Issue 158 | May – June 2022

GRDC

GROUNDCOVER SUPPLEMENT

PULSE AGRONOMY

PUSHING PULSES FROM BREAK CROP TO BANK CROP

With markets willing to pay a premium for quality pulses, GRDC is targeting ways to reduce production risk

By Dr Kaara Klepper

■ Pulses are in high and increasing demand – from traditional markets, from increasingly health-conscious consumers, and for new value-added uses such as protein powder.

Enticingly profitable prices, although more volatile than for cereals, have driven a shift in how growers and advisers view pulses.

Traditionally considered the break crop for cereal-dominated farming systems, in some regions growers bank on pulses for high returns and, when grown sequentially with canola, they contribute to breaking cereal pest, weed and disease cycles. But the reliability of pulses varies dramatically depending on soil types and climate. For many, the risk of poor productivity still outweighs the potential reward.

GRDC's pulse investment is focused on reducing production risk in existing regions and expanding the area where pulses can be reliably grown. There is room in the market for Australia to supply more high-value pulse products, lifting the overall profitability of the industry. And in an environment where fertiliser prices are escalating, the value of residual nitrogen from healthy and robust pulse crops provides tangible benefit to the profitability of subsequent crops.

REACHING POTENTIAL

With an estimated yield gap (the gap between national average yields and modelled yield potential) around 40 per cent, there is plenty of opportunity for upside.

A substantial proportion of GRDC's pulse research investment targets genetic improvement. This includes identifying and introducing germplasm into Australia, evaluating and incorporating traits into locally adapted lines, as well as identifying rhizobia strains with better adaptation to acid soils.

However, the focus of this *GroundCover™ Supplement* is showcasing GRDC's investment helping growers get the most out of existing crops and varieties.

At its core this research seeks to answer the fundamental question – what is the water-limited yield potential for pulses and what agronomic levers do we need to adjust to enable growers to reach that potential?

Our approach combines proven research teams, new talent and local experience with laboratory and field experiments, alongside modelling to extend sites and seasons examining those agronomic levers. Agronomists are working with local grower groups to validate agronomy practices across cropping sequences to maximise farming system benefits.

SHARING THE OPPORTUNITIES

Expanding the area where pulses can be reliably grown depends not just on research to identify regionally

Photo: Katherine Hollaway

Pulses are in high demand.

appropriate management packages, but also to encourage and support growers to grow new crops successfully. GRDC investment is developing tools such as acid-tolerant varieties, resources such as management packages for high-rainfall and irrigated environments and, through bespoke extension effort, ensuring growers are confident to undertake pulse crop production.

Weeds and disease management are essential to reduce production and market risks. High standards of disease management are essential to preserve a premium product for the human consumption market. New novel herbicide tolerance traits provide better opportunities to manage weeds both ahead of and within the pulse phase of the rotation.

The future of the pulse industry depends not just on doing what we do better, but also on finding new opportunities for innovation and adapting to a changing climate. Profiled opportunities include alternative and summer crops, companion crops and precision planting. ☐

More information: Dr Kaara Klepper, 0477 742 926, kaara.klepper@grdc.com.au

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

***GroundCover™* is brought to you by growers and the Australian Government through the publisher, Grains Research and Development Corporation (GRDC).**

To subscribe to GroundCover™ email your full name and postal details to subscribers@grdc.com.au or write to: GroundCover™, PO Box 5367, KINGSTON ACT 2604

GRDC: 02 6166 4500, fax 02 6166 4599

WRITE TO: The Editor – *GroundCover™*, PO Box 5367, Kingston ACT 2604

EXECUTIVE EDITOR: Ms Maureen Cribb, manager, integrated publications, GRDC, 02 6166 4500

CONTENT CREATION AND PRODUCTION: Coretext Pty Ltd, www.coretext.com.au

GROUNDCOVER™ SUPPLEMENT edited by Katherine Hollaway

COVER IMAGE: FAR Australia's Ben Morris and Tom Price compare faba beans at the Coreen, NSW field day in 2021. **PHOTO:** ROHAN BRILL

PRINTING: IVE Group

CIRCULATION: Ms Maureen Cribb, 02 6166 4500

To view stories from past editions of *GroundCover™* go to: groundcover.grdc.com.au

ISSN 1039-6217 Registered by Australia Post Publication No. NAD 3994

PLANT BREEDER'S RIGHTS: PBR denotes that the variety is protected by Plant Breeder's Rights (ⓓ).

Research to put squeeze on 40 per cent yield gap

Reducing risks and maximising profit are the focus of a new national pulse research initiative

By Dr Fernanda Dreccer, Dr Jeremy Whish

KEY POINTS

- While pulses are highly profitable in many areas, there are still some regions that have had mixed success
- A new CSIRO-led national GRDC investment aims to narrow the water-limited yield gap of chickpeas, lentils, faba beans and narrow-leafed lupins

Photo: Yiyi Xiong

A CSIRO-led coalition is investigating opportunities to reduce the water-limited national pulse yield gap of 40 per cent. Pictured (from left): CSIRO's Yiyi Xiong, Nguyen Nguyen, Dr Fernanda Dreccer, Mary-Anne Awasi.

A new national research program aims to better match pulse varieties and management to soil and climate in a bid to reduce the 40 per cent gap between average pulse yields and yield potential.

Historically, pulse crops have been encouraged as a disease break for cereal-dominated rotations, with the ability to fix nitrogen a welcome bonus. More recently, demand for pulses has seen increased prices and, in some areas, pulse crops have taken over as the central pillar of the rotation, with cereal crops providing a disease break and replenishing ground cover.

Yet, there are still some regions that have had mixed success with pulse production and are considered high-risk.

YIELD GAP

The pulse yield gap has been consistently and reliably estimated at about 40 per cent by GRDC-invested research across Australia. The latest analysis by CSIRO used a combination of crop modelling and experiments to confirm these estimates were appropriate in the northern region.

To understand the constraints and better match pulse crops to different environments, GRDC has invested in the National Pulse Agronomy project.

The CSIRO-led GRDC investment will focus on maximum yield formation under different seasonal conditions across Australian farming systems.

CSIRO will partner with teams led by Professor Daniel Rodriguez at the University of Queensland's Centre for Crop Sciences, Mark Richards at the New South Wales Department of Primary Industries, Dr Jason Brand at Agriculture Victoria, Professor Victor Sadras at the South Australian Research and Development Institute and Mark Seymour at the Western Australian Department of Primary Industries and Regional Development.

The aim is to find which crop management levers to pull to narrow the water-limited yield gap of chickpeas, lentils, faba beans and narrow-leafed lupins, using a combination of experimentation and crop simulation modelling.

Starting in the winter of 2022, the project will run a series of detailed satellite field trials with commercial pulse varieties to benchmark yield potential.

The project's main goal is to investigate yield formation in these indeterminate crops and identify how crop timing – including sowing date and the length of reproductive stage – can be used to manage or avoid yield-limiting environmental stressors such as temperature or water stress.

It will investigate the efficiency of nitrogen fixation in stressed plants and evaluate its role in achieving the crop water-limited yield potential.

MANAGEMENT PACKAGES

Crop modelling will be integrated with the detailed experimental work to expand and test the results across a range of environments. Ultimately, it will deliver appropriate variety by management (GxM) packages with information about different profit/risk scenarios.

For this purpose, and to continually enhance the underlying science within crop models – Agricultural Production Systems sIMulator (APSIM) Next Generation – validation datasets will be fed into the APSIM Initiative.

Importantly, the project will deliver consistent protocols for pulse researchers using standardised measurements applied across pulse crops. The project will link with GRDC's independent regional pulse crop development and extension investments and GRDC's farming systems research projects and aims to help build capacity and skills in the pulse sector.

It is intended that, by 2026, growers and agronomists will have an improved understanding of pulse growth and development across a range of environments. This will enable better matching of pulse varieties with soil and climate to maximise yield and profit, with manageable risk in Australian cropping systems. □

GRDC Codes CSP2107-003RTX, CSP1904-005RTX

More information: Dr Fernanda Dreccer, 0408 885 137, fernanda.dreccer@csiro.au

Fit-for-purpose research targets pulse profitability

A maturing pulse agronomy program aspires to shift pulses from risky to rewarding

Dr Jason Brand speaking to growers as part of a Birchip Cropping Group event at Curyo, Victoria, in 2021. Photo: Agriculture Victoria

By Dr Jason Brand, Rohan Brill, Mark Holland and Dr Penny Roberts

KEY POINTS

- **Pulse profitability is being targeted in four new GRDC research investments**
- **Each project will demonstrate locally relevant tools to reduce the risk and boost profitability of pulse crops**

■ GRDC's latest investment in pulse agronomy is aimed at closing the national yield gap in pulse species.

The four projects have a local focus; however, strong linkages between these projects will also enable a broader understanding of the main causes of the pulse yield gap.

The projects are led by Agriculture Victoria, the South Australian Research and Development Institute, Brill Ag in NSW and the Grower Group Alliance in WA, in collaboration with local researchers and grower groups.

A 'hub and spoke' model of learning centres will see major research validation sites complemented by smaller local demonstration trials focusing on local adoption and needs.

SOUTH

In Victoria and SA, pulses provide weed and disease break crops that can be lucrative in their own right. Trials will examine the economic impact of pulses on farm profitability, disease management and integrated weed management strategies.

Trials began in 2021 and, among other objectives, have already demonstrated the fit of herbicide-tolerant lentils in the farming system for weed management.

New lentil varieties that combine imidazolinone and clopyralid tolerance will be available in the next year. In Victoria, weed management trials aimed at controlling vetch demonstrated that vetch seed-set could be reduced to zero and grain yields maintained through growing this variety on soil with clopyralid residues and applying registered herbicide practices.

