

# OPTIMAL SOIL AND WATER MANAGEMENT INCREASES DROUGHT RESILIENCE — FROM THE PLOT TO THE Paddock

Drought is an inevitable part of farming in Australia, but outcomes from the *Improved drought resilience through optimal management of soils and available water* project are equipping farmers with a host of additional strategies with which they can prepare for the inevitable.

Numerous small-scale field trials across southern NSW have shown that early sowing of slower-maturing crops, diverse legume rotations and nitrogen banking can all increase profitability and productivity by increasing soil moisture availability and preventing carbon and nutrient loss under drought conditions. But proving these practices are profitable on a paddock scale is key to ensuring grower adoption.

Using on-farm demonstrations, this project has demonstrated how growers can apply the theoretical strategies profitably on a paddock scale, across different soil types, environments and land uses.

Charles Sturt University, under the Southern NSW Drought Resilience Adoption and Innovation Hub, led the project in partnership with Farming Systems Groups Riverina Plains, FarmLink Research, Central West Farming Systems and Southern Growers, in collaboration with CSIRO and the NSW Department of Primary Industries. The collaboration saw management strategies that had been tried and tested by researchers, over six years on four sites, validated on farm with growers and advisors.

The project was supported through funding from the Australian Government's Future Drought Fund Drought Resilient Soils and Landscapes Grants Program and is co-funded by the Grains Research and Development Corporation.

## **DIVERSE LEGUME (PULSE) ROTATIONS**

Incorporating pulse crops into a typical wheat–canola rainfed or irrigated rotation offers long-term benefits for subsequent crops. The primary goals are to manage disease and weeds more effectively and to enhance soil health. Pulse crops fix atmospheric nitrogen, providing an immediate benefit for the current season and potentially storing nitrogen for future crops.

# FABA BEANS OFFER FAVOURABLE OPTION FOR CONTINUOUS CROPPING SYSTEMS



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<b>Farmer:</b>	James Stephens, Charles Sturt University farm
<b>Location:</b>	Wagga Wagga, NSW
<b>Soil type:</b>	Red loam
<b>Rainfall (annual):</b>	572mm
<b>Growing season rainfall:</b>	239mm
<b>Enterprises:</b>	Cropping (wheat, canola, barley, pulse), prime lamb production, cattle (breeding and steers)

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<b>Management strategy:</b>	Diversity
<b>Treatments</b>	Faba beans (2022), canola and wheat (2023)
<b>Sowing date:</b>	3 May 2022 (faba beans), 19 April 2023 (canola), 23 May 2023 (wheat)
<b>Sowing rate:</b>	120kg/ha (faba beans), 2.2kg/ha (canola), 70kg/ha (wheat)
<b>Crop species and variety:</b>	Samira faba beans, Beckom wheat, Trifecta canola
<b>Row spacing:</b>	22.5cm (9 inches)
<b>Equipment:</b>	Serafin single disc seeder

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## AT A GLANCE

- Despite their reputation as ‘failure beans’, faba beans offer a bounty of benefits to traditional continuous cropping rotations.
- In addition to delivering ‘free’ nitrogen for subsequent crops, pulse crops such as faba beans offer disease-break benefits, increase weed-control options and provide a high-protein feed source for livestock.
- Although susceptibility to diseases, such as chocolate spot, can be a barrier to growing faba beans, new disease-resistant varieties could see their inclusion in the rotation increase.

Charles Sturt University farm manager James Stephens says in addition to the agronomic benefits of including faba beans in the system, the value-add to his livestock enterprise is the key reason he’ll continue to grow them as part of his cropping rotation.

The Charles Sturt commercial farm, located at Wagga Wagga, NSW is 1800 hectares, split into a continuous cropping block and mixed farming block.

“The continuous cropping program on our ‘Dhulura’ block has been in operation for around 18 years, with a rotation of canola, wheat, barley and then a pulse crop,” James said.

“It’s a complete system and one that doesn’t involve any livestock interaction at all, other than potentially feeding some of the grain that comes off this block.”

Faba beans have been a key part of the rotation for several years and have multiple benefits, particularly agronomically, but they do present some challenges.

“The main agronomic benefit we get from including pulses in the rotation is the nitrogen they provide, which enables the following crop to utilise the nitrogen in the soil profile, reducing the requirement to apply increased rates of fertiliser nitrogen,” explained Jeff McCormick, agronomy lecturer at Charles Sturt University.

“Other benefits include disease breaks — particularly cereal diseases — and alternative weed control options. So, pulses have a really important role to play in our crop rotations.”

James reiterated Jeff’s comments saying the inclusion of a pulse the year before sowing canola is a critical part of his rotation.

“Canola is a big user of nitrogen, so we want to get as much ‘free’ nitrogen from the previous pulse crop as possible as it is both an agronomic and financial benefit to our system,” James said.

“As Jeff pointed out, we also have more herbicide options with the broadleaf pulse crop, and a wider range of grass herbicides available to us, giving us options then coming out of canola.”

## THE CHALLENGES OF A DIVERSE SYSTEM

But many farmers choose not to grow pulses for several different reasons.

