the potential application of seaweed extracts in improving nutrient use and developing sustainable agricultural practices. This knowledge could then be applied to improve field crop growth.

The APPF is continuing its collaboration with Seasol to better understand the effect Seasol has on photosynthesis. It is hoped this type of science will lead to the discovery of new plant mechanisms and assist sustainable and regenerative agriculture.

***"The results are significant because nitrogen is a major constituent of the plant photosynthetic machinery, and these efficiencies were achieved despite Seasol plants containing less nitrogen overall".***

**Dr Gonzalo Estavillo**

# INTRODUCING BAGMUSTER

## AUSTRALIA'S FIRST NOT-FOR-PROFIT, WHOLE-OF-INDUSTRY GENUINE COLLECTION AND RECYCLING PROGRAM FOR AGRICULTURAL BAGS

**CropLife Australia, in partnership with the Australian Seed Federation, has announced bagMUSTER, Australia's first not-for-profit, whole-of-industry genuine collection and recycling program for agricultural bags.**

Chief Executive Officer of CropLife Australia, the national peak industry organisation for the plant science sector, Mr Matthew Cossey, said, "Plastic packaging plays an essential role in Australia's agricultural industry by protecting seed, pesticide and other ag products for transport, use and storage. What is also essential is that this packaging is collected and processed in a genuine and environmentally sustainable way onshore, here in Australia.

"CropLife Australia, with our initiative partner the Australian Seed Federation, has designed bagMUSTER following our extensive experience in developing and operating drumMUSTER and ChemClear™ for almost 30 years through our wholly owned stewardship organisation, Agsafe.

"bagMUSTER is being developed as a hybrid program, taking the best and most suitable components from drumMUSTER and ChemClear™ to deliver an industry-led and fit for purpose stewardship solution for agricultural seed, pesticide and other farm input product bags."

Chief Executive Officer of the Australian Seed Federation, the national peak industry organisation for the Australian seed industry, Mr Osman Mewett, said, "We're delighted to be partnering with CropLife to launch this important recycling initiative for all agricultural product bags.

"bagMUSTER is going to support our industry to meet its obligations in the Australian Packaging Covenant and the broader agricultural sector in its efforts to address the vitally important Recycling and Waste Reduction Act.

"Through bagMUSTER, collected bags will be processed locally, on shore in Australia, further supporting recycling capability and technology development in Australia."

Mr Cossey continued, "bagMUSTER further shows that the members of both CropLife and the Australian Seed Federation are leaders when it comes to a genuine whole-of-life-cycle approach to industry stewardship."

Mr Mewett added, "Partnerships with governments will be crucial to ensure a viable and sustainable model is delivered for the benefit of Australia's farmers when the pilot stage begins in 2022.

"Importantly, following the pilot phase, bagMUSTER will be delivered through an industry-funded model: those who import, manufacture and supply bags or import pre-packaged products will contribute on a fee-for-service basis. This will mean no farmer levy and minimise costs on the agricultural sector."

Mr Cossey concluded, "Through bagMUSTER and all of CropLife's StewardshipFirst initiatives, we are continuously adopting and promoting ethical and responsible practices right from discovery and development of agricultural products through to their use and the final disposal of associated waste, allowing us to better assist farmers and play our part in protecting the environment."

Find out more about bagMUSTER at bagmuster.org.au

Find out more about CropLife's StewardshipFirst initiatives at stewardshipfirst.org.au

**"Through bagMUSTER, collected bags will be processed locally, on shore in Australia, further supporting recycling capability and technology development in Australia."**

Mr Osman Mewett, Chief Executive Officer of the Australian Seed Federation.

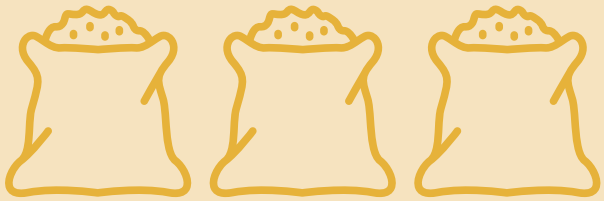
## HOW WILL BAGMUSTER WORK?