In comparison, a strategy based on conventional lentil varieties resulted in 23 per cent grain yield loss with higher levels of vetch seed-set. Future advances in genetic tolerance to herbicides are expected to improve vetch control in lentils.

Dry conditions in SA in 2021 highlighted the importance of selecting the correct herbicide in pulses. Many pulses were sown dry, resulting in ineffective weed control from pre-emergent herbicides and weeds germinating at the same time or later than the crop.

Small, infrequent rainfall events post-sowing caused damage from some Group 5 (Group C) herbicides. Herbicide choice is important in reducing risk of crop injury, particularly for lentils, which are sensitive to these herbicides in dry conditions. This choice will depend on a grower's attitude towards risk and experience with products, soil type, target weeds, environmental conditions, herbicide solubility and leaching rate.

It is important to remember that product label rates, plant-back periods and directions for use must be adhered to.

NORTH

In New South Wales, the focus is on quantifying the yield gap, understanding how the yield gap can be closed and how additional value is provided via nitrogen fixation to boost the yields of subsequent crops. The research will assist growers to chase high-value markets with species such as lentils in the western subregions and chickpeas in the more northern subregions of NSW.

An important part of understanding the yield gap is matching soils or soil amendments to particular pulse species and effective management of weeds and diseases. Consequently, trials target regions with specific soil challenges – such as sodicity and acidity – and locations where previous applied research has been limited.

Interim results from 2021 demonstrated the importance of selecting the right species for the environment. Done well, this led to some phenomenal results, such as faba beans that yielded up to 6.3 tonnes per hectare, 5.2t/ha and 4.9t/ha at Parkes, Caragabal and Ganmain respectively.

Chickpeas were a consistent performer with yields above 2t/ha across most sites, ranging from the acidic loams of Canowindra and Barellan to the dispersive and occasionally waterlogged soils of Caragabal and Parkes.

The project will calculate a nitrogen balance of each pulse species at each site. This will consider the proportion of nitrogen derived from fixation and that which is exported in grain to better understand the net nitrogen benefit for each species and agronomic management option.

Photo: SARDI

SARDI's Sarah Day and Dr Penny Roberts present pulse research and validation trials at South Australia's Melrose Expo in 2021.

Photo: Mark Seymour

Growers inspect a CBA Captain chickpea bulk-up crop at the Pulse Association of the South East (PASE) field walk at Salmon Gums in 2021.

Photo: Rohan Brill

Jim and Harry are eager to learn as their dad, agronomist Rohan Brill of Brill Ag, samples soil at Ganmain, NSW.

WEST

GRDC analysis indicates growers are aware of the benefits of growing a legume in their rotation but have concerns about pulse reliability and profitability, and lack confidence in their production consistency.

In the west, the project is looking to increase the frequency of grain legumes grown in the state by demonstrating best practice and measuring the benefits of growing grain legumes in the year of production and to the following crop.

This will include demonstrating recent advances in grain legume genetics, acid-tolerant rhizobia and on-farm management techniques. Field trials will commence in 2022.

The project seeks to generate a new groundswell in developing the necessary production expertise and hopes the new capabilities will present a 'Goldilocks moment' (just right) for grain legumes in WA. □

GRDC Codes BRA2105-001RTX, DJP2105-006RTX, GGA2110-002SAX, UOA2105-013RTX

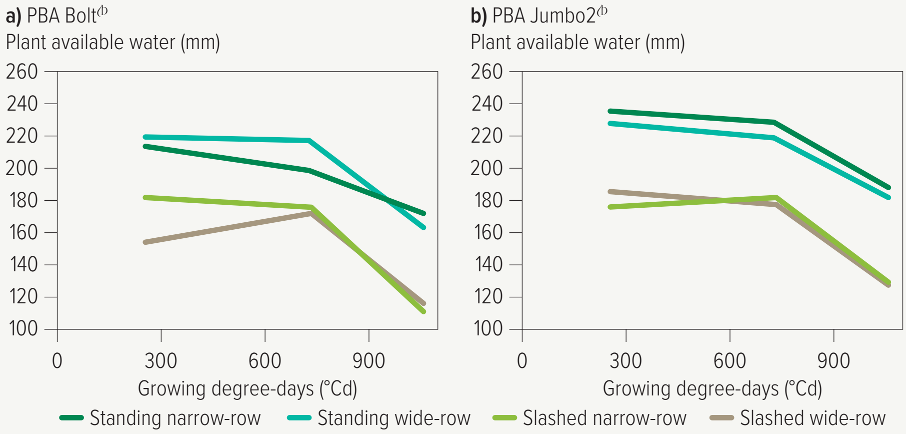
More information: Dr Jason Brand, 0409 357 076, jason.brand@ecodev.vic.gov.au; Rohan Brill, 0488 250 489, rohan@brillag.com.au; Mark Holland, 0429 202 393, mholland@gga.org.au; Dr Penny Roberts, 0436 678 982, penny.roberts@sa.gov.au

Perfect match needed to reduce lentil drought risk

Photo: Dr Garry Rosewarne

Dr Abeya Tefera is examining the factors that influence drought tolerance in lentils.

Figure 1: Plant available water to 160-centimetre depth at three timings (eight-node, 14-node and flowering) under lentil crops sown at Nhill, Victoria, in 2021. Lentils were sown into either standing or slashed stubble with either narrow (19.1cm) or wide (38.2cm) row spacing.



Source: Abeya Tefera

Matching lentil agronomy with shoot architecture traits can improve plant-available water and yield

By Dr Abeya Tefera, Dr Jason Brand, Dr Shiwangni Rao, Dr Viridiana Silva Perez, Dr Garry Rosewarne

■ The timing, lower intensity and shorter duration of rainfall has been identified as a major constraint in most seasons in Victoria's lentil growing districts as the prevalence of drought has also increased over the past two decades. Consequently, a better understanding of the agronomic and varietal impacts on soil water retention will allow growers to maximise the benefit of any rainfall received.

With GRDC investment, Agriculture Victoria researchers are investigating crop water use under different agronomic systems and with architecturally different varieties.

Modelling the impact of drought on modern-day lentil varieties using the Agricultural Production Systems sIMulator (APSIM) showed substantially greater yield loss since the turn of the century. The average per-decade yield loss due to drought prior to 2001 ranged from 10 to 25 per cent, but has risen to more than 35 per cent in the past two decades.

In an on-farm experiment at Nhill in the western Wimmera in 2021, the impact of row spacing, stubble retention and variety selection on crop water availability, biomass accumulation and grain yield were measured. Results clearly demonstrated the benefit of retained standing stubble in improving plant-available water (Figure 1) and lentil yield.

Lentils were sown narrow or wide row into retained narrow-row stubble. In general, the lentil row-spacing treatments had little effect on soil water; however, when stubble was retained, the narrow spacings (19.1 centimetres) produced a higher yield than the wide (38.2cm). This is likely because the retained stubble in the narrow-row spacings provided a more-effective trellis for the lentils, potentially improving light interception and reducing losses to shattering.

As expected, the higher-yielding variety PBA Jumbo2⊕ consistently outperformed PBA Bolt⊕.

The highest-performing treatment was PBA Jumbo2⊕ grown on narrow rows with stubble retention. This suggests that a synergistic interaction between plant architecture, row spacings and stubble retention can deliver significant yield improvements. This treatment gave the sprawling PBA Jumbo2⊕ maximum advantage, allowing it to produce a better stand.

Soil measurements found more plant-available water under PBA Jumbo2⊕ in the early growth stages than under PBA Bolt⊕. The sprawling habit of PBA Jumbo2⊕ is thought to more-effectively shade the soil and prevent early season evaporation losses.

The 2021 season had a dry start that slowed early growth. However, this was followed by higher-than-average rainfall during July, September and October. This type of season would limit the impact of these treatments (row spacings/stubble retention), yet there were still significant differences.

A normal opening to the season would likely enhance the ability of PBA Jumbo2⊕ to hinder soil-water evaporation through more-vigorous early growth, while drier months through the middle of the season would exacerbate the differences between agronomic treatments.

The impacts of water stress, including heat, frost and soil-related factors, will be further assessed on a large scale using crop growth models to identify opportunities to improve yield through interactions between agronomic practices and traits related to phenology and architecture.

This could be used as a decision-making tool by growers, breeders and agronomists to improve lentil productivity. □

GRDC Code DJP1910-006BLX

More information: Dr Garry Rosewarne, 0477 616 759, garry.rosewarne@agriculture.vic.gov.au

Soil amelioration a 'little ripper' for Mallee pulses

Deep ripping Mallee sands can generate substantial improvements in pulse crop gross margins in the first season

By Michael Moodie, Dr Jason Brand, Sundara Mawalagedera, Dr Penny Roberts

KEY POINTS

- Deep ripping of deep Mallee sands improved chickpea, faba bean, field pea, lentil and vetch gross margins by more than $300 per hectare
- Undertake ripping with caution to minimise the risk of erosion and herbicide damage

■ Trials located on deep Mallee sands over the past three seasons – 2019 to 2021 – have demonstrated substantial increases in pulse crop yields in response to soil amelioration practices such as deep ripping.

Mallee soils are highly variable and the productivity of all pulses, except lupins, decreases dramatically on the deep sands of the dune-swale system, which make up 20 to 30 per cent of the region's cropping soils.

These soils have high penetration resistance within the top 50 centimetres of the profile, limiting root penetration and crop water uptake.

Deep sandy soils were ripped to 400 or 500 millimetres in summer before sowing pulse crops in South Australia at Lameroo in 2019 and 2020 and in Victoria at Kooloonong in 2019 and 2020, Speed in 2020 and Tempy in 2021. Chickpeas, faba beans, field peas, lentils, narrow-leaf lupins and vetch were sown at a minimum of three sites each.