“Sometimes pulses don’t work as well in terms of price or yield, and that’s something we are looking to better understand through this *Improved drought resilience through optimal management of soils and available water* project,” James admitted.

“We are exploring what we can do to improve on those areas where there are limitations and encourage other farmers to include pulses in their rotation,” Jeff said.

Disease susceptibility, which ultimately impacts yield, is the biggest downside to faba beans according to James.

“Unfortunately, faba beans often don’t get a good wrap from farmers and they have a reputation as being ‘failure beans’,” he said.

“But we grow faba beans knowing there is a risk that if the season is wet, it is going to be difficult to manage disease in the crop and our yields will take a hit.”

“We applied only one fungicide spray during the 2023 season and the crop was disease free, so what we potentially lose due to a lack of moisture in a drier season, we gain in a disease-free crop and potentially a higher harvest yield,” James said.

## TESTING THE BENEFITS IN A DIVERSE SYSTEM

The Dulhura block consists of a four-paddock rotation of faba beans, canola, wheat and then barley. In 2022 the block was sown to faba beans. A re-alignment of the paddocks in 2023 allowed wheat and canola to be sown over faba bean stubble.

The wet 2022 season resulted in increased disease levels, with the faba beans severely impacted by chocolate spot. The inability to get on the paddock to apply the final fungicide application saw yield potential dramatically reduced to 1.5t/ha (Table 1).

“Their susceptibility to diseases, such as chocolate spot, can create issues, particularly in wet years like we saw in 2022. We applied four fungicides treatments to our beans but couldn’t get onto the paddock to apply the fifth application due to the wet conditions,” James said

“We still harvested the crop, but while it was looking every bit like a 3t/ha crop before the chocolate spot infestation, our final yield was 1.5t/ha, so the disease severely impacted yield.”

The grain yields for wheat and canola in 2023 following the faba bean crop were average for the area considering there was low rainfall in spring. The protein in the wheat exceeded 12% which indicated there was abundant mineral nitrogen available to the crop.

**TABLE 1. YIELD MEASUREMENTS CHARLES STURT UNIVERSITY FARM, WAGGA WAGGA, NSW.**

	2022	2023	
	Faba beans	Wheat	Canola
Grain yield (t/ha)	1.5	4.3	2.8

Small-plot trials carried out by CSIRO, show that legumes will leave around 50kg/ha of nitrogen — on average — at the time of sowing subsequent crops, but this can range from 20—180kgN/ha depending on the amount of legume biomass left in the paddock.

On the Charles Sturt University farm, deep soil nitrogen tests showed that total mineral nitrogen, pre-sowing of wheat and canola in 2023, ranged from 257-512kg N/ha (Table 2). This range of soil nitrogen was large and highly variable. The preceding faba bean crop had a peak biomass of 9.4t/ha yet only yielded 1.5t/ha due to disease, resulting in a large faba bean residue returning to the soil to be mineralised.

“While the faba bean crop was severely impacted by disease in 2022 and yield was reduced, this resulted in more biomass remaining in the paddock, essentially acting like a green manure crop, and boosting soil nitrogen levels,” Jeff explained.

**TABLE 2. SOIL TEST RESULTS — CHARLES STURT UNIVERSITY FARM, WAGGA WAGGA, NSW.**

PROPERTIES	PRE-FABA BEANS	PRE-WHEAT	POST-WHEAT	PRE-CANOLA	POST-CANOLA
Nitrogen (kg N/ha)	78	512	139	257	124
Sampling depth (cm)	60	120	90	90	90

### FABA BEANS THE WINNER FOR STABILITY AND STOCKFEED

For James, the value-add faba beans give his livestock enterprise will see him continue to include them in his rotation into the future.

“In our situation, growing pulses and faba beans is primarily for the benefit of our livestock. When we are lot feeding lambs, faba beans are a good mix. With their higher fat content — compared with lupins or lentils — it means we can fatten lambs and turn them off quicker,” James said.

“Looking at market trends and what some pulses are worth, lupins seem to be very price erratic, and reporting to the university, I find it’s easier for my budget to stick with something that’s more consistent. Faba beans give me this consistency, sitting at around \$400/t across most years.”

“We’ve experienced droughts in the past and buying protein for our animals during those times can be expensive.

“If we’ve got faba beans in the silo we have options. We can use them to supplement and early wean our lambs and calves, and we can also mix them with low-grade barley to enhance feed quality for our livestock.”

### **Paddock-scale trials provide the impetus for change**

Taking the key findings from the CSIRO small-plot research trials and seeing these findings replicated in larger on-farm trials can give farmers the confidence needed to implement these management practices on their own farms.

“We’re showing that the management strategies used in CSIRO small-plot trials can be easily implemented on farm, increasing productivity and profitability across farming enterprises” Jeff said.

“Our goal through this project is to equip farmers with strategies to manage drought, while boosting productivity and profitability across their farming enterprises. Demonstrating that the management strategies used in the CSIRO small-plot trials can be easily implemented on a paddock scale is key to increased adoption,” Jeff said.

“If farmers see these strategies working to increase productivity and drive profitability, under similar environments, land uses and soil types to their own farms, we’ll see increased adoption of the management strategies.”

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