To meet the requirements of both the Recycling and Waste Reduction Act 2020 + the Australian Packaging Covenant, collected bags will be processed on shore, here in Australia. Not only is this essential for the genuine stewardship of industry bags but doing so will provide feedstock for new recycling technologies + support their development in Australia.

bagMUSTER will be delivered as a fee-for-service model. Fees will be targeted at those who manufacture, supply or import pre-packed products. Using this model,

bagMUSTER will minimise costs to the farming sector.

Partnerships with governments will ensure a viable and sustainable model is delivered for the benefit of Australia's farmers when the pilot stage begins in 2022.



# FUTURE DROUGHT FUND CREATING DROUGHT RESILIENT LEADERS IN WESTERN AUSTRALIA AND SOUTH AUSTRALIA

**Rural and regional communities in South Australia and Western Australia are sharing in $11 million investment in local drought leadership through the Future Drought Fund's (FDF) Drought Resilience Leaders program.**

Minister for Agriculture and Northern Australia David Littleproud said 19 participants were selected for the SA Eyre Peninsula region and 35 participants selected for the WA Northern Wheatbelt region.

"As part of the broader Future Drought Fund, this program provides leadership training and community engagement activities necessary to build drought resilience in our rural, regional and remote communities," Minister Littleproud said.

"We know that farmers listen to farmers, and others in their community. That's why we are investing in developing a new generation of community leaders to drive conversations and action to better prepare for inevitable drought."

The Drought Resilience Leaders program is a partnership between the Australian Government and the Australian Rural Leadership Foundation Limited (ARLF).

The participants were selected after a competitive application process for a mix of residential and remote training, including personal and community resilience, and network and adaptive leadership.

To enable participants to apply their skills in their local communities, graduates from the program are also able to apply for a grant to put their leadership skills into action that benefits their local community. The leadership development program will be run in 12 regions across Australia.

For more information about the Future Drought Fund Drought Resilience Leaders program and other Future Drought Fund (FDF) programs visit: https://www.awe.gov.au/agriculture-land/farm-food-drought/drought/future-drought-fund

## FAST FACTS:

The Drought Resilience Leaders is a program under the $5 billion Future Drought Fund. The FDF provides a secure, continuous funding of $100 million per year for drought resilience initiatives.

In parallel with leadership development, ARLF is running a national mentoring program to foster informal knowledge sharing to build drought resilience of farmers.

The Drought Resilience Leaders program will be run in:

- Goulburn Valley, Victoria
- Central West Queensland
- Northern Wheatbelt, Western Australia
- Gascoyne Murchison, Western Australia
- Mallee, Victoria
- North West Slopes and Plains, New South Wales
- Eyre Peninsula, South Australia
- Murraylands, South Australia
- Western New South Wales
- Katherine, Barkley and Greater Darwin, Northern Territory
- South West Queensland
- East Tasmania.

# BILL BACKS AGRICULTURE BIODIVERSITY STEWARDSHIP MARKET

**A bill to create the legal framework for a national voluntary agriculture biodiversity stewardship market has been introduced in Parliament.**

Minister for Agriculture and Northern Australia David Littleproud said the Agriculture Biodiversity Stewardship Market Bill presented a new opportunity for Australian farmers to utilise their land management expertise to create new income streams.

“This Bill will allow farmers to use less productive agricultural land to improve biodiversity and provides a robust national legal framework to back it up,” Minister Littleproud said.

“We’re making sure there are clear definitions in place on what eligible projects are, through biodiversity protocols, which will enable farmers to be rewarded for their land stewardship.

“The Bill will create a biodiversity certificate, which will be tradeable. This will mean biodiversity outcomes can be purchased, transferred, claimed, or used.

“We’ll establish a single public register for the market. This will enable tracking of certificates, provide evidence for claims made by buyers and, over time, provide information to inform the market.

“We’ll have an independent expert advisory committee, who will be there to provide expert advice on biodiversity protocols.

“My Agriculture Biodiversity Stewardship Package is demonstrating that a market can deliver financial returns to farmers, by piloting projects that deliver biodiversity outcomes alongside carbon, and enhance remnant vegetation.

“We are building on the success of these pilots to deliver a long-term pathway to market for farmers - a market that is world-leading and informed by science.

“Australian farmers are amongst our most important caretakers of the land – they manage 58 per cent of Australia’s landscape.