The trials were conducted as part of GRDC's investment in southern pulse agronomy through Agriculture Victoria, the South Australian Research and Development Institute (SARDI) and Frontier Farming Systems, with additional support from the Murraylands and Riverland Landscape Board in collaboration with Mallee Sustainable Farming.

RIPPING BENEFITS

Results demonstrated that chickpeas and faba beans were the most-responsive pulse crops, with an average yield increase of 210 per cent across all trial sites. Average lentil yields improved by 166 per cent, and field peas and vetch by about 100 per cent.

Gross margin analysis showed that the average yield response observed across the trial sites was highly profitable (Table 1). This is based on the average January price for each pulse crop (2020 to 2022) and includes an annualised cost of deep ripping of $40 per hectare.

Chickpea gross margins were most improved at about $667/ha. Deep ripping also improved faba bean, field pea, lentil and vetch gross margins by more than $300/ha. Importantly, ripping reduced the financial risk of growing pulses by reducing the number of seasons with a negative gross margin.

In contrast to the other grain legumes, deep ripping provided no economic benefit to lupins in these trials. Lupins have a much-higher establishment risk than other pulses due to their requirement for shallow seed placement. They should not be sown in the first season post-amelioration as soft seedbeds can lead to deep seed placement, soil throw or slumping of furrow walls, resulting in poor establishment.

Subsequent cereal crops will benefit not only from the legacy effects of deep ripping, but also from the increased nitrogen fixation that results from improved pulse biomass.

RIPPING CONSIDERATIONS

While these trials have shown large productivity and profitability benefits, growers considering deep ripping must evaluate operational risks. For example, deep ripping before a pulse phase should be targeted to paddocks with high levels of residual stubble to ensure adequate ground cover is maintained and to minimise erosion risk. Care also needs to be taken with pre-emergent herbicides to minimise risk of crop damage. Trafficability of heavy machinery is also an issue that needs to be managed post-ripping. Rolling with heavy steel drum rollers is recommended to reconsolidate the surface and provide better flotation for the seeder and self-propelled sprayers. □

GRDC Codes DAV1706-003RMX (DAV00150), DJP2105-006RTX, UOA2105-013RTX

More information: Michael Moodie, 0448 612 892, michael@frontierfarming.com.au; Dr Jason Brand, 0409 357 076, jason.brand@agriculture.vic.gov.au; Dr Penny Roberts, 0436 678 982, penny.roberts@sa.gov.au

Photo: Michael Moodie

Faba beans grown at Tempy, Victoria, in 2021 clearly show the benefits of soil amelioration in deep Mallee sands. Control treatment (left) and deep-ripped treatment (right).

Table 1: Average gross margins demonstrate the yield benefit to pulses of deep ripping on deep sands across six Mallee trial sites from 2019 to 2021. Calculations are based on the average January grain price from 2020 to 2022 for each pulse crop and the annualised cost of ripping of $40 per hectare.

Crop	Average yield benefit (t/ha)	Average grain price ($/t)	Gross margin benefit ($/ha)
Chickpeas	1.1	$643	$668
Field peas	1.0	$427	$387
Faba beans	0.9	$449	$364
Vetch	0.7	$533	$333
Lentils	0.5	$703	$312
Narrow-leaf lupins	0.1	$486	$7

Source: Michael Moodie

Extending high-value pulses to WA

Local demonstration trials are helping growers in Western Australia to realise the full potential of high-value pulses in their cropping systems

By Mark Seymour, Stacey Power and Dr Harmohinder Dhammu

KEY MESSAGE

High-value pulses such as chickpeas, faba beans and lentils can add value to Western Australian farming systems.

■ While Western Australia produces the lion's share of Australia's lupins, its share of the high-value pulses – chickpeas, faba beans and lentils – is low.

In a bid to expand the area of lentils, chickpeas and faba beans grown in the west, GRDC invested in demonstration trials to raise awareness of these crops and help growers evaluate opportunities to improve agronomy and yields.

Led by the Western Australian Department of Primary Industries and Regional Development (DPIRD) with GRDC investment, the work was conducted with local grower groups – Mingenew Irwin Group, South East Premium Wheat Growers Association, Liebe Group and Stirlings to Coast Farmers – from 2019 to 2021.

Small-plot trials targeted the factors limiting the potential of each species and demonstrated best-bet packages for newly released varieties.

OPPORTUNITIES

Faba beans have been the surprise, with keen interest in southern WA. The recently released PBA Amberley⸸ provides a superior disease resistance package that will help combat the chocolate spot observed in many trials and grower paddocks in 2020.

PBA Amberley⸸ is the preferred variety for high disease-risk areas, with the imidazolinone-tolerant PBA Bendoc⸸ only recommended where growers are locked into using post-emergent imidazolinone herbicides in-crop.

The recently released chickpea CBA Captain⸸ is ideal for the central and northern agricultural regions as it is taller than existing desi varieties, improving harvestability. For all chickpea varieties, including CBA Captain⸸, planning to manage Ascochyta blight remains vital.

DPIRD's experiments highlighted the importance of early intervention with seed dressing and an early fungicide spray at six to eight weeks to help set up the crop for a good year. They also demonstrated the value of robust rhizobia inoculation techniques and effective weed control. New herbicide options, such as Palmero® TX and Reflex®, which provide good weed control options, were promoted to growers at major field days.

FABA BEANS HAVE BEEN THE SURPRISE PACKAGE, WITH KEEN INTEREST THROUGHOUT SOUTHERN WA.

While chickpeas can be a useful break crop, uptake has been slow in the targeted port zones of Geraldton and Kwinana. Much of this is related to the difficulty of sourcing seed and poor market access in these areas, as well as recent seasonal conditions and market outlooks. Lingering doubts about managing Ascochyta blight have also played a role.

The bulk of WA's lentils are grown in the Esperance port zone, and are typically sown in late April. However, a time-of-sowing experiment at Grass Patch in 2020 found that the first week of June produced maximum yields of 2.7 tonnes per hectare, compared to 1.5t/ha when sown on 28 April. This unexpected result is being investigated further as part of the new GRDC-Grower Group Alliance project 'Closing the Economic Yield Gap for Grain Legumes in Western Australia', which aims to further enhance the opportunities for WA growers. □

GRDC Codes DAW1903-004RTX, GGA2110-002SAX

More information: Mark Seymour, 0428 925 002, mark.seymour@dpird.wa.gov.au

DPIRD research scientists Dr Harmohinder Dhammu and Stacey Power inspecting CBA Captain⸸ in the Dalwallinu chickpea herbicide tolerance trial in August 2021.

Photo: Mark Seymour

LONGER-SEASON LUPIN POTENTIAL

Recent research has highlighted the potential for longer-season lupins to help growers capitalise on early sowing opportunities. Although the work was mainly focused on canola, the researchers considered that lupins might be a less-risky option, as the larger seed size would be more robust than canola if the surface soil dried out before emergence.

The trials showed that longer-season lupins were able to capitalise on early sowing (March to April) by producing more crop biomass; however, these varieties are older releases and are not able to deliver the yields expected from newer varieties. There were no increases in biomass in sowing early to mid-season varieties earlier than May.

GRDC Code DAW1901-005RTX

More information: Jackie Bucat, 08 9368 3481, jackie.bucat@agric.wa.gov.au

Irrigated faba beans break the 7t barrier

Irrigated faba bean crops generate more grain per tonne of dry matter than dryland

By Rachel Hamilton, Nick Poole, Dr Kenton Porker, Tracey Wylie

■ With two winter cropping seasons under its belt, a project that aims to optimise irrigated grains is already breaking the seven-tonne-per-hectare yield barrier in faba beans. The four-year project led by Field Applied Research (FAR) Australia is exploring opportunities to improve crop-specific agronomic management practices and novel soil management technologies in irrigated environments, in collaboration with the Irrigated Cropping Council and with GRDC investment.

In faba beans, the focus is on crop structure under irrigation, the impact of sowing directly after soil amelioration on a red duplex soil, and a suite of agronomic measures such as disease control, rhizobium inoculants and plant growth regulation and its effects on plant architecture.

In canola, grain maize and durum wheat there is a major emphasis on nutrition, particularly the role of nitrogen fertiliser in driving high yields.

Irrigated crop performance is being directly compared under both surface and overhead irrigation (lateral), and indirectly compared with dryland crops.

SEVEN TONNES

Experimental plots of faba beans grown under irrigation at Finley, New South Wales, in 2021 yielded in excess of 7.5t/ha. For the first time in 2021, FAR's dryland faba bean plots also yielded above 7t/ha in both the southern Victoria high-rainfall zone (HRZ) and north-eastern Victoria. While larger yields typically have a larger crop canopy, the trials comparing dryland and irrigated typically demonstrated that in irrigated crop canopies grain makes up a higher proportion of the dry matter – measured as harvest index in Table 1.

The irrigated canopy did not look very different in terms of stems per unit area. However, those stems and pods were larger, with better grain fill. Potential key metrics for improved yields and better harvest index – number of beans per pod or thousand-grain weight – is currently under analysis.

When faba bean crops have the potential to yield more than 7t/ha, some of the fundamental aspects of agronomy are magnified compared with dryland. Agronomic advice recommends avoiding overly thick faba bean crops to reduce the risk of disease and lodging and overly thin crops to limit weed populations.

Experiments comparing plant density under irrigation at Finley in 2020 and 2021 found that exceeding 30 plants per square metre had no impact on yield, but when density fell below 20 plants/m^2 yield losses could exceed 1t/ha. Optimum plant populations under both surface and overhead irrigation are about 25 to 30 plants/m^2 with late April sowing.

