Faculty of Science and Engineering

2021 Australian Government Research Training Program Scholarships

Strategic Project Profile

PROJECT TITLE: Characterisation of novel sources of resistance to combat Ascochyta lentis in the agriculturally important Australian pulse crop lentil (Lens culinaris)

FIELD OF RESEARCH CODE: 0703

PROJECT SYNOPSIS:

The world's population is estimated to grow to 9.5 billion by 2050 and therefore concerns around stable food supplies packed with nutritional benefits are warranted. In a changing climate and with a growing population there will be less arable land available and thus reliance on stable production of plant-based protein will be of great importance to meet the world's demand. It is estimated to require double the current production by 2050, with plant pathogens considered a major risk to meet the production targets. Lentils are high value protein crop produced by Australian grain growers. However, their production is hampered by the pathogen Ascochyta lentis, which causes ascochyta blight. To ensure stable production of lentils, this

RTP proposal will focus on protecting Australian lentils from this disease by identifying and characterising lentil germplasm with enhanced and durable resistance to its major pathogen. This aligns with Curtin University's mission to help feed the world, evident from its investment in the area of agriculture in CCDM in partnership with GRDC totalling $150 million.

Global lentil production was estimated at over 8.6 Mt in 2019, with Australia being the third largest exporter of high-quality lentil grain. Australian lentil production averages between 300,000 and 500,000 t per year and Australian lentils are preferred by importers because of their high quality, with 90% exported to India, Bangladesh, Sri Lanka and Egypt. Apart from the economic benefit for growers, the rotational benefits of using lentils include disease breaks for cereal crops and lentils being able to fix nitrogen in the soil.

The hemi-biotrophic fungal pathogen, A. lentis, causes ascochyta blight (AB) or black spot. This damaging pathogen greatly reduces grain quality and yield by causing lesions on all above ground parts of the plant. Management strategies to control AB include cultural practices, fungicide treatment, and use of resistant cultivars. Chemical control measures such as application of fungicides can be effective though are often expensive and toxic to non-target organisms. Breeding for AB resistance is still considered to be the most sustainable and economic control method thus, the PhD-candidate would characterise a number of novel resistance sources previously selected from a large lentil germplasm collection. Identification of novel resistance genes and stacking multiple resistance genes that recognize different strains of the pathogen would provide durable disease resistance and improve the currently degrading selection of elite AB-resistant lentil cultivars brought about by the intensive cropping in Australia's lentil growing regions.

The overall aim of the project is to characterise the novel sources of AB resistance, identify the genes in the lentil genome that control the resistance and combine these novel resistance genes in lentil pre-breeding lines along with molecular markers to the Australian lentil breeding program. This will lead to the development of varieties with enhanced and durable resistance which is key to sustainable management of AB. The PhD candidate would make crosses between resistant germplasm and susceptible Australian lentil varieties to determine which regions of the genome harbour the AB resistance genes. Microscopy studies of fluorescently labelled isolates will be conducted to determine where in the lentil plant the resistance mechanisms are operating, using the new Dragonfly confocal microscope secured in a recent ARC LIEF application, housed in the CHIRI building.

Another strategy to identify novel sources of resistance can be derived from identifying genes that are differentially regulated (e.g. turned on or off) in response to A. lentis using an RNA-sequencing. This can be achieved by monitoring gene expression in lentil lines that will be infected with A. lentis with different virulence profiles. The outcomes of this RTP proposal will lead to the development of broad genetic resistance to A. lentis, and better integrated management options through accelerated varietal development to assure increased lentil yield for Australian lentil growers.

The research activities will be conducted in the excellent CCDM facilities such as the B304 laboratories and the field trial area, including the new speed breeding facility under construction. There is also strong bioinformatics capability within CCDM and the interaction with Curtin Institute for Computation and the Pawsey Centre to access high-performance super computers to analyse the RNA sequencing datasets to be generated in this proposal. The supervisory team has the necessary skills to train the successful PhD candidate for this project. Furthermore, the CCDM has over 60 staff and students with a research focus on plant-microbe interactions and will thus be an excellent environment for the successful PhD

candidate of this proposal to develop their skills and interactions with fellow peers in their research field.

FEASIBILITY AND RESOURCING – DESCRIPTION OF THE SUPPORT THIS PROJECT WILL RECEIVE:

The project will be embedded in the Centre for Crop and Disease Management (CCDM), a co-investment between Curtin University and the GRDC.

THE SIGNIFICANCE OF THE PROJECT/ PROGRAM FOR THE ENROLLING SCHOOL OR INSTITUTION:

This RTP proposal aligns with the key growth area of the University in “Agriculture” and is embedded in the largest category 1 external funding of MLS in the CCDM. The project has a high likelihood of success and will make full use of MLS facilities such as the CHIRI confocal microscopy facility, the GRDC-funded Plant Growth Facility and the advanced CCDM laboratories. The outcomes of this RTP research on plant-defence processes in the lentil-Ascochyta pathosystem will likely lead to several high-quality publications and ensure the stable production of high-value plant-based protein to feed the world.

Students must express interest in this scholarship opportunity by emailing the Project Lead listed below. Please provide a copy of your current curriculum vitae and detail your suitability to be involved in this strategic project.

PROJECT LEAD CONTACT:

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