“This is a chance to reward our farmers for the work they do and continue to build Australia’s reputation as a sustainable supplier of agricultural products to the world.”

## FAST FACTS:

The Agriculture Biodiversity Stewardship Market Bill will create a framework to support new income streams for farmers, improved biodiversity, and international recognition of Australia's biodiversity stewardship credentials.

The Bill builds on the Agriculture Biodiversity Stewardship Package, which aims to improve on-farm land management practices and develop a market-based approach for rewarding farmers for the delivery of biodiversity services.

The Clean Energy Regulator will administer the scheme.

# NEW BARLEY VARIETIES TO HELP CUT COSTS AND BUILD A GREENER PLANET

**“This significant genetic breakthrough will generate far reaching benefits – boosting grains production, mitigating global warming and supporting market access,”**

Murdoch University Pro Vice Chancellor, Food Futures Institute, Peter Davies,

**New barley varieties with significantly improved nitrogen efficiency to help reduce fertiliser use and greenhouse gas emissions are on the horizon, as a result of advances made by a Western Australian research collaboration.**

New barley varieties with significantly improved nitrogen efficiency to help reduce fertiliser use and greenhouse gas emissions are on the horizon, as a result of advances made by a Western Australian research collaboration.

The Western Crop Genetics Alliance, between the Department of Primary Industries and Regional Development and Murdoch University, has used gene editing technology to lift nitrogen use efficiency without compromising yield or quality.

The nitrogen content of the new barley lines was up to 50 per cent higher at half the nitrogen rate, when compared with the control varieties in glasshouse trials, while grain yields increased by up to 30 per cent under typical nitrogen fertiliser application rates.

Alliance director Chengdao Li said the CRISPR/Cas 9, or Clustered Regularly Interspaced Short Palindromic Repeats, technology accurately turned barley genes on or off to create the superior trait.

Professor Li likened the use of CRISPR technology to that used by a surgeon during an operation.

“Just as a surgeon uses scissors to remove unwanted material, CRISPR silences or cuts out undesirable genes that regulate nitrogen use,” he said.

“The removal of these genes delays senescence, or haying off, by 10 to 14 days for grain filling, while increasing chlorophyll production by 50 to 180 per cent – providing an additional week or two for grain filling.

“This results in increased grain protein and grain plumpness – particularly desired for malting grade barley – and grain yield, under low nitrogen supply.”

The technique was performed successfully on an old European barley variety, Golden Promise, as well as the popular Australian variety RGT Planet.

Professor Li said the revolutionary technique would pave the way to reduced dependence on nitrogen fertiliser, cutting growers’ input costs and increasing profitability, while supporting efforts for the grains industry to become carbon neutral.

“Nitrogen fertiliser is a key profit driver in grains production, which has seen total nitrogen fertiliser use in Australia increase three-fold in the past 30 years to close to 1.3 million tonnes per annum, worth more than $1 billion,” he said.

“According to the Global Carbon Project, more than half of human-caused nitrous oxide emissions come from agriculture, of which up to 80 per cent is derived from nitrogen fertilisers.

“Fertiliser prices have increased radically in recent years, with synthetic nitrogen products currently worth about $1400 per tonne, placing pressure on growers’ profit margins.

“Improving nitrogen use efficiency will not only cut growers’ fertiliser costs, it will also help to reduce water pollution and – most importantly – greenhouse gas emissions.”

Glasshouse trials will be undertaken in 2022 to bulk up seed and the Alliance is looking to work with potential breeding companies to undertake field trials in 2023.

The application of the CRISPR/Cas 9 technology in this case is excluded from the criteria for genetically modified organisms under the Gene Technology Regulations 2001.

The use of the CRISPR/Case 9 technique in barley is the first successful example of an application to a major crop in Australia and has the potential to be applied to other grains and horticulture plants.

Murdoch University Pro Vice Chancellor, Food Futures Institute, Peter Davies, applauded the Alliance for its important contribution to both crop and environmental science.

“This significant genetic breakthrough will generate far reaching benefits – boosting grains production, mitigating global warming and supporting market access,” Professor Davies said.

“Global markets are becoming increasingly discerning about how products are produced so we must find more efficient ways of producing food with lower nitrogen inputs and emissions per unit of product.