DISEASE RISK

The larger crop canopies achieved under irrigation might put the crop at higher risk of disease, lodging and brackling. Brackling is similar to lodging but the stems bend higher up.

So, do bigger irrigated crop canopies show much greater responses to more disease management intervention? Using better resistance genetics in PBA Amberley⁽ᵈ⁾, the trial revealed little additional yield response to higher fungicide input based on more-expensive chemistry under irrigation at Finley.

While irrigation increased the canopy size at Finley in 2021, the conditions for disease were not as conducive as those in the longer growing season of the southern Victoria HRZ near Geelong, despite similar yields (6 to 7t/ha).

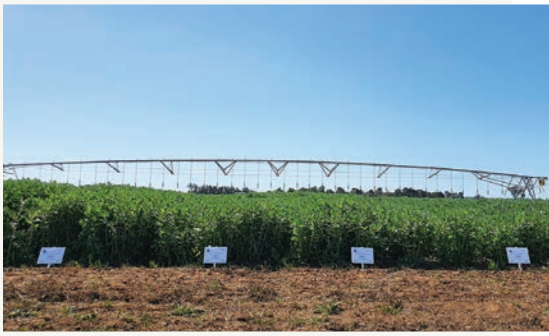
Experimental plant growth regulators have reduced crop height and lodging pressure in these larger canopies but have not generated any significant yield advantage in the past two years of irrigated trials.

Once the 2022 trials are completed, the key lessons will be released as best management practice guidelines for maize, faba beans, chickpeas, canola, durum and barley under surface and overhead irrigation systems. □

GRDC Code FAR1906-003RTX

More information: Rachel Hamilton, 0428 843 456, rachel.hamilton@faraustralia.com.au

Photo: Nick Poole



Faba bean crops grown under irrigation at Finley, NSW, in 2021 yielded 7.5 tonnes per hectare, with a higher proportion of grain to dry matter than dryland crops.

Table 1: A crop component analysis shows that irrigated PBA Amberley[d] faba bean crops generate more grain per tonne of dry matter – measured as harvest index – than dryland.

	Dryland		Irrigated
Yield component	Dookie, Vic, 2019 (sown 29 April)	Dookie, Vic, 2020 (sown 14 May)	Finley, NSW, 2020 (sown 28 April)
Plants/m^2	19	20	20
Stems/m^2	71	84	60
Pods/stem	4.5	3.7	7.6
Pods/m^2	320	308	453
Harvest dry matter (t/ha)	7.3	8.7	13.6
Grain yield (t/ha) at 14% moisture	2.3	3.8	7.5
Harvest index (%) expressed at 0% moisture	27.6	37.7	47.4

Source: FAR Australia

Peer-to-peer learning propelled lentil leap

Photo: Rebekah Starick

The Starick family's comparison paddock at Mannum showed its inaugural lentil crop outperformed field peas despite the tough season, providing a great comparison for a post 'Pulse Check' group revisit event in 2021.

SNAPSHOT

Owners: Matt and Sharon Starick and daughters Rebekah, Leah and Hannah
Location: Mannum, South Australia
Total farm area: 1500 hectares
Average annual rainfall: 300 millimetres
Soil types: sandy loam, sand and limestone
Soil pH: 8.5
Crops: wheat, barley, canola, pulses
Piggery: 220 sows

By Katherine Hollaway

■ Growing a new crop is never easy, but a bit of peer support gave Mannum grower Matt Starick the confidence to take the plunge.

Matt says his wife Sharon and daughter Rebekah had both advocated trying lentils, but it was talking to other local growers in the Mannum Pulse Check group that got him over the line.

"We had been growing peas for 15 or 20 years and, while we can use them as piggery feed, they were expensive to grow and not the most cost-effective source of protein for the pigs."

The Staricks wanted a pulse to fix nitrogen but with a better gross margin than peas. They typically sow about one-quarter of their cropping area to canola and peas.

Matt had heard a lot of positives about lentils but was concerned that the experience in other regions might not be relevant on his patch.

LOCAL KNOWLEDGE

"The local knowledge we got from talking with other growers in the Pulse Check group was invaluable. Everyone was more than willing to share what worked and what didn't," he says.

"It meant we were going in with our eyes open."

GRDC's Pulse Check program, coordinated by the Birchip Cropping Group, supported discussion groups across South Australia and Victoria between 2017 and 2021 to help expand lentil and chickpea production areas.

Where groups did not have easy access to existing pulse agronomy trials, investment from either GRDC or the SA Grain Industry Trust (SAGIT) enabled local grower groups to set up demonstration trials.

Agronomist and group facilitator Tony Craddock of Pinion Advisory says the program ran during some pretty lean years. "It wasn't a great time to grow pulses, but we were able to visit the trials run by Murray Plains Farmers Inc with SAGIT support."

Despite the challenging seasons, the program was well supported by experienced pulse growers, agronomists, pulse marketers and potential new growers.

SUCCESSFUL TRIAL

In 2020, the Staricks sowed 25 hectares of PBA HighlandXT$^{\phi}$ imidazolinone-tolerant lentils adjacent to their usual PBA Wharton$^{\phi}$ pea crop. It was a dry start to the year with no real break and there was a point where Matt was looking at both pulses and wondering if they would ever get out of the ground.

"Once they were up, I'd look at the lentil crop and think, there is nothing there, it's such a small crop. Tony and Rebekah both assured me it would be fine and they were right. We were lucky to receive 20 millimetres of rain in early November and the lentils were able to use that."

The Staricks were more than happy with the results and expect to sow about 120ha of lentils in 2022.

"The lentils were no more difficult to grow than the peas, but we needed to be more rigorous with the quality for the human consumption market. That meant we needed to be proactive in applying insecticide and fungicide to manage the grubs and the disease. I think the PBA HighlandXT$^{\phi}$ is an easier lentil to grow than what was available five or 10 years ago, and more suited to our region."

He says that they will not grow pulses on some paddocks due to the risk of wind erosion and they typically target paddocks with a heavy load of cereal stubble to minimise erosion risk.

"The only thing I would do differently is spray for post-emergent weeds sooner. The lentils are not as competitive as the peas." □

GRDC Code BWD1709-002SAX

More information: Matt Starick, 0407 726 980, kongoliafarms@bigpond.com; Tony Craddock, 0417 809 317, tcraddock@pinionadvisory.com

Early acidity management essential for pulse success

Acid soils require active management to prevent acidic sublayers from limiting pulse production

By Brian Hughes, Andrew Harding, Dr Nigel Fleming, Bonnie Armour, David Woodard

KEY POINTS

- Most pulses are highly vulnerable to soil acidity, which is on the increase across South Australia
- Early liming of acid soils is important to prevent the development of subsurface acidity as pulses seem to be sensitive to acid bands in the soil

South Australia's soils were largely neutral to alkaline when first cleared, but many decades of productive cropping have led to a rise in soil acidity. Lentils, vetch and – to a lesser extent – faba beans are highly sensitive indicator crops for acidity.

Acidity management provides lasting benefits, and the cost can be quickly recouped from these crops.

Areas affected are expanding, particularly where poorly buffered soils are being used for intensive cropping rotations with high yields and high nitrogen fertiliser inputs.

Under no-till systems, soil acidity appears in a patchy distribution across paddocks and at depth. In some soil types, pH stratified profiles are common, sometimes after liming, often with an acidic layer around seven to 15 centimetres deep.

Led by the South Australian Research and Development Institute (SARDI), the GRDC-invested research aims to generate new information regarding lime movement and its effectiveness when applied to different soils and environments in modern farming systems.

The Murraylands and Riverland Landscape Board, Hills and Fleurieu Landscape Board, the University of Adelaide, Trengove Consulting and Penrice Quarry & Mineral are partners in the three-year study.

LIMING TRIALS

Eleven trial sites have been established across SA since the project began in 2019, including several sites where soil acidity is an emerging issue. Sites cover a range of soil types, rainfall zones and liming histories, including two that were limed previously.

Elemental sulfur treatments were applied to most sites to accelerate acidification and simulate future productivity losses if treatment was not undertaken.

The trials showed large improvements in an acid-sensitive legume at three of the four sites where legumes were grown in the rotation as a grain crop or for feed.

At Sandilands, a loamy sand with ironstone gravel over red clay (pHca 4.4/4.1/4.5/5.1 at 5cm increments), lime treatments were applied in 2019. This resulted in up to 60 per cent increase in lentil dry matter in 2020 and up to 30 per cent increase in grain yield (Figure 1). Lime improved yield the most when applied at the highest rate (six tonnes per hectare) and incorporated.

At Spalding – a light sandy clay loam sodic red-brown earth (pHca 4.4/4.4) – lime treatments applied in 2020 doubled the biomass of vetch grown in 2021.

Symptoms of acidity observed on control plots included stunted yellow vetch plants with poor nodulation. End-of-season sampling showed large increases in legume rhizobia persistence where lime had been applied and pH increased.

At a number of trial sites, lime increased the availability and uptake of molybdenum, which is important for nodulation, and decreased levels of plant manganese, which can accumulate in toxic levels when pulses are grown under acidic conditions.

At Koonunga, deep incorporation or subsurface application of lime provided the best responses on a pH stratified profile in faba beans.

Early amelioration of acid soils is important to prevent the development of subsurface acidity, as pulses seem to be highly sensitive to acid bands deep in the soil. Targeting a pHca of 5.5 or greater in the top 10cm when liming often avoids issues with subsurface acidification.

