

COGGO Final Report

Expanding phenological diversity in narrow-leaved lupin using novel flowering time genes

COGGO Project 2023-2026

Co-funded by GRDC in GRDC Project UWA2307-004RTX

The University of Western Australia

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UWA confirms that Professor Wallace Cowling is the point of contact for further information.

Project resources	This section describes use of the funding listed in the initial plan and any refunds due to COGGO
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Expenditure of funds requested from COGGO	\$ Total funds budgeted (cash funds from GRDC & COGGO)	\$ Total funds expended (actual) (cash funds from GRDC & COGGO)	\$ Total funds requested from COGGO*	\$ Total COGGO funds expended	\$ Refund due to COGGO of any unexpended COGGO funds
Salary/Contractors	260,003	260,003	100,000	100,000	0
Operating costs					
Capital					
TOTAL	260,003	260,003	100,000	100,000	0

*Funding provided by COGGO.

IMPORTANT: Return of unused funds to COGGO is required as per *Clause 3.3* of the Research Agreement.

PROJECT SUMMARY

Australian narrow-leaved lupin (*Lupinus angustifolius* L.) is an important grain legume crop in rotational cropping systems on acid sandy soils in the wheatbelt of southern Australia. Historically, lupin cultivars bred in Australia have been early flowering based on the early flowering dominant allele *Ku* at the *LanFTc1* locus. This has led to very limited genetic diversity for flowering time in lupin breeding programs. *Ku* lupin varieties flower and mature too quickly when sown early in the main lupin-growing regions, and farmers choose other crops for early sowing opportunities. Also, *Ku* lupin varieties are too early to benefit from longer growing seasons in higher rainfall zones.

This project aimed to enhance the phenological diversity of lupins by introducing a new flowering *P* allele from wild lupin P22660 by backcrossing the allele into pre-commercial cultivated lupins. In prior work funded by COGGO (2019-2021), we established that the *P* allele was a unique allele at the *LanFTc1* locus, and *P/P* plants flowered 1-2 weeks after *Ku/Ku* plants in the field. The *P* allele was distinguished from the *Ku* allele by PCR-based molecular markers that were allele-specific and co-dominant; that is, the PCR markers were able to detect *P/Ku* heterozygotes as well as *P/P* and *Ku/Ku* homozygotes in segregating populations. Co-dominant allele-specific markers were essential for success of this project.

With these PCR-based markers, we undertook rapid-cycle backcrossing to generate fourth-backcross (BC4) derived progeny that carried the new *P* allele in a genetic background that contained more than 96% of the recurrent elite parent genome. We selected *P/P* plants from the BC4:S1 and lines developed from these plants will be evaluated for their agronomic and seed quality performance with the goal of releasing new commercial *P/P* lupin varieties. These new *P/P* mid-season varieties will open up new opportunities for lupin growers to expand production with new lupin varieties that are later flowering, taller and easier to harvest than traditional *Ku/Ku* varieties.

At the end of this project, several grams of seed of 33 BC4:S2 bulks of *P/P* lines were delivered to lupin breeding company Australian Grain Technologies (AGT) Pty Ltd for field testing and evaluation, and potential future release of new *P/P* lupin varieties to Australian growers. These *P/P* lines were selected from 5 backcross populations which were formed from 3 recurrent elite lupin parents provided by AGT Pty Ltd for this project (AGTP0013, AGTP0054 and AGTP0214).

The main project outcome is the potential future release of a wide range of flowering and maturity dates in future narrow-leaved lupin cultivars. AGT Pty Ltd will evaluate new *P/P* lupin varieties against *Ku/Ku* varieties under a wide range of conditions including opportunistic early sowing in the main lupin growing regions, and in higher rainfall zones. Future *P/P* lupin varieties are expected to have greater harvest height and higher yield than *Ku/Ku* varieties under these conditions.

Lupin growers across southern Australia will benefit from the new *P/P* varieties under a range of conditions such as opportunistic early sowing, and in long growing seasons and high rainfall conditions. The taller growth of *P/P* varieties will make them easier to harvest under some conditions.

Sustainable cropping in southern Australia will improve with adoption of the new *P/P* varieties. N-fixation in *P/P* lupins will provide significant benefits to subsequent cereal and canola crops and will reduce grower dependence on mineral N fertiliser.



GRDC lupin project UWA2307-004RTX team members (L-R) Karen Nelson, Aneeta Pradhan and Wallace Cowling in the growth room at UWA where lupin backcrossing was carried out from 2023 to 2026.

Date of photograph: 25th March 2025

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Fourth back-cross (BC4) progeny plants (right side) with the *P/P* gene for mid-season flowering (right), compared to mid-season wild lupin P22660 (*P/P*) and early flowering Tanjil (*Ku/Ku*) (left side).



Official hand-over of seed with the P/P gene from UWA to AGT Pty Ltd on 8th May 2026, at UWA: from left to right, Dr Ian Longson representing COGGO, Dr Camilla Hill representing GRDC, Dr Matthew Aubert representing AGT Pty Ltd, Karen Nelson, Dr Matthew Nelson, Dr Aneeta Pradhan, Dr Renu Saradadevi, and Prof Wallace Cowling