“Crop genetics is a powerful tool to satisfy customer demand for sustainably produced food, without changing farming systems or increasing costs, enabling farmers to be internationally competitive, while safeguarding the future of our planet.”

DPIRD research scientist Dr Yong Han (left), Murdoch University PhD student Sakura Karunarathne and Western Crop Genetics Alliance director Professor Chengdao Li have developed new barley lines with improved nitrogen efficiency.

# HOW DO YOUR FABA BEANS GROW?

**A team of enthusiastic early-career research agronomists has worked with industry to provide a comprehensive guide to growing faba beans.**

The Department of Primary Industries and Regional Development (DPIRD) released the 'Growing Faba Beans on the south coast of Western Australia' guide today, in time to celebrate World Pulse Day.

DPIRD's regional agronomy team developed the guide to address increasing interest in faba beans as a rotational break crop, particularly on the South Coast.

DPIRD Dryland Farming systems manager Vanessa Stewart said the team compiled 15 case studies on the experiences and learnings of current faba bean growers across the South Coast region, from Kojonup in the west, north to Dumbleyung and across to Beaumont in the east.

"Many growers had limited or no experience with the legumes and were looking for tips on how to grow a successful crop so this publication will help to fill that knowledge gap," she said.

"The online and hard copy guide was developed under the 'Building crop protection and crop production agronomy R&D capacity in regional Western Australia' project supported by DPIRD and Grains Research and Development Corporation (GRDC) co-investment."

Esperance based senior research scientist Mark Seymour said faba beans were a particularly good fit for growers on the South Coast looking for a legume break crop that fits into both cropping and mixed farming systems.

"Faba beans can be dry sown early to depth to chase moisture, they tolerate waterlogging better than other grain legumes and can be sown and harvested using existing machinery and equipment used for cereals," he said.

"The legume fixes nitrogen for itself and subsequent crops and has a higher yield potential than other pulses."

The project is just one of a number undertaken in partnership with the pulse industry, featured as part of World Pulse Day.

DPIRD research scientist King Yin Lui inspects a crop of faba beans.

The research team has just concluded a three-year GRDC co-investment high-value pulse project.

"We've been looking into new varieties of a range of pulses, including chickpea, faba bean and lentil and designing experiments to highlight their strengths and weaknesses, including trialling early disease intervention," Mr Seymour said.

"The department is also involved in managing experiments for eastern states breeders and industry to help develop new pulse varieties for WA growers.

"We are determining whether the new varieties coming through now are better than what we already have."

A new department project with co-investment from GRDC will focus on developing more acid tolerant lentils, as most lentils are currently grown in the Esperance area on alkaline soil.

Another new GRDC project about to get underway in partnership with the Grower Group Alliance is working with grower groups to help demonstrate the best practice agronomy of grain legumes in their respective regions.

'Growing Faba Beans on the south coast of Western Australia' can be downloaded for free from the regional research agronomy project page on the www.agric.wa.gov.au website or requested from DPIRD offices.

# REGROW EXPANDS CARBON OFFERINGS IN AUSTRALIA WITH CSIRO'S LOOC-C


**Regrow Ag, a global leader in helping farming and food companies monitor, report and verify sustainable farming practices, has undertaken a new licensing arrangement with CSIRO, Australia's national science agency, to expand and enable carbon market opportunities for Australian farmers.**

CSIRO has developed a carbon abatement calculator called LOOC-C ('Look see'), which helps producers understand the environmental benefits of implementing sustainable practice changes on their farms by providing only a few simple pieces of information.

CSIRO developed this tool to help producers assess various carbon projects under the nation's federal carbon emissions program, the Emissions Reduction Fund (ERF), compare the benefits of those options, and choose a program that best fits their goals.

Together, Regrow Ag and CSIRO will help Australian farmers access information about carbon markets, climate-smart farming practices and how the two could benefit their operations.

LOOC-C will be available for eligible producers through Regrow's FluroSense platform as a part of the company measurement, reporting and verification (MRV) offering in Australia. Regrow's set of MRV tools assists carbon project developers in enrolling farmers as well as in quantifying, reporting and verifying data for issuing carbon credits.