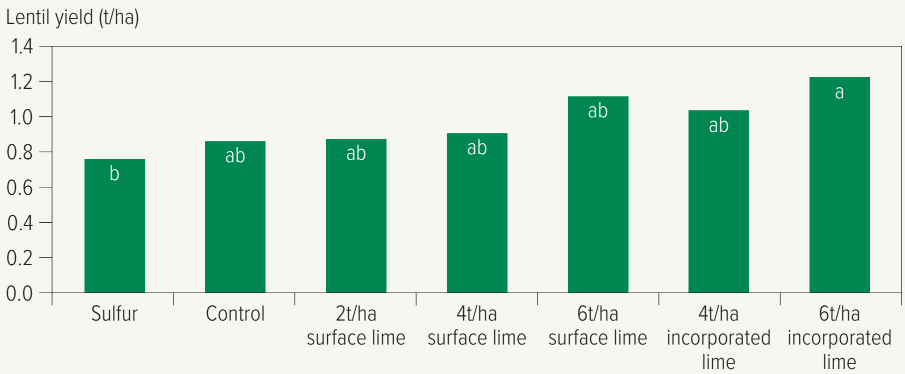
On sandy soils, treatments such as tillage or clay addition can help reduce soil acidity. Modest improvements in pH have also been observed where composted manures or gypsum have been applied at some sites.

The research is working to gain a better understanding of soil variation, pH stratification, liming strategies and lime movement to improve the management of soil acidity. ☐

GRDC Code DAS1905-015RTX

More information: Brian Hughes, 0429 691 468, brian.hughes@sa.gov.au, https://acidsoilssa.com.au

Figure 1: Lentil yield at Sandilands, South Australia, in 2020 with different lime rates and surface application or incorporated by tillage. Significant difference indicated by the letters, a/b (p<0.05).



Source: Andrew Harding

Fungicide timing essential for chocolate spot

SARDI's Sara Blake talks pulse disease management at the Hart Field Day in South Australia in 2021.

Photo: SARDI

Targeted disease management is vital to improve faba bean gross margins

By Sara Blake and Dr Joshua Fanning

KEY POINTS

- Surveys have shown that chocolate spot is reducing yield in faba bean crops in the south-east of South Australia and in Victoria
- The highest profitability will be achieved by combining varietal resistance with optimal fungicide timings

■ Recent broadacre crop disease surveys have found that chocolate spot is all too common in faba bean crops in South Australia and Victoria.

The surveys were conducted by the South Australian Research and Development Institute (SARDI) and Agriculture Victoria as part of GRDC's national surveillance program.

The incidence of other pulse foliar diseases was generally low in the 2020 and 2021 surveys, demonstrating that growers are effectively managing most diseases. Disease was more prevalent in high-rainfall regions, in paddocks with high plant densities, and where the frequency of pulse crops was high.

SURVEY FINDINGS

Chocolate spot is of particular concern because it is often found at severities that can limit yield. In SA, chocolate spot was observed in nine of the 14 faba bean paddocks surveyed in the south-east. In infected paddocks in 2020, an average of 81 per cent of plants were diseased. In 2021 the figure was 22 per cent.

In Victoria, chocolate spot was observed in 38 of the 40 faba bean paddocks surveyed. In infected paddocks in 2020, an average of 63 per cent of plants were diseased. In 2021, this figure was an average of 50 per cent of plants in the Western District and 28 per cent in the Wimmera.

The levels of disease detected in the south-east of SA and the Victorian Western District were high enough to cause yield loss in many of the paddocks.

FUNGICIDE TIMING

The best integrated disease management strategies rely on selecting varieties with improved disease resistance, avoiding close bean rotations and use of foliar fungicides.

When fungicides are required, timing is critical. An application at canopy closure, before symptoms develop, is the most effective. Agriculture Victoria and SARDI have evaluated the effectiveness and profitability of fungicide management strategies for chocolate spot management.

However, varietal resistance delivers the clearest benefit. In a trial at Lake Linlithgow in the Victorian high-rainfall zone in 2020, varietal resistance produced the strongest yield protection under high disease pressure.

In the trial, PBA Amberley$^{\Phi}$, which has the best-available chocolate spot resistance, outyielded the more-susceptible PBA Bendoc$^{\Phi}$ in every treatment regardless of fungicide control. No fungicide treatment was able to limit the severity of chocolate spot in the susceptible variety, PBA Bendoc$^{\Phi}$, at this site. The yield benefit from this varietal resistance was estimated at 2.8 tonnes per hectare, valued at $1120/ha.

Regardless of the fungicide used, all treatments increased gross margins for all varieties, under high disease pressure, despite the initial outlay.

In PBA Amberley$^{\Phi}$, gross margins increased by between $274/ha and $1051/ha depending on the fungicide treatment. In contrast, PBA Bendoc$^{\Phi}$ gross margins increased by between $300/ha and $785/ha.

In the medium-rainfall zone, similar experiments highlighted the importance of monitoring for disease and tailoring the number of applications to the environmental conditions. At Gymbowen, Victoria, only one fungicide application was required in both PBA Amberley$^{\Phi}$ and PBA Bendoc$^{\Phi}$ during 2020 to reduce chocolate spot severity and improve gross margins by between $182/ha and $367/ha.

In high-rainfall zones, multiple fungicide applications may be required in most seasons. Product choice(s) should be made as part of a spray program that includes differing modes of action for resistance management and that does not exceed the maximum number of sprays as stated on the product label. Industry best practice is to not exceed a maximum of two sprays from the same mode of action in any one season. □

GRDC Codes UOA2007-006RTX, UOA2104-012RTX, DJP2103-005RTX, DJP1907-001RTX, DAV1706-003RMX

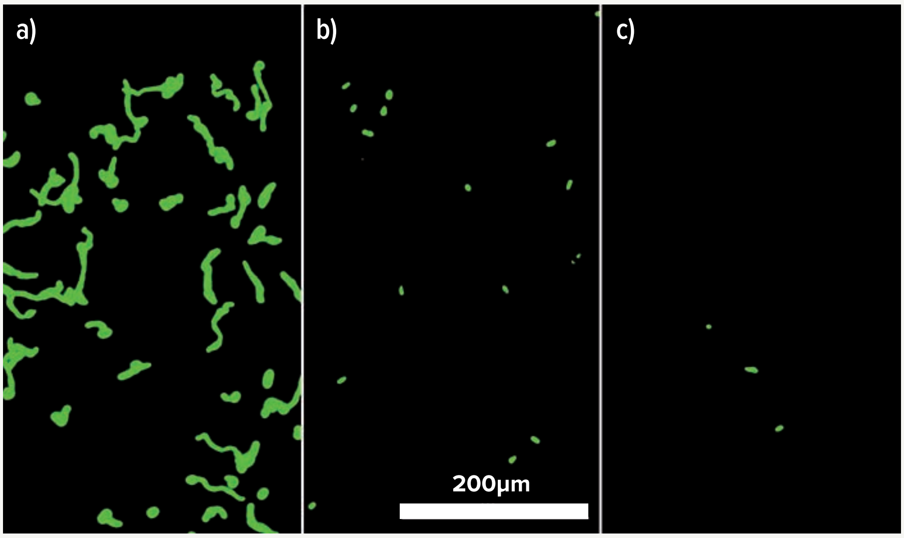
More information: Sara Blake, 08 8429 2248, sara.blake@sa.gov.au; Dr Joshua Fanning, 03 4344 3111, joshua.fanning@agriculture.vic.gov.au

Bacteria versus fungus – fighting Ascochyta carryover on stubble

By Dr Susie Sprague, Dr Luke Barrett, Dr Louise Thatcher

KEY POINTS

- A new approach to managing Ascochyta blight in chickpeas is targeting inoculum build-up on stubble between seasons
- Microbial inoculants have shown efficacy against Ascochyta in initial laboratory studies
- The research is part of a broader plan to understand how *Ascochyta rabiei* inoculum builds up in both the local and broader regional environment



CSIRO is testing microbial inoculant products for activity against *Ascochyta rabiei*. *Ascochyta rabiei* was transformed with a fluorescent protein, which makes it easier to see and measure using microscopic imaging. Treatments show that after 24 hours *A. rabiei* spores germinate and grow prolifically in the untreated control (a), but are not viable and fail to germinate with products one (b) and two (c).

Chickpeas have a reputation as a difficult crop to grow because Ascochyta blight can easily get out of control, reducing yield and quality. Limiting the impact of Ascochyta blight requires constant vigilance with in-season monitoring and often multiple fungicide applications. GRDC has now invested in a new approach to help chickpeas shake off their troublesome reputation.

The CSIRO-led research is investigating *Ascochyta rabiei* inoculum on stubble – between seasons – and has already identified potential management opportunities using microbial inoculants.

MICROBIAL ACTION

Microbial inoculants are used globally in row crops and horticultural industries to reduce the level of pathogen inoculum to control disease. Products can be fungal or bacterial, or in combination with the bioactive natural products they produce.

Modes of action can include:

- ability to outcompete the disease-causing pathogen;
- activity to enhance stubble breakdown; and
- production of antifungal chemicals.

CSIRO is testing microbial products from its own commercialisation pipeline and some existing commercial inoculants.

The four microbial inoculants have already shown efficacy against *A. rabiei* spores in initial laboratory 'in-vitro' studies. The process involved transforming *A. rabiei* with a fluorescent protein, which makes it easier to see and measure, and mixing the spores with different doses of the microbial inoculant. The efficacy of the inoculants was determined by measuring the growth of *A. rabiei* at different doses using fluorescent imaging technology.

The next step is to screen microbial inoculants for their activity against seed-borne inoculum and on stubble.

While the initial results are promising, it is still early days and the products need to be proven to be effective, reliable and economically viable. Rates and application timing also need to be determined.

This alternate approach aims to reduce the build-up of inoculum on stubble during the off-season, thereby reducing the frequency and severity of epidemics. It is intended to complement the traditional detailed in-season fungicide management packages that are tailored to levels of genetic resistance.

BROADER APPROACH

The research is part of a broader plan to take a 'whole-of-system' approach to understanding how *A. rabiei* inoculum builds up in both the local and broader regional environment and identify opportunities to reduce it. This means understanding more about the factors that influence *A. rabiei* inoculum survival and growth on chickpea stubble outside the cropping season. For instance, do different in-season control approaches – such as different levels of varietal resistance or fungicide usage – have an impact on the proliferation of inoculum out of season?

The aim is to develop a model that can analyse the cumulative effect of all the tools in the box – resistant varieties, fungicides, crop rotation and out-of-season inoculum management.

Ultimately, researchers hope the model will not only reduce the disease management burden but serve as a guide for future research investment.

The CSIRO researchers are working with Professor Rebecca Ford at Griffith University to access a range of *A. rabiei* strains as part of a suite of GRDC investments seeking to improve management of the disease. □

GRDC Code CSP2007-001RTX

More information: Dr Susie Sprague, 0466 643 227, susan.sprague@csiro.au; Dr Luke Barrett, 0419 563 789, luke.barrett@csiro.au

Expanding the opportunities for pulse weed control

As the range of herbicide options in pulses expands, crop safety and yield remain paramount

By Dr Penny Roberts,
Dr Navneet Aggarwal, Dr Jason Brand

KEY POINTS

- Improved opportunities to control broadleaf weeds in pulses are being targeted in future herbicide-tolerant varieties
- New lentil varieties are expected to combine tolerance to imidazolinone herbicides with either tolerance to metribuzin or to soil residues of clopyralid
- Herbicide-tolerant field peas and faba beans are also in development

■ Herbicide-tolerant varieties have been a game changer in how pulse crops are managed and tend to be the preferred option where broadleaf weeds are an issue.

In southern Australia, about 60 per cent of today's lentil crops are imidazolinone (IMI)-tolerant varieties, with some areas – such as the Yorke Peninsula – being close to 100 per cent. PBA Bendoc⁽ᵈ⁾, the first IMI-tolerant faba bean, has also had rapid uptake in some regions.

Several new IMI-tolerant varieties are expected to be released in coming seasons. However, conventional varieties such as PBA Jumbo2⁽ᵈ⁾ and PBA Bolt⁽ᵈ⁾ still offer a five to 10 per cent yield advantage in weed-free situations.

Research into novel herbicide tolerance traits in pulse crops will provide growers with improved weed management options.

To help ensure the practicality of novel herbicide tolerance traits, GRDC invests in pulse agronomy through Agriculture Victoria and the South Australian Research and Development Institute (SARDI). In collaboration with local farming systems groups, potential tolerant varieties are evaluated and appropriate usage is demonstrated to growers ahead of commercial release.

TARGETED VALUE

Varieties with herbicide tolerance have proved invaluable in managing broadleaf weeds in lentil, faba bean and field pea crops. In experiments in South Australia, registered IMI herbicides provided more-effective control of vetch, bifora, medic, wild radish, wild turnip, prickly lettuce and common sowthistle, compared with non-IMI herbicides in IMI-tolerant faba beans and lentils.

Improved broadleaf weed control with IMI herbicides was associated with a yield advantage of 23 to 48 per cent in lentils and 10 to 41 per cent in faba beans compared with conventional practices using non-IMI herbicides.

Similarly, in Victorian trials a conventional non-IMI herbicide strategy was able to reduce yield loss from vetch competition to 23 per cent, while a strategy incorporating the use of IMI chemistry over tolerant varieties was able to prevent yield loss. However, neither of these control strategies completely prevented vetch seed set.

NEW DEVELOPMENTS

Although the release date is unknown, new lentil varieties have been developed that combine tolerance to IMI herbicides with tolerance to either metribuzin or to soil residues of clopyralid.

The metribuzin tolerance trait in lentils allowed the use of this herbicide at its highest label rate in research trials with no resulting crop damage.

Usage at this rate improved control of bifora, IMI-resistant Indian hedge mustard, common sowthistle and prickly lettuce, when compared with metribuzin used at lower rates because of safety concerns in conventional lentils.

A new Kaspa-type field pea with improved tolerance to residual IMI and sulfonylurea herbicides is expected soon.

New faba bean germplasm has shown improved tolerance to label rates of metribuzin applied post-sowing pre-emergent when compared with PBA Samira⁽ᵈ⁾ in field trials near Horsham. This breeding line yields well in Victoria and South Australia and could provide improved crop safety to metribuzin when applied post-sowing pre-emergent across a range of soil types, as well as improved broadleaf weed control.

Tolerance traits are invaluable in managing weed populations in pulse crops. However, herbicide rotation remains important in limiting the development of resistant weeds and preserving the future value of tolerant varieties. □

GRDC Codes DJP2105-006RTX, UOA2105-013RTX

More information: Dr Penny Roberts, 0436 678 982, penny.roberts@sa.gov.au; Dr Jason Brand, 0409 357 076, jason.brand@agriculture.vic.gov.au

Photo: Dr Penny Roberts

GRDC's Ruth Peek and Jason Emms inspect pulse agronomy trials with the South Australian Research and Development Institute's Dr Navneet Aggarwal.

Swathing could improve mungbean desiccation

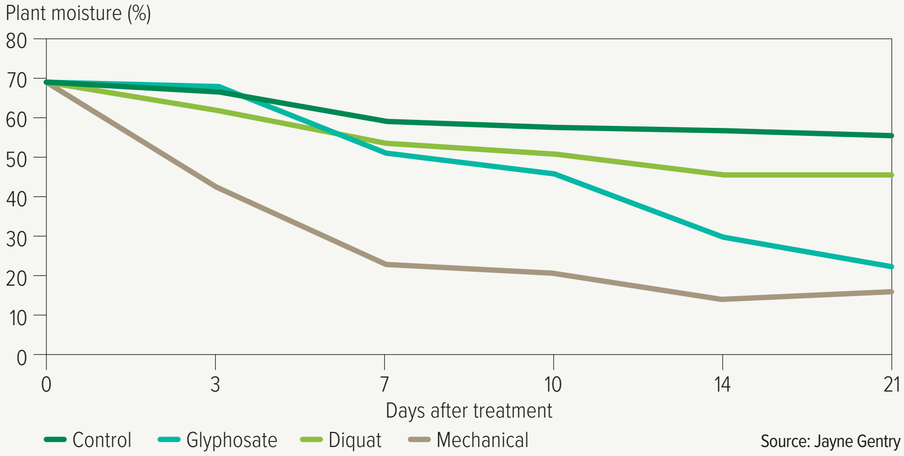
Mechanical desiccation – or swathing – has potential to provide a more effective alternative to chemical desiccation

By Jayne Gentry and Paul McIntosh

KEY POINTS

- Newer, high-yielding varieties are proving to be difficult to desiccate with current chemical options
- An alternative option, swathing or mechanical desiccation, may be equally or more effective

Figure 1: Mungbean moisture content at Emerald, Queensland, after chemical and mechanical desiccation at crop physiological maturity (LSD = 3.42, *p*=0.05).



Source: Jayne Gentry

Recent improvements in mungbean varieties have resulted in higher-yielding, more-vigorous plants that are more difficult to desiccate effectively. Chemical desiccation prior to harvest aids in plant dry down to facilitate harvest and maximise grain quality.

Moisture remaining in the stem is problematic for harvest and causes seed coat staining resulting in downgrading of grain quality. Mungbean growers have been searching for more-effective desiccation methods.

There are four herbicides registered for mungbean desiccation in Australia – glyphosate and diquat, along with metsulfuron-methyl and saflufenacil when mixed with glyphosate or diquat; glyphosate is the most-used product. Current industry best practice is to apply registered chemical desiccants once the crop has reached physiological maturity and 90 per cent of pods have changed colour to brown/black.

Anecdotal evidence has suggested that mechanical desiccation of mungbeans – also known as swathing or windrowing – could be used for drying down the crop in place of chemical desiccation.

Some key markets have reduced or removed their import tolerances to glyphosate residues in mungbeans.

The use of swathing would enable Australian mungbeans to access these high-value markets once again. Illegal use of higher-than-label rates or unregistered chemicals put all markets at risk.

SWATHING

Swathing was trialled by several growers in 2020-21, despite the limited published research in mungbeans.

To find out if swathing is effective, the Queensland Department of Agriculture and Fisheries and NSW Department of Primary Industries implemented small plot replicated trials in 2021 at Emerald and Warwick in Queensland and Narrabri in NSW.

The trials, undertaken as part of a GRDC investment in mungbean agronomy, were designed to compare the ideal timing of chemical and mechanical desiccation to maximise mungbean yield and grain quality.

Treatments compared mechanical and chemical desiccation at 30, 60 or 90 per cent crop physiological maturity. Plants were sampled at zero, 3, 7, 10, 14 and 21 days after treatment (DAT) to determine plant moisture (to track dry down), grain yield and grain quality.

The ideal stage for desiccation (chemical or mechanical) was when a majority of the crop had reached physiological maturity. This can be difficult to assess in the paddock and is typically judged as being when 90 per cent of pods have changed to a brown/black colour. However, pod colour is not a reliable method.

To assess maturity more accurately – which can be from pod yellowing onwards – split the pods longitudinally. Mature seeds will fall away from the inside pod coating.

EARLY INDICATORS

The results showed that mechanical desiccation allowed faster dry down and earlier harvest. Mechanical desiccation was best performed when the crop was at physiological maturity, with 90 per cent of pods having changed colour to brown/black. Earlier desiccation reduced grain quality and yield by up to 500 kilograms per hectare in some cases.