"This arrangement solidifies Regrow's commitment to enabling regenerative and resilient agriculture practices in Australia by enabling participation in carbon programs," said Anastasia Volkova, PhD, CEO of Regrow.

"We're proud of our company's roots in Australia, and eager to connect the sustainably-minded producers in the region to this global opportunity."

"CSIRO is excited to license LOOC-C to Regrow and to see our work being taken up to support the growing carbon farming industry in Australia," CSIRO's LOOC-C project leader, Peter Fitch, said.

**"Having LOOC-C available through Regrow's Flurosense platform will allow Regrow's users to more easily access the LOOC-C's initial estimates of carbon benefit and co-benefits and decide if a carbon project might be something that is worth investigating for their business."**

Regrow Ag began as FluroSat in 2016, with a team and offerings in Australia. Over the last five years, the company has expanded its footprint internationally, while maintaining a strong base of Australian customers and partners.

The work between Regrow and CSIRO will lower the barrier of entry for Australian producers to explore, adopt and maintain climate-smart farming practices, and with provision of the ecosystem services - opening new revenue opportunities.

To learn more visit www.regrow.ag/mrv
To try out LOOC-C, visit LOOC-C.farm

# ROOT SYMBIOSIS IS REGULATED THROUGH NUTRIENT STATUS OF PLANTS

**Land plants absorb phosphate better when they collaborate with certain soil fungi. Arbuscular mycorrhiza (AM), a symbiosis with such fungi, is used by more than 80 percent of plants. The fungi penetrate the root cortex cells and form hyphal networks in the soil. These take up phosphate from the soil and transport it directly into the root, where it is released into the root cells via tree-shaped fungal structures called arbuscules.**

### Plants regulate the establishment of symbiosis

"Interestingly, the plant can regulate the establishment of the symbiosis according to its physiological condition. The symbiosis is promoted at low plant phosphate status and is inhibited when the plant has sufficient phosphate, for example as a result of fertilizer use," says Caroline Gutjahr, Professor for Plant Genetics at TUM. "This likely happens in order to conserve organic carbon, which the plant supplies to the fungus." Although this phenomenon was first observed around 50 years ago, the molecular mechanism for inhibiting the arbuscular mycorrhiza at high phosphate status was unknown.

A protein called PHR is a key transcription factor in the process. Transcription factors are proteins that control the copying of DNA into mRNA, thus ensuring that finally the required quantity of a protein is formed. PHR activates genes that enable the plant to respond to a phosphate deficiency.

### Experiments with rice - one of the most important agricultural crops

"We wanted to find out how the formation of arbuscular mycorrhiza is regulated depending on phosphate availability. Our hypothesis was that PHR might be responsible," says Prof. Gutjahr. In addition to lab results with rice and the model legume Lotus japonicus, the researchers also conducted an experiment in soil from rice fields. They were able to show that PHR is needed to promote AM symbiosis when soil phosphate is low to ensure normal grain yields.

A key result of the study is that PHR not only regulates classical phosphate deficiency genes, but also an entire group of genes required for the establishment and function of AM.

These include, for example, biosynthesis genes for the hormone strigolactone. This hormone is produced by the plant and released into the soil where it activates and attracts the fungus.

### Potential for sustainable agriculture

AM symbiosis has enormous potential for application in sustainable agriculture by reducing the need for artificial fertilizers.

"Our insights could be used to modify the phosphate sensitivity of plants through selective breeding or gene editing," says Prof. Gutjahr.

The improved uptake of phosphate is not the only benefit of AM. It also promotes the absorption of other nutrients such as nitrogen, potassium and sulphate and improves plant resistance to various stressors such as drought.

"By tuning PHR, for example, we could reduce the phosphate sensitivity of plants and promote the symbiosis at higher concentrations of phosphate in the soil and thus use its other benefits for agricultural production," says the Professor of Plant Genetics.

Journal Reference: Debatosh Das, Michael Paries, Karen Hobecker, Michael Gigl, Corinna Dawid, Hon-Ming Lam, Jianhua Zhang, Moxian Chen, Caroline Gutjahr. PHOSPHATE STARVATION RESPONSE transcription factors enable arbuscular mycorrhiza symbiosis. Nature Communications, 2022; 13 (1) DOI: 10.1038/s41467-022-27976-8

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