Grain quality was more consistent with mechanical desiccation. However, yield can decline if mechanically desiccated mungbeans are not picked up in a timely manner. Grain is also more vulnerable to damage by mice and rain after swathing.

While the results from this small plot research indicate that mechanical desiccation may be an effective alternative to chemical desiccation, the technique needs to be tested in the paddock with commercial-scale equipment.

The mungbean agronomy project team is rolling out paddock strips in collaboration with mungbean growers in the 2022 season to add further insights into mechanical desiccation of mungbeans. ☐

GRDC Code DAQ1806-003RTX

More information: Jayne Gentry, 0428 459 138, jayne.gentry@daf.qld.gov.au

Can companion cropping improve fallow efficiency?

Companion cropping is under evaluation as an alternative to cover crops to protect the soil after a chickpea crop

By Andrew Erbacher, Doug Sands

KEY POINTS

- Cover crops are commonly used in Queensland to cover bare soil and improve fallow efficiency
- New research is evaluating the option of growing a cover crop as a companion crop with chickpeas to ensure the soil is not left bare

■ Chickpeas are a valuable part of the Queensland cropping system, but they leave the soil quite bare. Bare soil reduces fallow efficiency – the amount of fallow rainfall captured for use by the next crop – which is a problem in areas that rely on stored soil water for yield.

Recent Queensland Department of Agriculture and Fisheries (DAF) research has shown that cover crops improve ground cover and soil water available for the next crop, prompting the question: is there merit in growing a cover crop such as wheat as a companion crop with chickpeas?

Companion crops are not new and are common in home gardens, for instance, growing marigolds to reduce tomato pests. What is novel is doing this on a broadacre scale and with mechanically harvested crops.

Investment by GRDC and DAF has enabled the DAF team to investigate the value of companion cropping of chickpeas and cereals for improved crop water use efficiency and fallow efficiency. Consultation with local growers and agronomists informed the choice of treatments that were planted at Emerald and Goondiwindi.

The real challenge is working out how to grow these two crops so that the more-competitive wheat does not significantly impact on chickpea yield.

The Goondiwindi trial (Table 1) demonstrated that the combined yield of the companion crops added up to the equivalent of the respective monoculture crops, had they been grown alone.

This said, and as expected, grain yields confirmed that wheat had a competitive advantage over chickpeas.

This was most evident in the chickpea/wheat 50:50 mix and two spray-out treatments, where the wheat population established was high enough to limit the chickpea yield to just 10 per cent of the monoculture chickpea.

Wheat and chickpeas were sprayed out on the same date, which was the first flower of the chickpea and, coincidently, flag leaf of the wheat. Spraying out the wheat or chickpeas at this stage meant the remaining crop produced the same yield as it achieved when both crops were harvested in the 50:50 mix, but without the benefit of the matching yield from the terminated crop. That said, a yield penalty is not unexpected in an environment where crops frequently rely on stored water to set grain.

Separating wheat and chickpeas into alternate rows increased chickpea yield from 10 per cent to 30 per cent of the monoculture chickpea, but at the expense of wheat yield.

Increasing the population of chickpeas relative to wheat (a 67:33 mix based on best practice populations of 25 chickpea plants per square metre and 100 wheat plants/m^2) had the same effect.

The Emerald trial, which evaluated early or late sowing times and different row spacings for wheat and chickpeas, showed similar trends but was not analysed in time for this publication.

While being careful not to draw strong conclusions from only one season's data, this does show that it is possible to grow companion crops in Queensland on stored soil water without an overall yield penalty.

More work is required to determine the most-appropriate crop mixes and configurations. The primary objective of the companion crop was to increase fallow efficiency after chickpeas, increasing the yield potential of the next crop.

For this reason, sites have been maintained over the summer with cover crops grown after chickpeas. In 2022, the sites will be soil sampled for water and nitrogen, then planted to a common winter crop to measure whether companion cropping has provided any residual benefits to this next crop. □

GRDC Code DAQ2104-006RTX

More information: Andrew Erbacher, 0475 814 432, andrew.erbacher@daf.qld.gov.au


Photo: Department of Agriculture and Fisheries

Wheat and chickpeas grown as companion crops in alternate rows at Emerald, Queensland.

Table 1: Harvested grain yield of the crops grown at Goondiwindi as kilogram per hectare for monoculture controls and percentage of the controls for mixed treatments. Treatments with different letters had a significantly different grain yield to other treatments in that crop only (p=0.05). Analysis was not completed across crop type or for combined yields.

	Wheat	Chickpea	Combined yield
Control (wheat or chickpea monoculture)	2160 a	1571 a	100.0%
Chickpea/wheat, alternate rows	56.3% *b*	30.4% *c*	86.6%
Chickpea/wheat, mixed within rows, 50:50	86.7% *a*	6.6% *d*	93.4%
Chickpea/wheat, mixed within rows, 67:33	69.8% *b*	27.7% *c*	97.5%
Chickpea/wheat, narrow row, spray out chickpea	87.4% *a*		87.4%
Chickpea/wheat, narrow row, spray out wheat		10.8% c	10.8%
LSD (p=0.05)	295 = 13.7%	214 = 13.6%	

Source: Andrew Erbacher

Turning necessity into opportunity with summer chickpeas

Photo: Drew Penberthy

Outlook Ag agronomist Ally Redden in a PBA Seamer⑰ summer chickpea crop at 'Boorah' in Bellata, NSW in 2021.

Summer chickpeas could provide the perfect opportunity for cash and cover

By Katherine Hollaway

KEY POINTS

- After repairing wheel track damage resulting from a wet harvest, growers in northern NSW typically plant a cover crop to protect from soil erosion and limit summer weeds
- Growers in northern NSW have been experimenting with replacing the cover crop with an opportunistic cash crop of chickpeas
- Sown in late January, these chickpeas need to be started well and grown fast to reach harvest in April

■ After a wet harvest, northern growers often need to repair damaged ground – and this also means planting a cover crop to prevent erosion and weed proliferation.

Faced with this necessity, growers in the Narrabri region of New South Wales identified an opportunity: what if that cover crop could be harvested for profit?

Drew Penberthy, who is a grower and Outlook Ag agronomist, says the idea arose after a grower tour to India. "We already knew how well chickpeas could handle the heat and drier weather in Australia, but after seeing how they grew the crop outside traditional growing windows in India, we thought they might suit a different role here as a potential cash crop to plant as a cover for our soils," he says.

OPPORTUNITY

Wet harvests are a recurring challenge in the northern region and can lead to severe wheel track damage. "Sometimes we have wheel tracks that are 500 millimetres deep, and the ground needs to be worked, leaving it bare and at risk of erosion and weeds."

Mr Penberthy acknowledges it is a speculative option and will not be appropriate every year. "Why not give it a go? Everyone has chickpeas in the silo – let's plant those in January and see if we can get them through to harvest by April," he says.

The first PBA Seamer⑰ crops were sown in late January 2020 at four sites between Narrabri and Bellata. Under ideal conditions they performed well with good gross margins, proving that the concept had legs. Mr Penberthy says they could potentially be as good as mungbeans.

"We tried it again in 2021, but obviously it was a pretty wet summer. The crops were fabulous, with an estimated yield of four tonnes per hectare, but then we had 200mm of rain at harvest over three weeks. Some were flooded and the rest were stripped just to tidy them up.

"We chose not to plant any in 2022 as the season was too wet to get on the ground in time and the forecast cool season made us nervous about disease and having enough time to mature the crop before winter."

SHORT-SEASON CROP

"We have to grow chickpeas fast. Ideally, we want to sow after a wet harvest and then get plenty of warm weather. We sow in late January after the worst of the summer heat and push them along with starter fertiliser. We are using sowing rates of 100 kilograms/ha to fill the space quickly and quicken maturity."

The herbicides that can be used in chickpeas also mean that the crop is a good fit for managing some of the more difficult-to-control summer grass weeds.

"Our biggest concern is a cool wet season that would encourage disease, particular Botrytis grey mould. Ideally, they should be sown away from any paddocks where chickpeas are going to be planted in the winter to minimise inoculum."

Mr Penberthy says that the varieties PBA Seamer⑰ and CBA Captain⑰ seem to be a bit more determinate and quicker to flower.

"With the way our seasons are changing and the higher temperatures, we need to look outside the box and take every opportunity to try something new." □

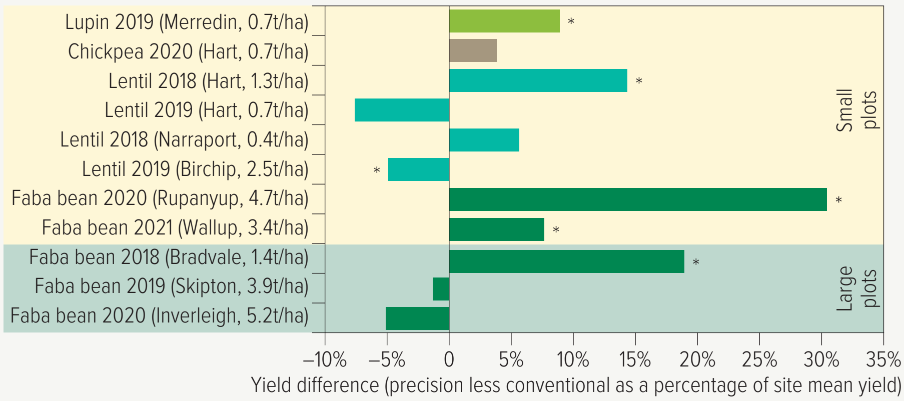
More information: Drew Penberthy, 0427 255 752, drew@penagcon.com.au

Care worth more than precision in seeding pulses

Precision seeding shows some merit, but conventional seeding can be just as effective

By Associate Professor Glenn McDonald, Genevieve Clarke, Rebekah Allen, Ashley Amourgis

Figure 1: The difference in yield between the precision-planted and the conventionally sown treatments in lupins, chickpeas, lentils and faba beans. Positive values show precision planting was better than conventional, negative values the reverse. Captions list the site mean yield at each location. Asterisk denotes significant difference at *p*=0.05.



Source: Glenn McDonald

KEY POINTS

- Trials showed precision seeding improved plant spacing and stand uniformity; however, yields were not consistently better than with conventional seeding
- Regardless of seeding equipment, careful attention to detail is vital to maximise crop establishment and outcomes

Precision seeding trials have shown the system improves the evenness of plant spacing and stand uniformity in pulse crops – however, this did not consistently improve crop establishment or yield.

Precision planters are designed to place seeds at a consistent inter-plant distance and depth to promote uniform emergence and minimise inter-plant competition. They were originally developed for summer row crops, but in recent years there has been increasing interest in adapting the technology to winter crops.

In principle, having plants equally spaced in a crop reduces inter-plant competition and allows each plant to grow to its potential.

Trials conducted between 2018 and 2021 compared precision planting with the conventional sowing of pulses across a range of plant densities. The University of Adelaide led the four-year GRDC investment in collaboration with the University of South Australia, Birchip Cropping Group, Hart Field Site Group, Southern Farming Systems (SFS) and the Western Australian No-Tillage Farmers Association.

Plot trials were sown with a purpose-built small-plot seeder capable of sowing plots either as a conventional disc seeder or a precision planter. The large-scale faba bean trials conducted by SFS compared two commercially available Väderstad seeders – a precision planter versus a conventional system (airseeder in 2018 and seed drill in 2019 and 2020).

Precision planting yields were generally comparable to or slightly better than those with conventional sowing. The benefits were often greater at low plant densities, mitigating the effect of low plant numbers on yield.

The eight small-plot experiments with lentils, faba beans and lupins (Figure 1) resulted in:

- four where yield was eight to 30 per cent higher with precision planting;
- one where yield was five per cent lower; and
- three where yields were not significantly different.

The improvements in yield from precision planting in some of the small-plot experiments could be attributed to better crop establishment, but in others higher yields were achieved even at lower plant densities.

The three large-scale trials found that the precision planter improved faba bean yield in the 2018 trial by 18 per cent (from 1.32 to 1.54 tonnes per hectare), despite having a slightly lower plant population (Figure 1). There was no significant difference in yield between the conventional seed drill and the precision planter in the other two trials.

Plant density was the main cause of variation in yield. In the small-plot trials, where density was studied in detail, yields declined as plant density fell below approximately 100 plants per square metre in lentils and 20 to 30 plants/m^2 in faba beans. When precision planting assisted with yield, the effect was more consistent at low densities.

This might be related to the more-even inter-plant spacing with precision seeding, which resulted in a reduction in variability of between 30 and 50 per cent.

Being able to maintain yields at a lower plant density might allow a reduction in seed input costs. However, the benefits of this could be small in pulses compared with crops such as canola, which has much higher seed costs. For example, a reduction in sowing rate of 10 to 20 plants/m^2 in lentils would equate to a saving of less than $1/ha.

While these results are encouraging, the benefits of precision planting remain variable and modest.

Rather than invest in new equipment, careful preparation and seeder adjustment might be a better way of improving crop establishment and outcome. Grower surveys have found that the model and age of a seeder was of much less importance than the operator in achieving good establishment. □

GRDC Code U0A1803-009RTX

More information: Associate Professor Glenn McDonald, 08 8313 7358, glenn.mcdonald@adelaide.edu.au

Opportunity for summer legumes in Victoria

By Dr James Nuttall

KEY POINTS

- The potential value of opportunistic summer crops in Victoria has been investigated over the past four summers
- The higher-rainfall zone and irrigation areas provide better opportunities for summer grain production of soybeans, mungbeans and dry beans than the low to medium-rainfall areas

Photo: Audrey Delahunty

Brendan Christy in a soybean plot at Rutherglen.

Victorian researchers are investigating the agronomic viability of a range of summer legume species that would allow growers to take advantage of sporadic summer rainfall events.

The crops under investigation include adzuki beans, cowpeas, dry beans (black, turtle, navy and pinto beans), lab lab, mungbeans, pigeon peas and soybeans – a wide-enough range of options to help growers identify opportunities for summer cropping and pick the best species for different localities.

Potential benefits include utilising summer rainfall to opportunistically grow three crops in two years, reducing reliance on artificial nitrogen, improving farm profitability and boosting Australian plant-based protein production.

This research is part of the Victorian Grains Innovation Partnership between Agriculture Victoria and GRDC.

These crops, typically grown in subtropical environments, have the advantage of an indeterminate growth habit, giving them more flexibility to maintain yield potential in the southern environment, where summer rainfall tends to be episodic.

ASSESSING SUITABILITY

Field trials from 2019–21 assessed the seasonal triggers needed to grow summer legumes and the suitability of current commercial species to growing environment – specifically biomass production, susceptibility to pests and diseases, grain yield and system fit (days to maturity).

The next steps included an analysis of long-term weather patterns to look at the probability of spring sowing opportunities and the amount of summer rainfall expected. In mid-2022, spatial crop models based on risk and yield will identify the most-suitable growing regions for soybeans, mungbeans and adzuki beans, which showed the most potential.

Field trials confirmed that north-east Victoria and the high-rainfall zone of the Western District – areas with more-reliable summer rainfall – have significant potential to support summer cropping. Soybeans were particularly well-suited with an average grain yield in 2020-21 of 1.7 tonnes per hectare at Hamilton and 1t/ha at Rutherglen. Yield potential under rain-fed conditions in the current summer trials (2021-22) was good. Lab lab, cowpeas and dry beans also appear highly suitable for these environments, as either grain or high-protein fodder.

BEST FIT

The length of the growing season is an important factor in determining agronomic fit for each species. For example, mungbeans are considered a good fit with the Victorian winter cropping program because they are a short-duration summer crop that matures March to April. The current summer program is focused on determining the optimal time of sowing, maturity grouping, disease risk and growth habit.

Typically, mungbeans performed well in most regions, including the Mallee (0.8t/ha), Wimmera (1t/ha), north-east (1.3t/ha) and Western District (0.5t/ha). In the Mallee and Wimmera regions yield potential relies on adequate starting soil water and/or in-season rainfall of more than 120 millimetres.

In the low and medium-rainfall zones, the more variable nature of rainfall limited the viability of summer legumes for grain production. However, they will be well-suited to irrigation districts. Preliminary assessment under irrigation at Kyabram showed high yield potential. Dry beans, navy and pinto beans yielded 2.6t/ha and 3.1t/ha respectively, compared with an average of 1.4t/ha for mungbeans in this environment.

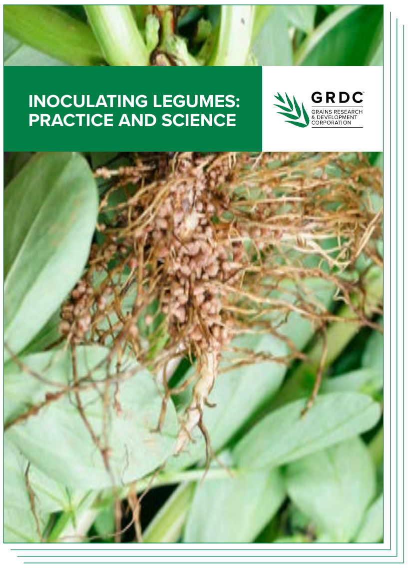
This research has accessed a diverse supply of global landraces from the Australian Grains Genebank at Horsham in the hope of finding some landraces with growth traits better suited to Victorian growing conditions than current commercial varieties.

Ultimately, this research aims to help growers make informed decisions about the viability of summer cropping for their region. Several growers are giving them a go, although markets still need to be identified. □

GRDC Code DJP1910-006BLX

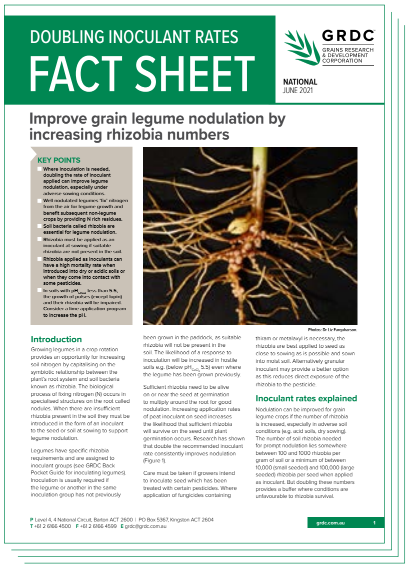
More information: Dr James Nuttall, 0409 423 541, james.nuttall@agriculture.vic.gov.au

Growing legumes in a rotation increases soil nitrogen and reduces fertiliser requirements for following crops



GRDC has published the following resources (currently in digital format only) with the aim of:

- increasing grower knowledge of legumes, rhizobia, nodulation and nitrogen fixation;
- improving the cost-effectiveness of inoculation as a key farm practice; and
- enabling growers to boost farm profits through improved legume nodulation and nitrogen supplies.



GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

grdc.com.au

Inoculating Legumes: Practice and Science https://grdc.com.au/inoculating-legumes

Inoculating Legumes: The Back Pocket Guide https://grdc.com.au/grdc-bpg-inoculatinglegumes

Inoculating Legumes in Acidic Soils Fact Sheet https://grdc.com.au/inoculating-legumes-in-acidic-soils

Doubling Inoculant Rates Fact Sheet https://grdc.com.au/doubling-inoculant-rates-fact-sheet